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THE ENCYCLOPÆDIA BRITANNICA

A DICTIONARY OF ARTS, SCIENCES, LITERATURE AND GENERAL INFORMATION

ELEVENTH EDITION

VOLUME II SLICE III

Apollodorus to Aral

Articles in This Slice

APOLLODORUS, an Athenian painter, who flourished at the end of the 5th century B.C. He is said to have introduced great improvements in perspective and chiaroscuro. What these were it is impossible to say: perspective cannot have been in his day at an advanced stage. Among his works were an Odysseus, a priest in prayer, and an Ajax struck by lightning.

APOLLODORUS, an Athenian grammarian, pupil of Aristarchus and Panaetius the Stoic, who lived about 140 B.C. He was a prolific and versatile writer. There is extant under his name a treatise on the gods and the heroic age, entitled Βιβλιοθήκη, a valuable authority on ancient mythology. Modern critics are of opinion that, if genuine, it is an abridgment of a larger work by him (Περὶ θεῶν).

Edition, with commentary, by Heyne (1803); text by Wagner (1894) (*Mythographi Graeci*, vol. i. Teubner series). Amongst other works by him of which only fragments remain, collected in Müller, *Fragmenta Historicorum Graecorum*, may be mentioned: Χρονικά, a universal history from the fall of Troy to 144 B.C.; Περιήγησις, a gazetteer written in iambics; Περὶ Νεῶν, a work on the Homeric catalogue of ships; and a work on etymology (Ἐτυμολογίαι).

APOLLODORUS, of Carystus in Euboea, one of the most important writers of the New Attic comedy, who flourished at Athens between 300 and 260 B.C. He is to be distinguished from an older Apollodorus of Gela (342-290), also a writer of comedy, a contemporary of Menander. He wrote 47 comedies and obtained the prize five times. Terence borrowed his *Hecyra* and *Phormio* from the Ἑκυρά and Ἐπιδικαζόμενος of Apollodorus.

Fragments in Koch, *Comicorum Atticorum Fragmenta*, ii. (1884); see also Meineke, *Historia Critica Comicorum Graecorum* (1839).

APOLLODORUS, of Damascus, a famous Greek architect, who flourished during the 2nd century A.D. He was a favourite of Trajan, for whom he constructed the stone bridge over the Danube (A.D. 104-105). He also planned a gymnasium, a college, public baths, the Odeum and the Forum Trajanum, within the city of Rome; and the triumphal arches at Beneventum and Ancona. The Trajan column in the centre of the Forum is celebrated as being the first triumphal monument of the kind. On the accession of Hadrian, whom he had offended by ridiculing his performances as architect and artist, Apollodorus was banished, and, shortly afterwards, being charged with imaginary crimes, put to death (Dio Cassius lxix. 4). He also wrote a treatise on *Siege Engines* (Πολιορκητικά), which was dedicated to Hadrian.

APOLLONIA, the name of more than thirty cities of antiquity. The most important are the following: (1) An Illyrian city (known as Apollonia κατ᾽ Ἐπίδαμνον or πρὸς Ἐπιδάμνῳ) on the right bank of the Aous, founded by the Corinthians and Corcyraeans. It soon became a place of increasing commercial prosperity, as the most convenient link between Brundusium and northern Greece, and as one of the starting-points of the Via Egnatia. It was an important military post in the wars against Philip and during the civil wars of Pompey and Caesar, and towards the close of the Roman republic acquired fame as a seat of literature and philosophy. Here Augustus was being educated when the death of Caesar called him to Rome. It seems to have sunk with the rise of Aulon, and few remains of its ruins are to be found. The monastery of Pollina stands on a hill which probably is part of the site of the old city. (2) A Thracian city on the Black Sea (afterwards Sozopolis, and now Sizeboli), colonized by the Milesians, and famous for its colossal statue of Apollo by Calamis, which Lucullus removed to Rome.

APOLLONIUS, surnamed ὁ δύσκολος (“the Surly or Crabbed”), a celebrated grammarian of Alexandria, who lived in the reigns of Hadrian and Antoninus Pius. He spent the greater part of his life in his native city, where he died; he is also said to have visited Rome and attracted the attention of Antoninus. He was the founder of scientific grammar and is styled by Priscian *grammaticorum princeps*. Four of his works are extant: *On Syntax*, ed. Bekker, 1817; and three smaller treatises, on *Pronouns*, *Conjunctions* and *Adverbs*, ed. Schneider, 1878.

Grammatici Graeci, i. in Teubner series; Egger, *Apollonius Dyscole* (1854).

APOLLONIUS, surnamed ὁ μαλακός ("the Effeminate"), a Greek rhetorician of Alabanda in Caria, who flourished about 120 B.C. After studying under Menecles, chief of the Asiatic school of oratory, he settled in Rhodes, where he taught rhetoric, among his pupils being Mark Antony.

APOLLONIUS, surnamed "the Sophist," of Alexandria, a famous grammarian, who probably lived towards the end of the 1st century A.D. He was the author of a Homeric lexicon (Λέξεις Ὁμηρικαί), the only work of the kind we possess. His chief authorities were Aristarchus and Apion's Homeric glossary.

Edition by Villoison (1773), I. Bekker (1833); Leyde, *De Apollonii Sophistae Lexico Homerico* (1885); E.W.B. Nicholson on a newly discovered fragment in *Classical Review* (Nov. 1897).

APOLLONIUS MOLON (sometimes called simply Molon), a Greek rhetorician, who flourished about 70 B.C. He was a native of Alabanda, a pupil of Menecles, and settled at Rhodes. He twice visited Rome as an ambassador from Rhodes, and Cicero and Caesar took lessons from him. He endeavoured to moderate the florid Asiatic style and cultivated an "Atticizing" tendency. He wrote on Homer, and, according to Josephus, violently attacked the Jews.

See C. Müller, *Fragmenta Historicorum Graecorum*, iii.; E. Schürer, *History of the Jewish People*, iii. (Eng. tr. 1886).

APOLLONIUS OF PERGA [Pergaeus], Greek geometer of the Alexandrian school, was probably born some twenty-five years later than Archimedes, *i.e.* about 262 B.C. He flourished in the reigns of Ptolemy Euergetes and Ptolemy Philopator (247-205 B.C.). His treatise on *Conics* gained him the title of The Great Geometer, and is that by which his fame has been transmitted to modern times. All his numerous other treatises have perished, save one, and we have only their titles handed down, with general indications of their contents, by later writers, especially Pappus. After the *Conics* in eight Books had been written in a first edition, Apollonius brought out a second edition, considerably revised as regards Books i.-ii., at the instance of one Eudemus of Pergamum; the first three books were sent to Eudemus at intervals, as revised, and the later books were dedicated (after Eudemus' death) to King Attalus I. (241-197 B.C.). Only four Books have survived in Greek; three more are extant in Arabic; the eighth has never been found. Although a fragment has been found of a Latin translation from the Arabic made in the 13th century, it was not until 1661 that a Latin translation of Books v.-vii. was available. This was made by Giovanni Alfonso Borelli and Abraham Ecchellensis from the free version in Arabic made in 983 by Abu 'l-Fath of Ispahan and preserved in a Florence MS. But the best Arabic translation is that made as regards Books i.-iv. by Hilal ibn Abi Hilal (d. about 883), and as regards Books v.-vii. by Tobit ben Korra (836-901). Halley used for his translation an Oxford MS. of this translation of Books v.-vii., but the best MS. (Bodl. 943) he only referred to in order to correct his translation, and it is still unpublished except for a fragment of Book v. published by L. Nix with German translation (Drugulin, Leipzig, 1889). Halley added in his edition (1710) a restoration of Book viii., in which he was guided by the fact that Pappus gives lemmas "to the seventh and eighth books" under that one heading, as well as by the statement of Apollonius himself that the use of the seventh book was illustrated by the problems solved in the eighth.

The degree of originality of the *Conics* can best be judged from Apollonius' own prefaces. Books i.-iv. form an "elementary introduction," *i.e.* contain the essential principles; the rest are specialized investigations in particular directions. For Books i.-iv. he claims only that the generation of the curves and their fundamental properties in Book i. are worked out more fully and generally than they were in earlier treatises, and that a number of theorems in Book iii. and the greater part of Book iv. are new. That he made the fullest use of his predecessors' works, such as Euclid's four Books on Conics, is clear from his allusions to Euclid, Conon and Nicoteles. The generality of treatment is indeed remarkable; he gives as the fundamental property of all the conics the equivalent of the Cartesian equation referred to *oblique* axes (consisting of a diameter and the tangent at its extremity) obtained by cutting an oblique circular cone in any manner, and the axes appear only as a particular case after he has shown that the property of the conic can be expressed in the same form with reference to any new diameter and the tangent at its extremity. It is clearly the form of the fundamental property (expressed in the terminology of the "application of areas") which led him to call the curves for the first time by the names *parabola*, *ellipse*, *hyperbola*. Books v.-vii. are clearly original. Apollonius' genius takes its highest flight in Book v., where he treats of normals as minimum and maximum straight lines drawn from given points to the curve (independently of tangent properties), discusses how many normals can be drawn

from particular points, finds their feet by construction, and gives propositions determining the centre of curvature at any point and leading at once to the Cartesian equation of the evolute of any conic.

The other treatises of Apollonius mentioned by Pappus are—1st, Λόγου ἀποτομή, *Cutting off a Ratio*; 2nd, Χωρίου ἀποτομή, *Cutting of an Area*; 3rd, Διωρισμένη τομή, *Determinate Section*; 4th, Ἐπαφαί, *Tangencies*; 5th, Νεύσεις, *Inclinations*; 6th, Τόποι ἐπίπεδοι, *Plane Loci*. Each of these was divided into two books, and, with the *Data*, the *Porisms* and *Surface-Loci* of Euclid and the *Conics* of Apollonius were, according to Pappus, included in the body of the ancient analysis.

1st. *De Rationis Sectione* had for its subject the resolution of the following problem: Given two straight lines and a point in each, to draw through a third given point a straight line cutting the two fixed lines, so that the parts intercepted between the given points in them and the points of intersection with this third line may have a given ratio.

2nd. *De Spatii Sectione* discussed the similar problem which requires the rectangle contained by the two intercepts to be equal to a given rectangle.

An Arabic version of the first was found towards the end of the 17th century in the Bodleian library by Dr Edward Bernard, who began a translation of it; Halley finished it and published it along with a restoration of the second treatise in 1706.

3rd. *De Sectione Determinata* resolved the problem: Given two, three or four points on a straight line, to find another point on it such that its distances from the given points satisfy the condition that the square on one or the rectangle contained by two has to the square on the remaining one or the rectangle contained by the remaining two, or to the rectangle contained by the remaining one and another given straight line, a given ratio. Several restorations of the solution have been attempted, one by W. Snellius (Leiden, 1698), another by Alex. Anderson of Aberdeen, in the supplement to his *Apollonius Redivivus* (Paris, 1612), but by far the best is by Robert Simson, *Opera quaedam reliqua* (Glasgow, 1776).

4th. *De Tactionibus* embraced the following general problem: Given three things (points, straight lines or circles) in position, to describe a circle passing through the given points, and touching the given straight lines or circles. The most difficult case, and the most interesting from its historical associations, is when the three given things are circles. This problem, which is sometimes known as the Apollonian Problem, was proposed by Vieta in the 16th century to Adrianus Romanus, who gave a solution by means of a hyperbola. Vieta thereupon proposed a simpler construction, and restored the whole treatise of Apollonius in a small work, which he entitled *Apollonius Gallus* (Paris, 1600). A very full and interesting historical account of the problem is given in the preface to a small work of J.W. Camerer, entitled *Apollonii Pergaei quae supersunt, ac maxime Lemmata Pappi in hos Libras, cum Observationibus, &c.* (Gothae, 1795, 8vo).

5th. *De Inclinationibus* had for its object to insert a straight line of a given length, tending towards a given point, between two given (straight or circular) lines. Restorations have been given by Marino Ghetaldi, by Hugo d'Omerique (*Geometrical Analysis*, Cadiz, 1698), and (the best) by Samuel Horsley (1770).

6th. *De Locis Planis* is a collection of propositions relating to loci which are either straight lines or circles. Pappus gives somewhat full particulars of the propositions, and restorations were attempted by P. Fermat (*Oeuvres*, i., 1891, pp. 3-51), F. Schooten (Leiden, 1656) and, most successfully of all, by R. Simson (Glasgow, 1749).

Other works of Apollonius are referred to by ancient writers, viz. (1) Περὶ τοῦ πυρίου, *On the Burning-Glass*, where the focal properties of the parabola probably found a place; (2) Περὶ τοῦ κοχλίου, *On the Cylindrical Helix* (mentioned by Proclus); (3) a comparison of the dodecahedron and the icosahedron inscribed in the same sphere; (4) Ἡ καθόλου πραγματεία, perhaps a work on the general principles of mathematics in which were included Apollonius' criticisms and suggestions for the improvement of Euclid's *Elements*; (5) Ὠκυτόκιον (quick bringing-to-birth), in which, according to Eutocius, he showed how to find closer limits for the value of π than the $3\frac{1}{7}$ and $3\frac{10}{71}$ of Archimedes; (6) an arithmetical work (as to which see Pappus) on a system of expressing large numbers in language closer to that of common life than that of Archimedes' *Sand-reckoner*, and showing how to multiply such large numbers; (7) a great extension of the theory of irrationals expounded in Euclid, Book x., from binomial to multinomial and from *ordered* to *unordered* irrationals (see extracts from Pappus' comm. on Eucl. x., preserved in Arabic and published by Woepcke, 1856). Lastly, in astronomy he is credited by Ptolemy with an explanation of the motion of the planets by a system of epicycles; he also made researches in the lunar theory, for which he is said to have been called Epsilon (ε).

The best editions of the works of Apollonius are the following: (1) *Apollonii Pergaei Conicorum libri quatuor, ex versione Frederici Commandini* (Bononiae, 1566), fol.; (2) *Apollonii Pergaei Conicorum libri octo, et Sereni Antissensis de Sectione Cylindri et Coni libri duo* (Oxoniae, 1710), fol. (this is the monumental edition of Edmund Halley); (3) the edition of the first four books of the Conics given in 1675 by Barrow; (4) *Apollonii Pergaei de Sectione, Rationis libri duo: Accedunt ejusdem de Sectione Spatii libri duo Restituti: Praemittitur, &c., Opera et Studio Edmundi Halley* (Oxoniae, 1706), 4to; (5) a German translation of the *Conics* by H. Balsam (Berlin, 1861); (6) the definitive Greek text of Heiberg (*Apollonii Pergaei quae Graece exstant Opera*, Leipzig, 1891-1893); (7) T.L. Heath, *Apollonius, Treatise on Conic Sections* (Cambridge, 1896); see also H.G. Zeuthen, *Die Lehre van den Kegelschnitten im Altertum* (Copenhagen, 1886 and 1902).

(T. L. H.)

APOLLONIUS OF RHODES (Rhodius), a Greek epic poet and grammarian, of Alexandria, who flourished under the Ptolemies Philopator and Epiphanes (222-181 B.C.). He was the pupil of Callimachus, with whom he subsequently quarrelled. In his youth he composed the work for which he is known—*Argonautica*, an epic in

four books on the legend of the Argonauts. When he read it at Alexandria, it was rejected through the influence of Callimachus and his party. Disgusted with his failure, Apollonius withdrew to Rhodes, where he was very successful as a rhetorician, and a revised edition of his epic was well received. In recognition of his talents the Rhodians bestowed the freedom of their city upon him—the origin of his surname. Returning to Alexandria, he again recited his poem, this time with general applause. In 196, Ptolemy Epiphanes appointed him librarian of the Museum, which office he probably held until his death. As to the *Argonautica*, Longinus' (*De Sublim*. p. 54, 19) and Quintilian's (*Instit*, x. 1, 54) verdict of mediocrity seems hardly deserved; although it lacks the naturalness of Homer, it possesses a certain simplicity and contains some beautiful passages. There is a valuable collection of scholia. The work, highly esteemed by the Romans, was imitated by Virgil (*Aeneid*, iv.), Varro Atacinus, and Valerius Flaccus. Marianus (about A.D. 500) paraphrased it in iambic trimeters. Apollonius also wrote epigrams; grammatical and critical works; and Κτίσεις (the foundations of cities).

Editio Princeps (Florence, 1496); Merkel-Keil (with scholia, 1854); Seaton (1900). English translations: Verse, by Greene (1780); Fawkes (1780); Preston (1811); Way (1901); Prose by Coleridge (1889); see also Couat, *La Poésie alexandrine*; Susemihl, *Geschichte der griech. Lit. in der alexandnnischen Zeit.*

APOLLONIUS OF TRALLES (in Caria), a Greek sculptor, who flourished in the 2nd century B.C. With his brother Tauriscus, he executed the marble group known as the Farnese Bull, representing Zethus and Amphion tying the revengeful Dirce to the tail of a wild bull.

See GREEK ART, pl. i. fig. 51.

APOLLONIUS OF TYANA, a Greek philosopher of the Neo-Pythagorean school, born a few years before the Christian era. He studied at Tarsus and in the temple of Asclepius at Aegae, where he devoted himself to the doctrines of Pythagoras and adopted the ascetic habit of life in its fullest sense. He travelled through Asia and visited Nineveh, Babylon and India, imbibing the oriental mysticism of magi, Brahmans and gymnosophists. The narrative of his travels given by his disciple Damis and reproduced by Philostratus is so full of the miraculous that many have regarded him as an imaginary character. On his return to Europe he was saluted as a magician, and received the greatest reverence from priests and people generally. He himself claimed only the power of foreseeing the future; yet in Rome it was said that he raised from death the body of a noble lady. In the halo of his mysterious power he passed through Greece, Italy and Spain. It was said that he was accused of treason both by Nero and by Domitian, but escaped by miraculous means. Finally he set up a school at Ephesus, where he died, apparently at the age of a hundred years. Philostratus keeps up the mystery of his hero's life by saying, "Concerning the manner of his death, *if he did die*, the accounts are various." The work of Philostratus composed at the instance of Julia, wife of Severus, is generally regarded as a religious work of fiction. It contains a number of obviously fictitious stories, through which, however, it is not impossible to discern the general character of the man. In the 3rd century, Hierocles (*q.v.*) endeavoured to prove that the doctrines and the life of Apollonius were more valuable than those of Christ, and, in modern times, Voltaire and Charles Blount (1654-1693), the English freethinker, have adopted a similar standpoint. Apart from this extravagant eulogy, it is absurd to regard Apollonius merely as a vulgar charlatan and miracle-monger. If we cut away the mass of mere fiction which Philostratus accumulated, we have left a highly imaginative, earnest reformer who laboured to infuse into the flaccid dialectic of paganism a saner spirit of practical morality.

See L. Dyer, *Studies of the Gods in Greece* (New York, 1891); A. Chassang, *Le Merveilleux dans l'antiquité* (1882); D.M. Tredwell, *Sketch of the Life of Apollonius of Tyana* (New York, 1886); F.C. Baur, *Apollonius von Tyana und Christus*, ed. Ed. Zeller (Leipzig, 1876,—an attempt to show that Philostratus's story is merely a pagan counterblast to the New Testament history); J. Jessen, *Apollonius v. Tyana und sein Biograph Philostratos* (Hamburg, 1885); J. Göttsching, *Apollonius von Tyana* (Berlin, 1889); J.A. Froude, *Short Studies*, vol. iv.; G.R.S. Mead, *Apollonius of Tyana* (London, 1901); B.L. Gildersleeve, *Essays and Studies* (New York, 1890); Philostratus's *Life of Apollonius* (Eng. trans. New York, 1905); O. de B. Priaulx, *The Indian Travels of Apollonius* (1873); F.W.G. Campbell, *Apoll. of Tyana* (1908); see also NEO-PYTHAGOREANISM.

APOLLONIUS OF TYRE, a medieval tale supposed to be derived from a lost Greek original. The earliest mention of the story is in the *Carmina* (Bk. vi. 8, II. 5-6) of Venantius Fortunatus, in the second half of the 6th century, and the romance may well date from three centuries earlier. It bears a marked resemblance to the *Antheia and Habrokomes* of Xenophon of Ephesus. The story relates that King Antiochus, maintaining incestuous relations with his daughter, kept off her suitors by asking them a riddle, which they must solve on pain of losing their heads. Apollonius of Tyre solved the riddle, which had to do with Antiochus's secret. He returned to Tyre, and, to escape the king's vengeance, set sail in search of a place of refuge. In Cyrene he married the daughter of King Archistrates, and presently, on receiving news of the death of Antiochus, departed to take possession of the kingdom of Antioch, of which he was, for no clear reason, the heir. On the

voyage his wife died, or rather seemed to die, in giving birth to a daughter, and the sailors demanded that she should be thrown overboard. Apollonius left his daughter, named Tarsia, at Tarsus in the care of guardians who proved false to their trust. Father, mother, and daughter were only reunited after fourteen years' separation and many vicissitudes. The earliest Latin MS. of this tale, preserved at Florence, dates from the 9th or 10th century. The pagan features of the supposed original are by no means all destroyed. The ceremonies observed by Tarsia at her nurse's grave, and the preparations for the burning of the body of Apollonius's wife, are purely pagan. The riddles which Tarsia propounds to her father are obviously interpolated. They are taken from the *Enigmata* of Caelius Firmianus Symposius. The many inconsistencies of the story seem to be best explained by the supposition (E. Rohde, *Der griechische Roman*, 2nd ed., 1900, pp. 435 *et seq.*) that the Antiochus story was originally entirely separate from the story of Apollonius's wanderings, and was clumsily tacked on by the Latin author. The romance kept its form through a vast number of medieval rearrangements, and there is little change in its outlines as set forth in the Shakespearian play of *Pericles*.

The Latin tale is preserved in about 100 MSS., and was printed by M. Velser (Augsburg, 1595), by J. Lapaume in *Script. Erot.* (Didot, Paris, 1856), and by A. Riese in the *Bibl. Teubneriana* (1871, new ed. 1893). The most widespread versions in the middle ages were those of Godfrey of Viterbo in his *Pantheon* (1185), where it is related as authentic history, and in the *Gesta Romanorum* (cap. 153), which formed the basis of the German folk-tale by H. Steinhöwel (Augsburg, 1471), the Dutch version (Delft, 1493), the French in *Le Violier des histoires romaines* (Paris, 1521), the English, by Laurence Twine (London, 1576, new ed. 1607), also of the Scandinavian, Czech, and Hungarian tales.

In England a translation was made as early as the 11th century (ed. B. Thorpe, 1834, and J. Zupitza in *Archiv für neuere Sprachen*, 1896); there is a Middle English metrical version (J.O. Halliwell, *A New Boke about Shakespeare*, 1850), by a poet who says he was vicar of Wimborne; John Gower uses the tale as an example of the seventh deadly sin in the eighth book of his *Confessio Amantis*; Robert Copland translated a prose romance of *Kynge Apollyne of Thyre* (Wynkyn de Worde, 1510) from the French; *Pericles* was entered at Stationers' Hall in 1607, and was followed in the next year by George Wilkins's novel, *The Painfull Adventures of Pericles, Prynce of Tyre* (ed. Tycho Mommsen, Oldenburg, 1857), and George Lillo drew his play *Marina* (1738) from the piece associated with Shakespeare; *Orendel*, by a Middle High German minnesinger, contains some of the episodes of *Apollonius*; Heinrich von Neustadt wrote a poem of 20,000 lines on *Apollonius von Tyrland* (*c.* 1400); the story was well known in Spanish, *Libre de Apolonio* (verse, *c.* 1200), and in J. de Timoneda's *Patrañuelo* (1576); in French much of it was embodied in *Jourdain de Blaives* (13th cent.), and it also appears in Italian and medieval Greek. See A.H. Smyth, *Shakespeare's Pericles and Apollonius of Tyre* (Philadelphia, 1898); Elimar Klebs, *Die Erzahlung van A. aus Tyrus* (Berlin, 1899); S. Singer, *Apollonius van Tyrus* (Halle, 1895).

APOLLOS (Ἀπολλώς; contracted from Apollonius), an Alexandrine Jew who after Paul's first visit to Corinth worked there in a similar way (1 Cor. iii. 6). He was with Paul at a later date in Ephesus (1 Cor. xvi. 12). In 1 Cor. i. 10-12 we read of four parties in the Corinthian church, of which two attached themselves to Paul and Apollos respectively, using their names, though the "division" can hardly have been due to conflicting doctrines. (See PAUL.) From Acts xviii. 24-28 we learn that he spoke and taught with power and success. He may have captivated his hearers by teaching "wisdom," as P.W. Schmiedel suggests, in the allegorical style of Philo, and he was evidently a man of unusual magnetic force. There seems to be some contradiction between Acts xviii. 25 *a b* and Acts xviii. 25 *c*, 26 *b c*; and it has been suggested that these latter passages are subsequent accretions. Since Apollos was a Christian and "taught exactly," he could hardly have been acquainted only with John's baptism or have required to be taught Christianity more thoroughly by Aquila and Priscilla. Martin Luther regarded Apollos as the author of the Epistle to the Hebrews, and many scholars since have shared his view.

Jerome says that Apollos was so dissatisfied with the division at Corinth, that he retired into Crete with Zenas, a doctor of the law; and that the schism having been healed by Paul's letter to the Corinthians, Apollos returned to the city, and became its bishop. Less probable traditions assign to him the bishopric of Duras, or of Iconium in Phrygia, or of Caesarea.

See the articles in the *Encyclopaedia Biblica*; Herzog-Hauck, *Realencyklopadie*; *The Jewish Encyclopaedia*; Hastings' *Dictionary of the Bible*; and cf. Weizsäcker, *Das apostolische Zeitalter*; A.C. McGiffert, *History of Christianity in the Apostolic Age*.

APOLLYON, the "foul fiend" who assaulted Christian on his pilgrimage through the Valley of Humiliation in John Bunyan's great allegory. The name (Gr. Ἀπολλύων), which means "destroyer" (ἀπολλύειν, to destroy), is taken from Rev. ix. 11, where it represents the Hebrew word *Abaddon* (lit. "place of destruction," but here personified). The identification with the Asmodeus (*q.v.*) of Tobit iii. 8 is erroneous.

APOLOGETICS, in theology, the systematic statement of the grounds which Christians allege for belief in (at least) a *supernatural revelation* and a *divine redemption* (cf. *e.g.* Heb. i. 1-3). The majority of apologists in the past have further believed in an *infallible Bible*; but they admit this position can only be reached at a late stage in the argument. We should note, however, that even a liberal orthodoxy, while saying nothing about infallibility, is pledged to the *essential* authority of the Bible; it cannot *e.g.* simply ignore the Old Testament with F.E.D. Schleiermacher. Catholic apologetics must further give a central position to *Church* authority, which Roman Catholics explicitly define as infallible; but this position too is debated in a late section of their system. On the other hand, there may be a Christianity which seeks to extricate the "spiritual" from the "supernatural" (Arnold Toynbee, characterizing T.H. Green). It would only lead to confusion, however, if we called this method "apologetic." Any *single* effort in apologetics may be termed "an apology." More elaborate contrasts have been proposed between the two words, but are of little practical importance.

I. *The Word itself.*—In Greek, ἀπολογία is the defendant's reply (personally, not through a lawyer) to the speech for the prosecution—κατηγορία. Sometimes defendants' speeches passed into literature, *e.g.* Plato's splendid version of the *Apology* of Socrates. Thus, in view of persecution or slander, the Christian church naturally produced literary "Apologies," The word has never quite lost this connotation of standing on the defensive and rebutting criticism; *e.g.* Anselm's *Apologia contra insipientem Gaunilonem* (*c.* 1100); or the Lutheran *Apology for the Augsburg Confession* (1531); or J.H. Newman's *Apologia pro vita sua* (1864); or A.B. Bruce's *Apologetics; or Christianity Defensively Stated* (1892). Of course, defence easily passes into counterattack, as when early apologists denounce Greek and Roman religion. Yet the purpose may be defence even then. And there is perhaps a reason of a deeper kind for holding Apologetics to the defensive. Christianity is a prophetic religion. Now a prophet does not argue; he declares what he feels to be God's will. For himself, he rests, like the mystic, upon an immediate vision of truth; but he differs from most mystics in having a message for others; and—again unlike most mystics—he addresses the hearer's *conscience*, which we might call (in one sense) the mystic element in every man—or better, perhaps, the prophetic. Can the positive grounds for a prophet's message be analysed and stated in terms of argument? If so, apologetics is literally a science, and it is pedantry to claim the defensive and pretend to throw the *onus probandi* upon objectors. But, if not, then apologetics is a mere auxiliary, and is only "a science" in so far as it presents a *conscious* and *systematic* plea. Bruce's title, and his programme of "succouring distressed faith," imply the latter alternative; the moral appeal of Christianity, primary and essential; its confirmation by argument, secondary. The view has its difficulties; but it is hignly suggestive.

The word ἀπολογία is used by Origen (*Contra Cel.* ii. 65, v. 19) of the general Christian defence. But the introduction of the adjective "apologetic" and of the substantive "apologetics" is recent. They are serviceable as bracketing together (1) Natural Theology or Theism, (2) Christian Evidences—chiefly "miracles" and "prophecy"; or, on a more modern view, chiefly the character and personality of Christ. The lower usage of Apology (as expression of regret for a fault) has tipped many a sarcasm besides George III.'s on the occasion of Bishop Watson's book, "I did not know that the Bible needed an apology!"

II. *Apologetics in the Bible.*—The Old Testament does not argue in support of its beliefs, unless when (chiefly in parts of the Wisdom literature) it seeks to rebut moral difficulties (cf. T.K. Cheyne, *Job and Solomon*; A.S. Peake, *Problem of Suffering in the Old Testament*, 1904). The New Testament reflects chiefly controversy with Jews. Great emphasis is laid upon alleged fulfilments—striking or fanciful, but very generally striking to that age—of Old Testament prophecy (Matt. especially; rather differently Ep. to Heb.). The miracles of Jesus are also canvassed. Jews do not deny their wonderful character, but attribute them to black art (Mark iii. 22 &c., &c.). On the other hand, Christians and Jews are pretty well agreed on natural theology; so the New Testament tends to take its theism for granted. However, Rom. i. 20 has had great influence on Christian theology (*e.g.* Thomas Aquinas) in leading it to base theism upon reason or argument. One apologetic contention, aimed at Gentile readers, is found among the motives of Acts. Christianity is not a lawless but an excellent law-abiding faith. So (it is alleged) rulers, both Jewish and Gentile, have often admitted (xviii. 14; xix. 37; xxiii. 9; xxvi. 32).

III. *Early Christian.*—When we leave the New Testament, apologetics becomes conspicuous until the political triumph of Christianity, and even somewhat later. The atmosphere is no longer Jewish but fully Greek. True there are, as always, Jewish controversialists. Justin Martyr writes a *Dialogue with Trypho*; Origen deals with many anti-Christian arguments borrowed by Celsus from a certain nameless Jew. Yet Greece was the sovereign power in all the world of ancient culture. And so Christianity was necessarily Hellenized, necessarily philosophized. One result was to bring natural theology into the forefront. A pure morality, belief in one God, hopes extending beyond death—these appealed to the age; the Church taught them as philosophically true *and* divinely revealed. But, further still, philosophy offered a vehicle which could be applied to the contents of Christianity. The Platonic or eclectic theism, which adopted the conception of the Logos, made a place for Christ in terms of philosophy within the Godhead. (John i. 1 may or may not be affected by Philo; it is almost or quite solitary in the N.T.) Similarly, the immortality of the soul may be maintained on Platonic or quasi-Platonic lines, as by St Athanasius (*Contra Gentes*, § 33)—a writer who repeatedly quotes the Alexandrian Book of Wisdom, in which Platonism and the Old Testament had already joined partnership. This phase of Platonism, however, was much more slowly adopted. The earlier apologists dispute the natural immortality of the soul; Athanasius himself, in *De Incarnatione Dei*, §§ 4, 5, tones down the teaching of *Wisdom*; and the somewhat eccentric writer Arnobius, a layman—from Justin Martyr downwards apologetics has always been largely in the hands of laymen—stands for what has recently been called "conditional immortality"—eternal life for the righteous, the children of God, alone.

Allied with this more empiricist stand-point is the assertion that Greek philosophy borrowed from Moses; but in studying the Fathers we constantly find that groundless assertion uttered in the same breath with the dominant Idealist view, according to which Greek philosophy was due to incomplete revelation from the divine Logos.

On purely defensive lines, early apologists rebut charges of cannibalism and sexual promiscuity; the Christians had to meet in secret, and the gossip of a rotten age drew malignant conclusions. They make counter attacks on polytheism as a folly and on the shamefulness of obscene myths. Here they are in line with

non-Christian writers or culture-mockers like Lucian of Samosata; or graver spirits like Porphyry, who champions Neo-Platonism as a rival to Christianity, and does pioneer work in criticism by attacks on some of the Old Testament books. Turning to Christian evidence proper, we are struck with the continued prominence of the argument from prophecy. The Old Testament was an immense religious asset to the early church. Their enemies had nothing like it; and—the N.T. canon being as yet but half formed—the Old Testament was pushed into notice by dwelling on this imperfect "argument," which grew more extravagant as the partial control exercised by Jewish learning disappeared. An argument from miracles is also urged, though with more reserve. Formally, every one in that age admitted the supernatural. The question was, whose supernatural? And how far did it carry you? Miracle could not be to a 3rd century writer what it was to W. Paley—a conclusive and well-nigh solitary proof. Other apologies are by Aristides (recently recovered in translation), Athenagoras ("elegant"), Eusebius of Caesarea, Cyril of Alexandria; in Latin by Minucius Felix, Tertullian (a masculine spirit and phrase-coiner like T. Carlyle, if bitterer still), Lactantius Firmianus, &c., &c.[1]

As Christianity wins the day, a new objection is raised to it. The age is full of troubles; Christianity is ruining the empire! Besides notices elsewhere, we find the charge specially dealt with by St Augustine and his friends. Paulus Orosius argues that the world has always been a vale of tears. Salvian contends that not the acceptance of Christianity, but the sins of the people are bringing trouble upon them; and he gives ugly evidence of the continued prevalence of vice. Most impressive of all was Augustine's own contribution in *The City of God*. Powers created by worldliness and sin are crumbling, as they well may; "the city of God remaineth!" Whether he meant it so or not, the saint's argument became a programme and an apologia for the imperializing of the Western Church under the leadership of Rome during the middle ages.

IV. *Middle Ages.*—From the point of view of apologetics, we may mass together the long stretch of history which covers the period between the disappearance and the re-appearance of free discussion. When emperors became converts, the church, so lately a victim and a pleader for liberty, readily learned to persecute. Under such conditions there is little scope for apologetics. Force kills argument and drives doubt below the smooth surface of a nominal conformity. But there were two influences beyond the bounds or beyond the power of the christianized empire. The Jew remained, as always, stubbornly unconvinced, and, as often, fond of slanders. Many of the principal medieval attempts in apologetics are directed chiefly against him, *e.g.* the *Pugio Fidei* of Raymond Martini (*c.* 1280), which became one of Pascal's sources (see V. below), or Peter Abelard's *Dialogus inter Judaeum Philosophum et Christianum*. And the Moslem came on the scenes bringing, as a gift for Christendom, fuller knowledge of classical, especially Aristotelian, texts. The Jews, less bitterly opposed to Mahommedanism than the Christians were, caught fire more rapidly, and in some cases served as an intermediate link or channel of communication. These two religions anticipated the discussion of the problem of faith and reason in the Christian church. According to the great Avicenna and Maimonides, faith and the highest reason are sure to coincide (see Arabian Philosophy). According to Ghazali, in his *Destruction of Philosophers*, the various schools of philosophy cancel each other; reason is bankrupt; faith is everything. (So nearly Jehuda Halevi.) According to Averroes, reason suffices, and faith, with (what he considers) its dreams of immortality and the like, is useful only for the ignorant masses. Christian theology, however, strikes out a line of its own. Moslems and Jews were applying Aristotelian philosophy to rigorously monotheistic faiths; Christianity had been encouraged by Platonism in teaching a trinity of divine persons, and Platonism of a certain order long dominated the middle ages as part of the Augustinian tradition. In sympathy with this Platonism, the medieval church began by assuming the entire mutual harmony of faith and reason. Such is the teaching, along different lines, alike of St Anselm and of Abelard. But, when increased knowledge of Aristotle's texts (and of the commentaries) led to the victory of a supposed Aristotelianism over a supposed Platonism, Albertus Magnus, and his still more distinguished pupil Thomas Aquinas, mark certain doctrines as belonging to faith but not to reason. They adhere to the general position with exceptions (in the case of what had been considered Platonic doctrines). From the point of view of philosophy, this was a compromise. Faith and reason partly agree, partly diverge. The tendency of the later middle ages is to add to the number of the doctrines with which philosophy cannot deal. Thomas's great rival, Duns Scotus, does this to a large extent, at times affirming "two truths." The latter position, ascribed by the schoolmen to the Averroists, becomes dominant among the later Nominalists, William of Occam and his disciples, who withdraw *all* doctrines of faith from the sphere of reason. This was a second and a more audacious compromise. It is not exactly an attempt to base Christian faith on rational scepticism. It is a consistent policy of harbouring inconsistencies in the same mind. A statement may be true in philosophy and false in theology, or vice versa. To the standpoint of Aquinas, however, the Church of Rome (at least in regard to the basis of doctrine) has more and more returned. The councils of Trent and of the Vatican mark the Two Truths hypothesis as heretical, when they affirm that there *is* a natural knowledge of God and natural certainty of immortality. Along with this affirmation, the Church of Rome (if less decisively) has adopted the limitations of the Thomist theory by the condemnation of "Ontologism"; certain mysterious doctrines are beyond reason. This cautious compromise sanctioned by the Church does not represent the *extremest* reaction against nominalism. Even in the nominalistic epoch we have Raymond of Sabunde's *Natural Theology* (according to the article in Herzog-Hauck, not the title of the oldest Paris MS., but found in later MSS. and almost all the printed editions) or *Liber Creaturarum* (*c.* 1435). The book is not what moderns (schooled unconsciously in post-Reformation developments of Thomist ideas) expect under the name of natural theology. It is an attempt once more to demonstrate *all* scholastic dogmas out of the book of creation or on principles of natural reason. At many points it follows Anselm closely, and, of course, very often "makes light work" of its task.

The Thomist compromise—or even the more sceptical view of "two truths"—has the merit of giving filling *of a kind* to the formula "supernatural revelation"—mysteries inaccessible to reason, beyond discovery and beyond comprehension. According to earlier views—repeatedly revived in Protestantism—revelation is just philosophy over again. Can the choice be fairly stated? If revelation is thought of as God's personal word, and redemption as his personal deed, is it reasonable to view them either as open to a sort of scientific prediction or as capricious and unintelligible? Even in the middle ages there were not wanting those—the St Victors, Bonaventura—who sought to vindicate mystical if not moral redemption as the central thought of Christianity.

V. *Earlier Modern Period.*—It will be seen that apologetics by no means reissued unchanged from the long

period of authority. The compromise of Aquinas, though not unchallenged, holds the field and that even with Protestants. G.W. Leibnitz devotes an introductory chapter in his *Théodicée*, 1710 (as against Pierre Bayle), to faith and reason. He is a good enough Lutheran to quote as a "mystery" the Eucharist no less than the Trinity, while he insists that truths *above* are not *against* reason. Stated thus baldly, has the distinction any meaning? The more celebrated and central thesis of the book—this finite universe, the best of all such that are possible—also restates positions of Augustine and Aquinas.

Before modern philosophy began its career, there was a great revival of ancient philosophy at the Renaissance; sometimes anti-Christian, sometimes pro-Christian. The latter furnishes apologies by Marsilio Ficino, Agostino Steuco, J.L. Vives.

Early in the modern period occurs the great name of Blaise Pascal (1623-1662). A staunch Roman Catholic, but belonging to a school of Augustinian enthusiasts (the Jansenists), whom the Church put down as heretics, he stands pretty much apart from the general currents. His *Pensées*, published posthumously, seems to have been meant for a systematic treatise, but it has come to us in fragments. Once again, a lay apologist! A layman's work may have the advantage of originality or the drawback of imperfect knowledge. Pascal's work exhibits both characters. It has the originality of rare genius, but it borrows its material (as industrious editors have shown) from very few sources—the *Pugio Fidei*, M. de Montaigne, P. Charron. Ideas as well as learning are largely Montaigne's. The latter's cheerful man-of-the-world scepticism is transfigured in Pascal to a deep distrust of human reason, in part, perhaps, from anti-Protestant motives. But this attitude, while not without parallels both earlier (Ghazali, Jehuda Halevi) and later (H.L. Mansel), has peculiarities in Pascal. It is *fallen* man whom he pursues with his fierce scorn; his view of man's nature—intellect as well as character—is to be read in the light of his unflinching Augustinianism. Again, Pascal, unlike most apologists, belongs to the small company of saintly souls. This philosophical sceptic is full of humble joy in salvation, of deep love for the Saviour.

Another French Roman Catholic apologist, P.D. Huet (1630-1721)—within the conditions of his age a prodigy of learning (in apologetics see his *Demonstratio Evangelica*)—is not uninfluenced by Pascal (*Traité de la faiblesse de l'esprit humaine*).

As we might expect, Protestant lands are more busily occupied with apologetics. Intolerant reliance upon *force* presents greater difficulties to them; soon it grows quite obsolete. Benedict Spinoza, the eminent Jewish pantheist (1632-1677), to whom miracle is impossible, revelation a phrase, and who renews pioneer work in Old Testament criticism, finds at least a fair measure of liberty and comfort in Holland (his birth-land). Bayle, the historical sceptic, lectured and published his learned *Dictionnaire* (1696) at Rotterdam. From Holland, earlier, had proceeded an apologetic work by a man of European fame. Hugo Grotius's *De Veritate Christianae Religionis* (1627) is partly the medieval tradition:—Oppose Mahommedans and Jews! It is partly practical:—Arm Christian sailors against religious danger! But in its cool spirit it forecasts the coming age, whose master is John Locke. His *Reasonableness of Christianity* (1695) is the thesis of "a whole century" of theologians. And his *Essay on the Human Understanding* (1690) is almost a Bible to men of education during the same period; its lightest word treasured. Locke does not break with the compromise of Aquinas. But he transfers attention from *contents* to *proof*. Reason proves that a revelation has been made-and then submits. Leibnitz has to supplement rather than correct Locke on this point.

In such an atmosphere, deism readily uttered its protest against mysterious revelation. Deism is, in fact, the Thomist natural theology (more clearly distinguished from dogmatic theology than in the middle ages, alike by Protestants and by the post-Tridentine Church of Rome) now dissolving partnership with dogmatic and starting in business for itself. Or it is the doctrine of unfallen man's "natural state"—a doctrine intensified in Protestantism—separating itself from the theologians' grave doctrine of sin. If Socinianism had challenged natural theology—Christ, according to it, was the prophet who first revealed the way to eternal life—it had glorified the natural powers of man; and the learning of the Arminian divines (friends of Grotius and Locke) had helped to modernize Christian apologetics upon rational lines. Deism now taught that reason, or "the light of nature," was all-sufficient.

Not to dwell upon earlier continental "Deists" (mentioned by Viret as quoted first in Bayle's *Dictionary* and again in the introduction to Leland's *View of the Deistical Writers*), Lord Herbert of Cherbury (*De Veritate*, 1624; *De Religione Gentilium*, 1645?—according to J.G. Walch's *Bibliotheca Theologica* (1757) not published complete until 1663) was universally understood as hinting conclusions hostile to Christianity (cf. also T. Hobbes, *Leviathan*, 1651, ch. xxxi.; Spinoza, *Tractatus Theologico-Politicus*, 1670, ch. xiv.). Professedly, Herbert's contention merely is that non-Christians feeling after the "supreme God" and the law of righteousness must have a chance of salvation. Herbert was also epoch-making for the whole 18th century in teaching that *priests* had *corrupted* this primitive faith. During the 18th century deism spread widely, though its leaders were "irrepressible men like Toland, men of mediocre culture and ability like Anthony Collins, vulgar men like Chubb, irritated and disagreeable men like Matthew Tindal, who conformed that he might enjoy his Oxford fellowship and wrote anonymously that he might relieve his conscience" (A.M. Fairbairn). More distinguished sympathizers are Edward Gibbon, who has the deistic spirit, and David Hume, the historian and philosophical sceptic, who has at least the letter of the deistic creed (*Dialogues Concerning Natural Religion*), and who uses Pascal's appeal to "faith" in a spirit of mockery (*Essay on Miracles*). In France the new school found powerful speaking-trumpets, especially Voltaire, the idol of his age—a great denier and scoffer, but always sincerely a believer in the God of reason—and the deeper but wilder spirit of J.J. Rousseau. Others in France developed still more startling conclusions from Locke's principles, E.B. Condillac's sensationalism—Locke's philosophy purged of its more ideal if less logical elements—leading on to materialism in J.O. de la Mettrie; and at least one of the Encyclopedists (P.H. von Holbach) capped materialism with confessed atheism.

In Germany the parallel movement of "illumination" (H.S. Reimarus; J.S. Semler, pioneer in N.T. criticism; and a layman, the great Lessing) took the form of "rationalism" within the church—interpreting Bible texts by main force in a way which the age thought "enlightened" (H.E.G. Paulus, 1761-1851, &c.).

Among the innumerable English anti-deistic writers (see W. Law, The *Case of Reason*; R. Bentley, or

"Phileleutherus Lipsiensis"; &c., &c.), three are of chief importance. Nathaniel Lardner (Arian, 1684-1768) stands in the front rank of the scholarship of his time, and uses his vast knowledge to maintain the genuineness of all books of the New Testament and the perfect accuracy of its history. Joseph Butler, a very original, careful and honest thinker, lifts controversy with deists from details to principles in his *Analogy of Religion both Natural and Revealed to the Constitution and Course of Nature* (1736). This title introduces us to a new conception. Deists and orthodox in those days agreed in recognizing not merely natural theology but natural religion—"essential religion," Butler more than once styles it; the expression shows how near he stood intellectually to those he criticized. But morally he stood aloof. In part i.—on Natural Religion—he defends a moral or punishing Deity against the sentimental softness of the age. The God of Nature, whom deists confess does punish in time, if they will but look at the facts; why not in eternity? "Morality," as others have confessed, is "the nature of things"! Not the Being of God is discussed—Butler will not waste words on triflers (as he thinks them) who deny that—but God's character. Unfortunately (perhaps) Butler prefers to argue on *admitted principles*; holds much of his own moral belief in reserve; tries to reduce everything to a question of *probable fact*. If this hampers him in part i., the situation appears still worse in part ii., which is directly occupied with the defence of Christianity. Butler says nothing about incomprehensible mysteries, and protests that reason is the only ground we have to proceed upon. But by treating the atonement simply as revealed (and unexplained) matter of fact—in spite of some partial analogies in human experience, a thing essentially anomalous—Butler repeats, and applies to the *moral* contents of Christianity, what Aquinas said of its speculative doctrines. (Whether one calls the unknowable a revealed mystery or an unexplained and inexplicable fact makes little difference.) William Paley (1743-1805) borrows from many writers; he borrows Lardner's learning and Butler's "particular evidence for Christianity," viz. miracles, prophecy and "history"; and he states his points with perfect clearness. No man ever filled a typical position more exactly than Paley. Eighteenth-century ethics—Hedonism, with a theological background. Empiricist Natural Theology—the argument from Design. Christian Evidences—the strong probability of the resurrection of Christ and the consequent authority of his teaching. *Horae Paulinae*—mutual confirmations of *Acts* and Epistles; better, though one-sided. When such exclusively "external" arguments are urged, the contents of Christianity go for next to nothing.

VI. *Later Modern Period.*—Towards the end of the 18th century a new epoch of reconstruction begins in the thought and life of civilization. The leader in speculative philosophy is Immanuel Kant, though he includes many agnostic elements, and draws the inference (which some things in the letter of Butler might seem to warrant) that the essence of Christianity is an ethical theism. While he thus created a new and more ethical "rationalism," Kant's many-sided influence, alike in philosophy and in theology, worked to further issues. He (and other Germans, but not G.W.F. Hegel) was represented in England in a fragmentary way by S.T. Coleridge (1772-1834), probably the most typical figure of his period—another layman. His general thought was that "rationalism" represents an uprising of the lower reason or "understanding" against the higher or true "reason." The mysteries of theology are its best part—not alien to reason but of its substance, the "logos." This is to upset the compromise of Aquinas and go back to a Christian platonism. Of course the difficulty revives again: If a philosophy, why supernaturally revealed? Thomas Arnold, criticizing Edward Hawkins, appeals rather to the atonement as deeper neglected truth. So in Scotland, Thomas Erskine and Thomas Chalmers—the latter in contradiction to his earlier position—hold that the doctrine of salvation, when translated into experience, furnishes "internal evidence"—a somewhat broader use of the phrase than when it applies merely to evidence of date or authorship drawn from the contents of a book. This gives a new and moral filling to the conception of "supernatural revelation" The attempt to work out either of the reactions against Thomism in new theological systems is pretty much confined to Germany. Hegel's theological followers, of every shade and party, represent the first, and Schleiermacher's the second. Schleiermacher rejects natural religion in favour of the positive religions, while the school of A. Ritschl and W. Herrmann reject natural theology outright in favour of revelation—a striking external parallel to early Socinianism. British and American divines, on the other hand, are slow to suspect that a new apologetic principle may mean a new system of apologetics, to say nothing of a new dogmatic. Among the evangelicals, for the most part, natural theology, far from being rejected, is not even modified, and certain doctrines continue to be described as incomprehensible mysteries. No Protestant, of course, can agree with Roman Catholic theology that (supernatural) faith is an obedient assent to church authority and the mysteries it dictates. To Protestantism, faith is personal trust. But the principle is hardly ever carried out to the end. Mysterious doctrines are ascribed by Protestants to *scripture*; so half of revelation is regarded as matter for blind assent, if another half is luminous in experience. The movement of German philosophy which led from Kant to Hegel has indeed found powerful British champions (T.H. Green, J. and E. Caird, &c.), but less churchly than Coleridge (or F.D. Maurice or B.F. Westcott), though churchly again in J.R. Illingworth and other contributors to *Lux Mundi* (1890). Before this wave of thought, H.L. Mansel tried (1858) to play Pascal's game on Kantian principles, developing the sceptical side of Kant's many-faceted mind. But as he protested against relying on the human conscience—the one element of positive conviction spared by Kant—his ingenuity found few admirers except H. Spencer, who claims him as justifying anti-Christian agnosticism. Butler's tradition was more directly continued by J.H. Newman—with modifications on becoming a Roman Catholic in the light of the church's decision in favour of Thomism. A.M. Fairbairn (*Catholicism, Roman and Anglican*, ch. v., and elsewhere) and E.A. Abbott (*Philomythus*, and elsewhere) suspect Newman of a sceptical leaven and extend the criticism to Butler's doctrine of "probability." Yet it seems plain that any theology, maintaining redemption as historical fact (and not merely ideal), must attach religious importance to conclusions which are technically probable rather than proven. If we transfer Christian evidence from the "historical" to the "philosophical" with H. Rashdall—we surely cut down Christianity to the limits of theism. And the *inner* mind of Butler has moral anchorage in the *Analogy*, quite as much as in the *Sermons*. It is in part ii. more than in part i. of his masterpiece that the light seems to grow dim. Another of the Oxford converts to Rome, W.G. Ward, made vigorous contributions to natural theology.

VII. *Contents of Modern Apologetics.*—Superficially regarded, philosophy ebbs and flows, whatever progress the debate may reveal to speculative insight. Old positions re-emerge from forgetfulness, and there is always a philosophy to back every "case." More visible dangers arise for the apologist in the region of science, historical or physical. There the progress of truth, within whatever limits, is manifest. *Essays and*

Reviews (1860) was a vehement announcement of scientific results—startling English conservatism awake for the first time. And in the scientific region the great apologetic classics, like Butler, are hopelessly out of date. The modern apologist must do ephemeral work—unless it should chance that he proves to be the skirmisher, pioneering for a modified dogmatic. He holds a watching brief. While he must beware of hasty speech, he has often to plead that new knowledge does not really threaten faith; or that it is not genuinely established knowledge at all; or else, that faith has mistaken its own grounds, and will gain strength by concentrating on its true field. The work is not always well done; but the Christian church needs it.

1. *Apologetics and Philosophy.*—The main part of this subject is discussed under THEISM. Some notes may be added on special points, (*a*) Freewill is generally assumed on the Christian side (R.C. Church; Scottish philosophy; H. Lotze; J. Martineau; W.G. Ward. Not in a libertarian sense; Leibnitz. New and obscure issues raised by Kant). But there is no continuous tradition or steady trend of discussion. (*b*) Personal immortality is affirmed as philosophically certain by the Church of Rome and many Protestant writers. Others teach "conditional immortality." Others base the hope on belief in the resurrection of Christ, (*c*) Theodicy—the tradition of Leibnitz is preserved (on libertarian lines) by Martineau (*A Study of Religion*, 1883). See also F.R. Tennant's *Origin and Propagation of Sin* (1902)—sin a "bye-product" of a generally good evolution. Others find in the gospel of redemption the true theodicy. (*d*) The problem of Christian apologetic has been simplified in the past by the prevalence of the Christian ethics and temper even among many non-Christians (*e.g.* J.S. Mill). But hereafter it may not prove possible for the apologist to assume as unchallenged the Christian moral outlook. Germans have suspected an anti-Christian strain in Goethe; all the world knows of it in E. von Hartmann or F. Nietzsche.

2. *Apologetics and Physical Science.*—(*a*) Copernicanism has won its battles and the Church of Rome would fain have its error forgotten. The admission is now general that the Bible cannot be expected to use the language of scientific astronomy. Still, it is not certain that the shock of Copernicanism on supernatural Christianity is exhausted. (*b*) Geology has also won its battles, and few now try to harmonize it with Genesis. (*c*) Evolution came down from the clouds when C. Darwin and A.R. Wallace succeeded in displacing the naïf conception of special creation by belief in the origin of species out of other species through a process of natural law. This gave immense vogue to wider and vaguer theories of evolutionary process, notably to H. Spencer's grandiose cosmic formula in terms of mechanism. Here the apologist has more to say. The special Darwinian hypothesis—natural "selection"—may or may not be true; it was at least a fruitful suggestion. If true, it need not be exhaustive. Again, evolution itself need not apply everywhere. We are offered a philosophical rather than a scientific speculation when E. Caird (*Evolution of Religion*, 1893) tries to vindicate Christianity as the highest working of nature—true just *because* evolved from lower religions. The Christian apologist indeed may himself seek, following John Fiske, to philosophize evolution as a restatement of natural theology—"one God, one law, one element and one far-off divine event"—and as at least pointing *towards* personal immortality. But if evolution is to be the whole truth regarding Christianity, we should have to surrender both *supernatural revelation* and *divine redemption*. And these, it may be strongly urged, contain the magic of Christianity. Losing them it might sink into a lifeless theory.

As far as pure science goes, the inference from science in favour of materialism has visibly lost much of its plausibility, and Protestant apologists would probably be prepared to accept in advance all verified discoveries as belonging to a different region from that of faith. Roman Catholic apologetic prefers to negotiate in detail.

3. *Apologetics and History.*—History brings us nearer the heart of the Christian position. (*a*) Old Testament criticism won startling victories towards the end of the 19th century. It blots out much supposed knowledge, but throws a vivid and interesting light on the reconstrued process of history. Most Protestants accept the general scheme of criticism; those who hang back make not a few concessions (*e.g.* J. Orr, *Problem of the O.T.*, 1906). The Roman Catholic Church again prefers an attitude of reserve, (*b*) New Testament criticism raises even more delicate issues. Positively it may be affirmed that the recovered figure of the historical Jesus is the greatest asset in the possession of modern Christian theology and apologetics. The "Lives" of Christ, Roman Catholic and Protestant; "critical" (D.F. Strauss, A. Renan, &c., &c.) and "believing," imply this at least. Negatively, "unchallenged historical certainties" are becoming few in number, or are disappearing altogether, through the industry of modern minds. True, the Tübingen criticism of F.C. Baur and his school—important as the first scientific attempt to conceive New Testament conditions and literature as a whole—has been abandoned. (A. Ritschl's *Entstehung der alt-katholischen Kirche*, 2nd edition, 1857, was an especially telling reply.) The synoptic gospels are now treated with considerable respect. It is no longer suggested in responsible quarters that they are party documents sacrificing truth to "tendency." But not all quarters are responsible; and in the effort to grasp scientifically, *i.e.* accurately, the amazing facts of Christ and primitive Christianity, every imaginable hypothesis is canvassed. Even the Roman Catholic Church produced the Abbé Loisy (though he undertakes to play off church certainties against historical uncertainties). Hitherto at least the fourth gospel has been the touchstone. The authorship of the epistles is in many cases a matter of subordinate importance; at least for Protestants or for those surrendering Bible infallibility, which Rome can hardly do. (*c*) New Testament history, The apologist must maintain (1) that Jesus of Nazareth is a real historical figure—a point well-nigh overlooked by Strauss, and denied by some modern advocates of a mythical theory; (2) that Jesus is knowable (not one "of whom we really know very little"—B. Jowett) in his teaching, example, character, historical personality; and that he is full of moral splendour. On the other hand, faith has no special interest in claiming that we can compose a biographical study of the development of Jesus. Certainly no early writer thought of providing material for such use. It is a common opinion in Germany that our material is in fact too scanty or too self-contradictory. Yet the fascination of the subject will always revive the attempt. If it succeeds, there will be a new line of communication along which that great personality will tell on men's minds and hearts. If it fails—there are other channels; character can be known and trusted even when we are baffled by a thing necessarily so full of mystery as the development of a personality. Notably, the manifest *non-consciousness of personal guilt* in Jesus suggests to us his sinlessness. (3) Apologists maintain that Jesus "claimed" Messiahship. There are speculative constructions of gospel history which eliminate that claim; and no doubt apologetics could—with more or less difficulty—restate its position in a changed form if the paradox of to-day became accepted as historical fact to-morrow. The central

apologetic thesis is the *uniqueness* of the "only-begotten"; it is here that "the supernatural" passes into the substance of Christian faith. But most probably the description of Jesus as thus unique will continue to be associated with the allegation—He told us so; he claimed Messiahship and "died for the claim." (See preface to 5th ed. of *Ecce Homo*.) Nor did so superhuman a claim crush him, or deprive his soul of its balance. He imparted to the title a grander significance out of the riches of his personality. (4) In the light of this the "argument from prophecy" is reconstructed. It ceases to lay much stress upon coincidences between Old Testament predictions or "types" and events in Christ's career. It becomes the assertion; historically, providentially, the expectation of a *unique religious figure* arose—"the" Messiah; and Jesus gave himself to be thought of as that great figure. (5) It is also claimed as certain that Jesus had marvellous powers of healing. More reserve is being shown towards the other or "nature" miracles. These latter, it may be remarked, are more unambiguously supernatural. But, if Jesus really cured leprosy or really restored the dead to life, we have miracle plainly enough in the region of healing. (6) For Jesus' own resurrection several lines of evidence are alleged. (i.) All who believe that in any sense Christ rose again insist upon the impression which his personality made during life. It was *he* whose resurrection seemed credible! Some practically stop here; the apologist proceeds. (ii.) There is the report of the empty grave; historically, not easily waved aside. (iii.) We have New Testament reports of appearances of the risen Jesus; subjective? the mere clothing of the impression made by his personality during life? or objective? "telegrams" from heaven (Th. Keim)—"Veridical Hallucinations"? or something even more, throwing a ray of light perhaps on the state and powers of the happy dead? (iv.) There is the immense influence of Jesus Christ in history, *associated with belief in him* as the risen Son of God.

In view of the claims of Jesus, different possibilities arise, (i.) The evangelists impute to him a higher claim than he made. This may be called the rationalistic solution; with sympathy in Christ's ethical teaching, there is relief at minimizing his great claim. So, brilliantly, Wellhausen's Gospel commentaries and Introduction. (Mark fairly historical; other gospels' fuller account of Christ's teaching and claims unreliable.) (ii.) The claim was fraudulent (Reimarus; Renan, ed. 1; popular anti-Christian agitation). This is a counsel of despair. (iii.) He was an enthusiastic dreamer, expecting the world's end. This the apologist will recognize as the most plausible hostile alternative. He may feel bound to admit an element of illusion in Christ's vision' of the future; but he will contend that the apocalyptic form did not destroy the spiritual content of Christ's revelations—nay, that it was itself the vehicle of great truths. So he will argue as the essence of the matter 194
that (iv.) he who has occupied Christ's place in history, and won such reverence from the purest souls, was what he claimed to be, and that his many-sidedness comes to focus and harmony when we recognize him as the Christ of God and the Saviour of the world.

To a less extent, similar problems and alternatives arise in regard to the church:—Catholicism a compromise between Jewish Christianity and Pauline or Gentile Christianity (F.C. Baur, &c.); Catholicism the Hellenizing of Christianity (A. Ritschl, A. Harnack); the Catholic church for good and evil the creation of St Paul (P. Wernle, H. Weinel); the church supernaturally guided (R.C. apologetic; in a modified degree High Church apologetic); essential—not necessarily exclusive—truth of Paulinism, essential error in first principles of Catholicism (Protestant apologetic).

LITERATURE.—Omitting the Christian fathers as remote from the present day, we recognize as works of genius Pascal's *Pensées* and Butler's *Analogy*, to which we might add J.R. Seeley's *Ecce Homo* (1865). The philosophical, Platonist, or Idealist line of Christian defence is represented among recent writers by J.R. Illingworth [Anglican], in *Personality, Human and Divine* (1894), *Divine Immanence* (1898), *Reason and Revelation* (1902), who at times seems rather to presuppose the Thomist compromise, and A.M. Fairbairn [Congregationalist], in *Place of Christ in Modern Theology* (1893), *Philosophy of the Christian Religion* (1902). The appeal to ethical or Christian experience—"internal evidence"—is found especially in E.A. Abbott [Christianity supernatural and divine, but not miraculous], *Through Nature to Christ* (1877), *The Kernel and the Husk* (1886), *The Spirit on the Waters* (1897), &c., or A.B. Bruce, *Chief End of Revelation* (1881), *The Miraculous Element in the Gospels* (1886), *Apologetics* (1892), and other works; Bruce's posthumous article, "Jesus" in *Encyc. Bib.*, was understood by some as exchanging Christian orthodoxy for bare theism, but probably its tone of aloofness is due to the attempt to keep well within the limits of what the author considered pure scientific history. Scholarly and apologetic discussion on the gospels and life of Jesus is further represented by the writings of W. Sanday or (earlier) of J.B. Lightfoot. Much American work of merit on the character of Christ is headed by W. E Channing, and by H. Bushnell (in *Nature and the Supernatural*). For defence of Christ's resurrection, reference may be made to H. Latham's *The Risen Lord* and R. Mackintosh's *First Primer of Apologetics*. For modification in light of recent scholarship of argument from prophecy, to Riehm's *Messianic Prophecy*, Stanton's *Jewish and Christian Messiah*, and Woods's *Hope of Israel*. Roman Catholic apologetics—of necessity, Thomist—is well represented by Professor Schanz of Tübingen. The whole Ritschl movement is apologetic in spirit; best English account in A.E. Garvie's *Ritschlian Theology* (1899). See also the chief church histories or histories of doctrine (Harnack; Loofs; Hagenbach; Shedd); A.S. Farrar's *Critical History of Free* (*i.e.* anti-Christian) *Thought* (Bampton Lectures, 1862); R.C. Trench's Introduction to *Notes on the Miracles*, and F.W. Macran's *English Apologetic Theology* (1905). For the 18th century, G.V. Lechler's *Geschichte des englischen Deismus* (1841); Mark Pattison in *Essays and Reviews* (1860); Leslie Stephen's *English Thought in 18th Century* (agnostic); John Hunt, *Religious Thought in England* (3 vols., 1870-1873).

(R. MA.)

1 While these writings are of great historical value, they do not, of course, represent the Christian argument as conceived to-day. The Church of Rome prefers medieval or modern statements of its position; Protestantism can use only modern statements.

APOLOGUE (from the Gr. ἀπόλογος, a statement or account), a short fable or allegorical story, meant to

serve as a pleasant vehicle for some moral doctrine or to convey some useful lesson. One of the best known is that of Jotham in the Book of Judges (ix. 7-15); others are “The City Rat and Field Rat,” by Horace, “The Belly and its Members,” by the patrician Menenius Agrippa in the second book of Livy, and perhaps most famous of all, those of Aesop. The term is applied more particularly to a story in which the actors or speakers are taken from the brute creation or inanimate nature. An apologue is distinguished from a fable in that there is always some moral sense present, which there need not be in a fable. It is generally dramatic, and has been defined as “a satire in action.” It differs from a parable in several respects. A parable is equally an ingenious tale intended to correct manners, but it can be *true*, while an apologue, with its introduction of animals and plants, to which it lends our ideas and language and emotions, is necessarily devoid of real truth, and even of all probability. The parable reaches heights to which the apologue cannot aspire, for the points in which brutes and inanimate nature present analogies to man are principally those of his lower nature, and the lessons taught by the apologue seldom therefore reach beyond prudential morality, whereas the parable aims at representing the relations between man and God. It finds its framework in the world of nature as it actually is, and not in any grotesque parody of it, and it exhibits real and not fanciful analogies. The apologue seizes on that which man has in common with creatures below him, and the parable on that which he has in common with God. Still, in spite of the difference of moral level, Martin Luther thought so highly of apologues as counsellors of virtue that he edited and revised Aesop and wrote a characteristic preface to the volume. The origin of the apologue is extremely ancient and comes from the East, which is the natural fatherland of everything connected with allegory, metaphor and imagination. Veiled truth was often necessary in the East, particularly with the slaves, who dared not reveal their minds too openly. It is noteworthy that the two fathers of apologue in the West were slaves, namely Aesop and Phaedrus. La Fontaine in France; Gay and Dodsley in England; Gellert, Lessing and Hagedorn in Germany; Tomas de Iriarte in Spain, and Krilov in Russia, are leading modern writers of apologues. Length is not an essential matter in the definition of an apologue. Those of La Fontaine are often very short, as, for example, “Le Coque et la Perle.” On the other hand, in the romances of Reynard the Fox we have medieval apologues arranged in cycles, and attaining epical dimensions. An Italian fabulist, Corti, is said to have developed an apologue of “The Talking Animals” to the bulk of twenty-six cantos. La Motte, writing at a time when this species of literature was universally admired, attributes its popularity to the fact that it *ménage et flatte l’amour-propre* by inculcating virtue in an amusing manner without seeming to dictate or insist. This was the ordinary 18th-century view of the matter, but Rousseau contested the educational value of instruction given in this indirect form.

A work by P. Soullé, *La Fontaine et ses devanciers* (1866), is a history of the apologue from the earliest times until its final triumph in France.

APOLOGY (from Gr. ἀπολογία, defence), in its usual sense, an expression of regret for something which has been wrongfully said or done; a withdrawal or retraction of some charge or imputation which is false. In an action for libel, the fact that an apology has been promptly and fully made is a plea in mitigation of damages. The apology should have the same form of publicity as the original charge. If made publicly, the proper form is an advertisement in a newspaper; if made within the hearing of a few only, a letter of apology, which may be read to those who have heard what was said, should be sufficient. By the English Libel Act 1843, s. 2, it was enacted that in an action for libel contained in a newspaper it is a defence for the defendant to plead that the libel was inserted without actual malice and without gross negligence, and that before the commencement of the action and at the earliest opportunity afterwards he inserted in the newspaper a full apology for the libel, or, where the newspaper in which the libel appeared was published at intervals exceeding one week, he offered to publish the apology in any newspaper selected by the plaintiff. The apology must be full and must be printed in as conspicuous a place and manner as the libel was.

The word “apology” or “apologia” is also used in the sense of defence or vindication, the only meaning of the Greek ἀπολογία, especially of the defence of a doctrine or system, or of religious or other beliefs, &c., *e.g.* Justin Martyr’s *Apology* or J.H. Newman’s *Apologia pro vita sua*. (See Apologetics.)

APONEUROSIS (ἀπο, away, and νεῦρον, a sinew), in anatomy, a membrane separating muscles from each other.

APOPHTHEGM (from the ἀπόφθεγμα), a short and pointed utterance. The usual spelling up to Johnson’s day was *apothegm*, which Webster and Worcester still prefer; it indicates the pronunciation—*i.e.* “apothem”—better than the other, which, however, is more usual in England and follows the derivation. Such sententious remarks as “Knowledge is Power” are apophthegms. They become “proverbs” by age and acceptance. Plutarch made a famous collection in his *Apophthegmata Laconica*.

APOPHYGE (Gr. ἀποφυγή, a flying off), in architecture, the lowest part of the shaft of an Ionic or Corinthian column, or the highest member of its base if the column be considered as a whole. The apophyge is the inverted cavetto or concave sweep, on the upper edge of which the diminishing shaft rests.

APOPHYLLITE, a mineral often classed with the zeolites, since it behaves like these when heated before the blowpipe and has the same mode of occurrence; it differs, however, from the zeolites proper in containing no aluminium. It is a hydrous potassium and calcium silicate, $H_7KCa_4(SiO_3)_8 + 4½(H_2O)$. A small amount of fluorine is often present, and it is one of the few minerals in which ammonium has been detected. The temperature at which the water is expelled is higher than is usually the case with zeolites; none is given off below 200°, and only about half at 250°; this is slowly reabsorbed again from moist air, and is therefore regarded as water of crystallization, the remainder being water of constitution. When heated before the blowpipe, the mineral exfoliates, owing to loss of water, and on this account was named apophyllite by R.J. Haüy in 1806, from the Greek ἀπο, from, and φύλλον, a leaf.

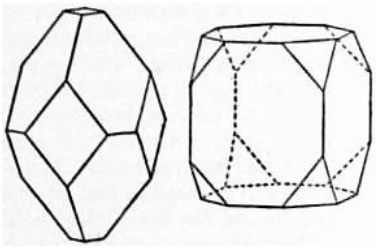

FIG. 1. FIG. 2.

Apophyllite always occurs as distinct crystals, which belong to the tetragonal system. The form is either a square prism terminated by the basal planes (fig. 2), or an acute pyramid (fig. 1). A prominent feature of the mineral is its perfect basal cleavage, on which the lustre is markedly pearly, presenting, in white crystals, somewhat the appearance of the eye of a fish after boiling, hence the old name fish-eye-stone or ichthyophthalmite for the mineral. On other surfaces the lustre is vitreous. The crystals are usually transparent and colourless, sometimes with a greenish or rose-red tint. Opaque white crystals of cubic habit have been called albine; xylochlore is an olive-green variety. The hardness is 4½, and the specific gravity 2.35.

The optical characters of the mineral are of special interest, and have been much studied. The sign of the double refraction may be either positive or negative, and some crystals are divided into optically biaxial sectors. The variety known as leucocyclite shows, when examined in convergent polarized light, a peculiar interference figure, the rings being alternately white and violet-black and not coloured as in a normal figure seen in white light.

Apophyllite is a mineral of secondary origin, commonly occurring, in association with other zeolites, in amygdaloidal cavities in basalt and melaphyre. Magnificent groups of greenish and colourless tabular crystals, the crystals several inches across, were found, with flesh-red stilbite, in the Deccan traps of the Western Ghâts, near Bombay, during the construction of the Great Indian Peninsular railway. Groups of crystals of a beautiful pink colour have been found in the silver veins of Andreasberg in the Harz and of Guanaxuato in Mexico. Crystals of recent formation have been detected in the Roman remains at the hot springs of Plombières in France.

(L. J. S.)

APOPHYSIS (Gr. ἀπόφυσις, offshoot), a bony protuberance, in human physiology; also a botanical term for the swelling of the spore-case in certain mosses.

APOPLEXY (Gr. ἀποπληξία, from ἀποπλήσσειν, to strike down, to stun), the term employed by Galen to designate the “sudden loss of feeling and movement of the whole body, with the exception of respiration,” to which, after the time of Harvey, was added “and with the exception of the circulation.” Although the term is occasionally employed in medicine with other significations, yet in its general acceptation apoplexy may be defined as a sudden loss of consciousness, of sensibility, and of movement without any *essential* modification of the respiratory and circulatory functions occasioned by some brain disease. It was discovered that the majority of the cases of apoplexy were due to cerebral haemorrhage, and what looked like cerebral haemorrhage, red softening; and the idea for a long time prevailed that apoplexy and cerebral haemorrhage could be employed as synonymous terms, and that an individual who, in popular parlance, “had an apoplectic stroke,” had necessarily suffered from haemorrhage into his brain. A small haemorrhage may not, however,

cause an apoplectic fit, nor is an apoplectic fit always caused by haemorrhage; it may be due to sudden blocking of a large vessel by a clot from a distant part (embolism), or by a sudden clotting of the blood in the vessel itself (thrombosis). Owing to the prevailing idea in former times that cerebral haemorrhage and apoplexy were synonymous terms, the word apoplexy was applied to haemorrhage into other organs than the brain; thus the terms pulmonary apoplexy, retinal apoplexy and splenic apoplexy were used.

The term “apoplexy” is now used in clinical medicine to denote that form of coma or deep state of unconsciousness which is due to sudden disturbance of the cerebral circulation occasioned by a local cause within the cranial cavity, as distinct from the loss of consciousness due to sudden failure of the heart’s action (syncope) or the coma of narcotic or alcoholic poisoning, of *status epilepticus*, of uraemia or of head injury.

The sudden coma of sunstroke and heat-stroke might be included, although owing to the suddenness with which a person may be struck down, the term *heat apoplexy* is frequently used, and, from an etymological point of view, quite justifiably. The older writers use the term *simple apoplexy* for a sudden attack which could not be explained by any visible disease. Again, *congestive apoplexy* was applied to those cases of coma where, at the autopsy, nothing was found to account for the coma and death except engorgement of the vessels of the brain and its membranes. In senile dementia and in general paralysis the brain is shrunken and the convolutions atrophied, the increased space in the ventricles and between the convolutions being filled up with the cerebro-spinal fluid. In these diseases apoplectic states may arise, terminating fatally; the excess of fluid found in such cases was formerly thought to be the cause of the symptoms, consequently the condition was called *serous apoplexy*. Such terms are no longer used, owing to the better knowledge of the pathology of brain disease.

Having thus narrowed down the application of the term “apoplexy,” we are in a position to consider its chief features, and the mechanism by which it is produced. Apoplexy may be rapidly fatal, but it is very seldom *instantly* fatal. The onset is usually sudden, and sometimes the individual may be struck down in an instant, senseless and motionless, “warranting those epithets, which the ancients applied to the victims of this disease, of *attoniti* and *siderati*, as if they were thunder-stricken or planet-struck” (Sir Thomas Watson). The attack, however, may be less sudden and, not infrequently, attended by a convulsion; while occasionally, in the condition termed *ingravescent apoplexy*, the coma is gradual in its onset, occupying hours in its development. Although unexpected, various warning symptoms, sometimes slight, sometimes pronounced, occur in the majority of cases. Such are, fulness in the head, headache, giddiness, noises in the ears, mental confusion, slight lapses of consciousness, numbness or tingling in the limbs. A characteristic apoplectic attack presents the following phenomena: the individual falls down suddenly and lies without sense or motion, except that his pulse keeps beating and his breathing continues. He appears to be in a deep sleep, from which he cannot be roused; the breathing is laboured and stertorous, and is accompanied with puffing out of the cheeks; the pulse may be beating more strongly than natural, and the face is often flushed and turgid. The reflexes are abolished. Although apoplexy may occur without paralysis, and paralysis without apoplexy, the two, owning the same cause, very frequently co-exist, or happen in immediate sequence and connexion; consequently there is in most cases definite evidence of paralysis affecting usually one side of the body in addition to the coma. Thus the pupils are unequal; there may be asymmetry of the face, or the limbs may be more rigid or flaccid on one side than on the other. These signs of localized disease enable a distinction to be made from the coma of narcotic poisoning and alcoholic intoxication. It must be borne in mind that a person smelling strongly of liquor and found lying in the street in a comatose state may be suffering from apoplexy, and the error of sending a dying man to a police cell may be avoided by this knowledge.

If the fit is only moderately severe, the reflexes soon return, and the patient may in a few hours show indications of returning consciousness by making some movements or opening his eyes when spoken to, although later it may be found that he is unable to speak, or may be paralysed or mentally afflicted (see Paralysis). In severe cases the coma deepens and the patient dies, usually from interference with the breathing, or, less commonly, from arrest of the heart’s action.

The mechanism by which apoplexy is produced has been a matter of much dispute; the condition was formerly ascribed to the pressure exerted by the clot on the rest of the brain, but there is no increase of intracranial pressure in an apoplectic fit occurring as a result of the sudden closure of a large vessel by embolism or thrombosis. Suddenness of the lesion appears to be, then, the essential element common to all cases of apoplexy from organic brain disease. It is the sudden shock to the delicate mechanism that produces the unconsciousness; but seeing that the coma is usually deeper and more prolonged in cerebral haemorrhage than when occasioned by vascular occlusion, and that an ingravescent apoplexy coma gradually develops and deepens as the amount of haemorrhage increases, we may presume that increase of intracranial pressure does play an important part in the degree and intensity of the coma caused by the rupture of a vessel. Apoplexy seldom occurs under forty years of age, but owing to the fact that disease of the cerebral vessels may exist at any age, from causes which are fully explained in the article Neuropathology, no period of life is exempt; consequently cases of true apoplexy are not wanting even in very young children. Recognizing that there are two causes of apoplexy in advanced life, viz. (1) sudden rupture of a diseased vessel usually associated with high arterial pressure, enlarged, powerfully acting heart and chronic renal disease, and (2) the sudden clotting of blood in a large diseased vessel favoured by a low arterial pressure due to a weak-acting heart, it is obvious that the character of the pulse forms a good guide to the diagnosis of the cause, the prevention and warding off of an attack, and the treatment of such should it occur.

Anything which tends directly or indirectly to increase arterial pressure within the cerebral blood-vessels may bring on an attack of cerebral haemorrhage; and although the identification of an apoplectic habit of body with a stout build, a short neck and florid complexion is now generally discredited, it being admitted that apoplexy occurs as frequently in thin and spare persons who present no such peculiarity of conformation, yet a plethoric habit of body, occasioned by immoderate eating or drinking associated with the gouty diathesis, leads to a general arterio-sclerosis and high arterial pressure. All conditions which can give rise to a local intracranial or a general bodily increase of the arterial pressure, *i.e.* severe exertion of body and mind, violent emotions, much stooping, overheated rooms, exposure to the sun, sudden shocks to the body, constipation and straining at stool, may, by suddenly increasing the strain on the wall of a diseased vessel,

lead to its rupture.

The outlook of apoplexy is generally unfavourable in cases where the coma is profound; death may take place at different intervals after the onset. If the patient, after recovering from the initial coma, suffers with continual headache and lapses into a drowsy state, the result is likely to be serious; for such a condition probably indicates that an inflammatory change has taken place about the clot or in the area of softening.

Treatment.—The patient should be placed in the recumbent position with the head and shoulders slightly raised. He should be moved as little as possible from the place where the attack occurred. The medical man who is summoned will probably give the following directions: an ice-bag to be applied to the head; a few grains of calomel or a drop of croton oil in butter to be placed on the tongue, or an enema of castor oil to be administered. He may find it necessary to draw off the water with a catheter. The practice of blood-letting, once so common in this disease, is seldom resorted to, although in some cases, where there is very high arterial tension and a general state of plethora, it might be beneficial. Depletives are not employed where there is evidence of failure of the heart's action; indeed the cautious administration of stimulants may be necessary, either subcutaneously or by the mouth (if there exist a power of swallowing), together with warm applications to the surface of the body; a water-bed may be required, and careful nursing, is essential to prevent complications, especially the formation of bedsores.

(F. W. Mo.)

APOROSE (from Gr. ἀ, without, and πόρος, passage), a biological term meaning imperforate, or not porous: there is a group of corals called *Aporosa*.

APOSIOPESIS (the Greek for "becoming silent"), a rhetorical device by which the speaker or writer stops short and leaves something unexpressed, but yet obvious, to be supplied by the imagination. The classical example is the threat, "Quos ego——!" of Neptune (in Virgil, *Aen.* i. 135).

APOSTASY (ἀπόστασις, in classical Greek a defection or revolt from a military commander), a term generally employed to describe a complete renunciation of the Christian faith, or even an exchange of one form of it for another, especially if the motive be unworthy. In the first centuries of the Christian era, apostasy was most commonly induced by persecution, and was indicated by some outward act, such as offering incense to a heathen deity or blaspheming the name of Christ.[1] In the Roman Catholic Church the word is also applied to the renunciation of monastic vows (*apostasis a monachatu*), and to the abandonment of the clerical profession for the life of the world (*apostasis a clericatu*). Such defection was formerly often punished severely.

1 The readmission of such apostates to the church was a matter that occasioned serious controversy. The emperor Julian's "Apostasy" is discussed under Julian.

APOSTIL, or Apostille (possibly connected with Lat. *appositum*, placed near), a marginal note made by a commentator.

APOSTLE (ἀπόστολος, one sent forth on a mission, an envoy, as in Is. xviii. 2; Symmachus, ἀποστέλλειν ἀποστόλους; Aquila, πρεσβευτάς), a technical term used in the New Testament and in Christian literature generally for a special envoy of Jesus Christ. How far it had any similar use in Judaism in Christ's day is uncertain; but in the 4th century A.D., at any rate, it denoted responsible envoys from the central Jewish authority, especially for the collection of religious funds. In its first and simplest Christian form, the idea is present already in Mark iii. 14 f., where from the general circle of his disciples Jesus "made twelve ('whom he also named apostles,' Luke vi. 13, but doubtful in Mark), that they should be with him, and that he might from time to time send them forth (ἵνα ἀποστέλλῃ) to preach and to have authority to cast out demons." Later on (vi. 6 ff.), in connexion with systematic preaching among the villages of Galilee, Jesus begins actually to "send forth" the twelve, two by two; and on their return from this mission (vi. 30) they are for the first time

described as “apostles” or missionary envoys. Matthew (x. 1 ff.) blends the calling of the twelve with their actual sending forth, while Luke (vi. 13) makes Jesus himself call them “apostles” (for Luke’s usage cf. xi. 49, “prophets and apostles,” where Matthew, xxiii. 34, has “prophets and wise men and scribes”). But it is doubtful whether Jesus ever used the term for the Twelve, in relation to their temporary missions, any more than for the “seventy others” whom he “sent forth” later (Luke x. 1). Even the Fourth Gospel never so describes them. It simply has “a servant is not greater than his lord, neither an apostle (envoy) greater than he that sent him” (xiii. 16); and applies the idea of “mission” alike to Jesus (cf. Heb. iii. 1, “Jesus, the apostle ... of our profession”) and to his disciples, generally, as represented by the Twelve (xvii. 18, with 3, 6 ff.). But while ideally all Christ’s disciples were “sent” with the Father’s Name in charge, there were different degrees in which this applied in practice; and so we find “apostle” used in several senses, once it emerges as a technical term.

1. In the Apostolic age itself, “apostle” often denotes simply an “envoy,” commissioned by Jesus Christ to be a primary witness and preacher of the Messianic Kingdom. This wide sense was shown by Lightfoot (in his commentary on *Galatians*, 1865) to exist in the New Testament, *e.g.* in 1 Cor. xii. 28 f., Eph. iv. ii, Rom. xvi. 7; and his view has since been emphasized[1] by the discovery of the *Teaching of the Twelve Apostles* (see Didache), with its itinerant order of “apostles,” who, together with “prophets” (cf. Eph. ii. 20, iii. 5) and “teachers,” constituted a *charismatic* and seemingly unordained ministry of the Word, in some part of the Church (in Syria?) during the early sub-apostolic age. Paul is our earliest witness, as just cited; also in 1 Cor. xv. 5 ff., where he seems to quote the language of Palestinian tradition, in saying that Christ “appeared to Cephas; then to the Twelve; then ... to James; then to the apostles one and all (τοῖς ἀποστόλοις πᾶσιν); and last of all ... to me also.” The appearance to “*all* the Apostles” must refer to the final commission given by the risen Christ to certain assembled disciples (Acts i. 6 ff., cf. Luke xxiv. 33), including not only the Twelve and the Lord’s brethren (i. 13 f.), but also some at least of the Seventy. Of this wider circle of witnesses, taken from among personal disciples during Jesus’s earthly ministry, we get a further glimpse in the election of one from their number to fill Judas’s place among the Twelve (i. 21 ff.), as the primary official witnesses of Messiah and his resurrection. Many of the 120 then present (Acts i. 15), and not only the two set forward for final choice, must have been personal disciples, who by the recent commission had been made “apostles.” Among such we may perhaps name Judas Barsabbas and Silas (Acts xv. 22, cf. i. 23), if not also Barnabas (1 Cor. ix. 6) and Andronicus and Junia (Rom. xvi. 7).

So far, then, we gather that the original Palestinian type of apostleship meant simply (a) personal mission from the risen Christ (cf. I Cor. ix. i), following on (b) some preliminary intercourse with Jesus in his earthly ministry. It was pre-eminence in the latter qualification that gave the Twelve their special status among apostles (Acts i. 26, ii. 14, vi. 2; in Acts generally they are simply “the apostles”). Conversely, it was Paul’s lack in this respect which lay at the root of his difficulties as an apostle.

> It is possible, though not certain, that even those Judaizing missionaries at Corinth whom Paul styles “false-apostles” or, ironically, “the superlative apostles” (2 Cor. xi. 5, 13; xii. 11), rested part of their claim to superiority over Paul on (*b*), possibly even as having done service to Christ when on earth (2 Cor. xi. 18, 23). There is no sign in 2 Cor. that they laid claim to (*a*). If this be so, they were “Christ’s apostles” only indirectly, “through men” (as some had alleged touching Paul, cf. Gal. i. 1), *i.e.* as sent forth on mission work by certain Jerusalem leaders with letters of introduction (2 Cor. iii. 1; E. von Dobschutz, *Problems der apost. Zeitalters*, p. 106).

2. *The Twelve.*—When Jesus selected an inner circle of disciples for continuous training by personal intercourse, his choice of “twelve” had direct reference to the tribes of Israel (Matt. xix. 28; Luke xxii. 30). This gave them a symbolic or representative character as a closed body (cf. Rev. xxi. 14), marking them off as the primary religious authority (cf. Acts ii. 42, “the apostles’ teaching”) among the “disciples” or “brethren,” when these began to assume the form of a community or church. The relationship which other “apostles” had enjoyed with the Master had been uncertain; *they* had been his recognized intimates, and that as a body. Naturally, then, they took the lead, collectively—in form at least, though really the initiative lay with one or two of their own number, Peter in particular. The process of practical differentiation from their fellow apostles was furthered by the concentration of the Twelve, or at least of its most marked representatives, in Jerusalem, for a considerable period (Acts viii. 1, cf. xii. 1 ff.; an early tradition specifies twelve years). Other apostles soon went forth on their mission to “the cities of Israel” (cf. Acts ix. 31), and so exercised but little influence on the central policy of the Church. Hence their shadowy existence in the New Testament, though the actual wording of Matt. x. 5-42, read in the light of the *Didachi*, may help us to conceive their work in its main features.

3. “*Pillar*” *Apostles.*—But in fact differentiation between apostles existed among the Twelve also. There were “pillars,” like Peter and John (and his brother James until his death), who really determined matters of grave moment, as in the conference with Paul in Gal. ii. 9—a conference which laid the basis of the latter’s status as an apostle even in the eyes of Jewish Christians. Such pre-eminence was but the sequel of personal distinctions visible even in the preparatory days of discipleship, and it warns us against viewing the primitive facts touching apostles in the official light of later times.

Consciousness of such personal pre-eminence has left its marks on the lists of the Twelve in the New Testament. Thus (1) Peter, James, John, Andrew, always appear as the first four, though the order varies, Mark representing relative prominence during Christ’s ministry, and Acts actual influence in the Apostolic Church (cf. Luke viii. 51, ix. 28). (2) The others also stand in groups of four, the first name in each being constant, while the order of the rest varies.

The same lesson emerges when we note that one such apostolic “pillar” stood outside the Twelve altogether, viz. James, the Lord’s brother (Gal. ii. 9, cf. i. 19); and further, that “the Lord’s brethren” seem to have ranked above “apostles” generally, being named between them and Peter in 1 Cor. ix. 5. That is, they too were apostles with the addition of a certain personal distinction.

4. *Paul, the* “*Apostle of the Gentiles.*”—So far apostles are only of the Palestinian type, taken from among actual hearers of the Messiah and with a mission primarily to Jews—apostles “of the circumcision” (Gal. ii. 7-

9). Now, however, emerges a new apostleship, that to the Gentiles; and with the change of mission goes also some change in the type of missionary or apostle. Of this type Paul was the first, and he remained its primary, and in some senses its only, example. Though he could claim, on occasion, to satisfy the old test of having seen the risen Lord (1 Cor. ix. 1, cf. xv. 8), he himself laid stress not on this, but on the revelation within his own soul of Jesus as God's Son, and of the Gospel latent therein (Gal. i. 16). This was his divine call as "apostle of the Gentiles" (Rom. xi. 13); here lay both his qualification and his credentials, once the fruits of the divine inworking were manifest in the success of his missionary work (Gal. ii. 8 f.; 1 Cor. xi. 1 f.; 2 Cor. in. 2 f., xii. 12). But this new criterion of apostleship was capable of wider application, one dispensing altogether with vision of the risen Lord—which could not even in Paul's case be proved so fully as in the case of the original apostles—but appealing to the "signs of an apostle" (1 Cor. ix. 2; 2 Cor. xii. 12), the tokens of spiritual gift visible in work done, and particularly in the planting of the Gospel in fresh fields (2 Cor. x. 14-18). It may be in this wide charismatic sense that Paul uses the term in 1 Cor. xii. 28 f., Eph. ii. 20, iii. 5, iv. 11, and especially in Rom. xvi. 7, "men of mark among the apostles" (cf. 2 Cor. xi. 13, "pseudo-apostles" masquerading as "apostles of Christ," and perhaps 1 Thess. ii, 6, of himself and Silas). That he used it in senses differing with the context is proved by 1 Cor. xv. 9, where he styles himself "the least of apostles," although in other connexions he claims the very highest rank, co-ordinate even with the Twelve as a body (Gal. ii. 7 ff.), in virtue of his distinctive Gospel.

This point of view was not widely shared even in circles appreciative of his actual work. To most he seemed but a fruitful worker within lines determined by "the twelve apostles of the Lamb" as a body (Rev. xxi. 14). So we read of "the plant (Church) which the twelve apostles of the Beloved shall plant" (*Ascension of Isaiah*, iv. 3); "those who preached the Gospel to us (especially Gentiles)... unto whom He gave authority over the Gospel, being twelve for a witness to the tribes" (Barn. viii. 3, cf. v. 9); and the going forth of the Twelve, after twelve years, beyond Palestine "into the world," to give it a chance to hear (*Preaching of Peter*, in Clem. Alex. *Strom.* vi. 5.43; 6.48). Later on, however, his own claim told on the Church's mind, when his epistles were read in church as a collection styled simply "the Apostle." 198

As the primary medium of the Gentile Gospel (Gal. i. 16, cf. i. 8, ii. 2) Paul had no peers as an "apostle of the Gentiles" (Rom. xi. 13, cf. XV. 15-20, and see 1 Cor. xv. 8, "last of all to me"), unless it were Barnabas who shares with him the title "apostle" in Acts xiv. 4, 14—possibly with reference to the special "work" on which they had recently been "sent forth by the Spirit" (xiii. 2, 4). Yet such as shared the spiritual gift (*charisma*) of missionary power in sufficient degree, were in fact apostles of Christ in the Spirit (1 Cor. xii. 28, II). Such a secondary type of apostolate—answering to "apostolic missionaries" of later times (cf. the use of ἱεραπόστολος in this sense by the Orthodox Eastern Church to-day)—would help to account for the apostolic claims of the missionaries censured in Rev. ii. 2, as also for the "apostles" of the second generation implied in the Didachē.

In the *sub-apostolic age*, however, the class of "missionaries" enjoying a *charisma* such as was conceived to convey apostolic commission through the Spirit, soon became distinguished from "apostles" (cf. Hennas, *Sim.* ix. 15.4, "the apostles and teachers of the message of the Son of God," so 25.2; in 17.1 the apostles are reckoned as twelve), as the title became more and more confined by usage to the original apostles, particularly the Twelve as a body (*e.g. Ascension of Isaiah* and the *Preaching of Peter*), or to them and Paul (*e.g.* in Clement and Ignatius), and as reverence for these latter grew in connexion with their story in the Gospels and in Acts.[2] Thus Eusebius describes as "evangelists" (cf. Philip the Evangelist in Acts xxi. 8, also Eph. iv. 11, 2 Tim. iv. 5) those who "occupied the first rank in the succession to the Apostles" in missionary work (*Hist. Eccl.* iii. 37, cf. v. 10). Yet the wider sense of "apostle" did not at once die out even in the third and fourth generations. It lingered on as applied to the Seventy[3]—by Irenaeus, Tertullian, Clement and Origen— and even to Clement of Rome, by Clem. Alex. (? as a "fellow-worker" of Paul, Phil. iv. 3); while the adjective "apostolic" was applied to men like Polycarp (in his contemporary *Acts of Martyrdom*) and the Phrygian, Alexander, martyred at Lyons in A.D. 177 (Eus. v. 1), who was "not without share of apostolic *charisma*."

The *authority* attaching to apostles was essentially spiritual in character and in the conditions of its exercise. Anything like autocracy among his followers was alien to Jesus's own teaching (Matt, xxiii. 6-11). All Christians were "brethren," and the basis of pre-eminence among them was relative ability for service. But the personal relation of the original Palestinian apostles to Jesus himself as Master gave them a unique fitness as authorized witnesses, from which flowed naturally, by sheer spiritual influence, such special forms of authority as they came gradually to exercise in the early Church. "There is no trace in Scripture of a formal commission of authority for government from Christ Himself" (Hort, *Chr. Eccl.* p. 84) given to apostles, save as representing the brethren in their collective action. Even the "resolutions" (δόγματα) of the Jerusalem conference were not set forth by the apostles present simply in their own name, nor as *ipso facto* binding on the conscience of the Antiochene Church. They expressed "a claim to deference rather than a right to be obeyed" (Hort, *op. cit.* 81-85). Such was the kind of authority attaching to apostles, whether collectively or individually. It was not a fixed notion, but varied in quantity and quality with the growing maturity of converts. This is how Paul, from whom we gather most on the point, conceives the matter. The exercise of his spiritual authority is not absolute, lest he "lord it over their faith"; consent of conscience or of "faith" is ever requisite (2 Cor. i. 24; cf. Rom. xiv. 23). But the principle was elastic in application, and would take more patriarchal forms in Palestine than in the Greek world. The case was essentially the same as on the various mission-fields to-day, where the position of the "missionary" is at first one of great spiritual initiative and authority, limited only by his own sense of the fitness of things, in the light of local usages. So the notion of formal or constitutional authority attaching to the apostolate, in its various senses, is an anachronism for the apostolic age. The tendency, however, was for their authority to be conceived more and more on formal lines, and, particularly after their deaths, as absolute.

The authority attaching to apostles as writers, which led gradually to the formation of a New Testament Canon—"the Apostles" side by side with "the Books" of the Old Testament (so 2 Clement xiv., *c.* A.D. 120-140) —is a subject by itself (see BIBLE).

This change of conception helped to further the notion of a certain devolution of apostolic powers to

successors constituted by act of ordination. The earliest idea of an *apostolical succession* meant simply the re-emergence in others of the apostolic spirit of missionary enthusiasm. "The first rank in the succession of the apostles" consisted of men eminent as disciples of theirs, and so fitted to continue their labours (Euseb. iii. 37); and even under Commodus (A.D. 180-193) there were "evangelists of the word" possessed of "inspired zeal to emulate apostles" (v. 10). Such were perhaps the "apostles" of the *Didachē*. Of the notion of apostolic succession in ministerial grace conferred by ordination, there is little or no trace before Irenaeus. The famous passage in Clement of Rome (xliv. 2) refers simply to the succession of one set of men to another in an office of apostolic institution. The grace that makes Polycarp "an apostolic and prophetic teacher" (*Mart. Polyc*. 16) is peculiar to him personally. But Irenaeus holds, apparently on *a priori* grounds, that "elders" who stand in orderly succession to the apostolic founders of the true tradition in the churches, have, "along with the succession of oversight," also an "assured gift of (insight into) truth" by the Father's good pleasure ("cum episcopatus successione charisma veritatis certum secundum placitum Patris acceperunt"), in contrast to heretics who wilfully stand outside this approved line of transmission (*adv. Haer*. iv. 26. 2). So far, indeed, the succession is not limited to the monarchical episcopate as distinct from the presbyteral order to which it belonged (cf. "presbyterii ordo, principalis consessio" in the same context, and see iii. 14. 2), though the bishops of apostolic churches, as capable of being traced individually (iii. 3. 1), are specially appealed to as witnesses (cf. iv. 33. 8, v. 19. 2)—as earlier by Hegesippus (Euseb. iv. 22). Nor is there mention of sacerdotal grace attaching to the succession in apostolic truth.[4] But once the idea of supernatural grace going along with office as such (of which we have already a trace in the Ignatian bishop, though without the notion of actual apostolic succession) arose in connexion with *successio ab apostolis*, the full development of the doctrine was but a matter of time.[5]

LITERATURE.—In England the modern treatment of the subject dates from J.B. Lightfoot's dissertation in his *Commentary on Galatians*, to which Dr F.J.A. Hort's *The Christian Ecclesia* added elements of value; see also T.M. Lindsay, *The Church and the Ministry*, and articles in Hastings' *Dictionary of the Bible* and the *Ency. Biblica*; A. Harnack, *Die Lehre der Apostel*, pp. 93 ff., and *Dogmengeschichte* (3rd ed.), i. 153 ff.; E. Haupt, *Zum Verstandnis d. Apostolats in NT.* (Halle, 1896); and especially H. Monnier, *La Notion de l'apostolat, des origines à Irénée* (Paris, 1903). The later legends and their sources are examined by T. Schermann, *Propheten- und Apostellegenden* (Leipzig, 1907).

(J. V. B.)

1 By analogy, that is; for the wider sense of "apostle" in the Apostolic age need not be identical with a sub-apostolic use of the term (see below, 4 *fin.*).

2 The tendency is already visible in the Lucan writings. An anologous process is seen in the use of "disciple," applicable in the apostolic age to Christians at large, but in the course of the sub-apostolic age restricted to personal "disciples of the Lord" or to martyrs (Papias in Eus. iii. 39, cf. Ignatius, *Ad Eph.* i. 2).

3 In the Edessene legend of Abgar, in Eus. i. 12, we read that "Judas, who is also Thomas, sent Thaddaeus as apostle —one of the Seventy," where simply an authoritative envoy of Jesus seems intended. For traces of the wider sense of "apostle" in Gnostic, Marcionite and Montanist circles, see Monnier (as below).

4 The above is substantially the view taken by J.B. Lightfoot in his essay on "The Christian Ministry" (*Comm. on Philippians*, 6th ed., pp. 239, 252 f.), and by T.M. Lindsay, *The Church and the Ministry* (1902), pp. 224-228, 278 ff. Even C. Gore, *The Church and the Ministry* (1889), pp. 119 ff., while inferring a sacerdotal element in Irenaeus's conception of the episcopate, says: "But it is mainly as preserving the catholic traditions that Irenaeus regards the apostolic succession" (p. 120).

5 See Lightfoot's essay for Cyprian's contribution, as also for that of the Clementines, which fix on the twofold position of James at Jerusalem, as apostle and bishop, as bearing on apostolic succession in the episcopate.

APOSTLE SPOONS, a set of spoons, usually of silver or silver gilt, with the handles terminating in figures of the apostles, each bearing their distinctive emblem. They were common baptismal gifts during the 15th and 16th centuries, but were dying out by 1666. Often single spoons were given, bearing the figure of the patron or name saint of the child. Sets of the twelve apostles are not common, and complete sets of thirteen, with the figure of our Lord on a larger spoon, are still rarer. The Goldsmiths' Company in London has one such set, all by the same maker and bearing the hall-mark of 1626, and a set of thirteen was sold at Christie's in 1904 for £4900.

See William Hone, *The Everyday Book* and *Table Book* (1831); and W.J. Cripps, *Old English Plate* (9th ed., 1906).

APOSTOLICAL CONSTITUTIONS (Διαταγαὶ *or* Διατάξεις τῶν ἁγίων ἀποστόλων διὰ Κλήμεντος τοῦ Ῥωμαίων ἐπισκόπου τε καὶ πολίτου. Καθολικὴ διδασκαλία), a collection of ecclesiastical regulations in eight books, the last of which concludes with the eighty-five *Canons of the Holy Apostles*. By their title the Constitutions profess to have been drawn up by the apostles, and to have been transmitted to the Church by Clement of Rome; sometimes the alleged authors are represented as speaking jointly, sometimes singly. From the first they have been very variously estimated; the *Canons*, as a rule, more highly than the rest of the work. For example, the Trullan Council of Constantinople (*quini-sextum*), A.D. 692, accepts the Canons as genuine by its second canon, but rejects the Constitutions on the ground that spurious matter had been introduced into them by heretics; and whilst the former were henceforward used freely in the East, only a few

portions of the latter found their way into the Greek and oriental law-books. Again, Dionysius Exiguus (*c.* A.D. 500) translated fifty of the Canons into Latin,[1] although under the title *Canones qui dicuntur Apostolorum*, and thus they passed into other Western collections; whilst the Constitutions as a whole remained unknown in the West until they were published in 1563 by the Jesuit Turrianus. At first received with enthusiasm, their authenticity soon came to be impugned; and their true significance was largely lost sight of as it began to be realized that they were not what they claimed to be. Vain attempts were still made to rehabilitate them, and they were, in general, more highly estimated in England than elsewhere. The most extravagant estimate of all was that of Whiston, who calls them "the most sacred standard of Christianity, equal in authority to the Gospels themselves, and superior in authority to the epistles of single apostles, some parts of them being our Saviour's own original laws delivered to the apostles, and the other parts the public acts of the apostles" (Historical preface to *Primitive Christianity Revived*, pp. 85-86). Others, however, realized their composite character from the first, and by degrees some of the component documents became known. Bishop Pearson was able to say that "the eight books of the Apostolic Constitutions have been after Epiphanius's time compiled and patched together out of the *didascaliae* or doctrines which went under the names of the holy apostles and their disciples or successors" (*Vind. Ign.* i. cap. 5); whilst a greater scholar still, Archbishop Usher, had already gone much further, and concluded, forestalling the results of modern critical methods, that their compiler was none other than the compiler of the spurious Ignatian epistles (*Epp. Polyc. et Ign.* p. lxiii. f., Oxon. 1644). The Apostolical Constitutions, then, are spurious, and they are one of a long series of documents of like character. But we have not really gauged their significance by saying that they are spurious. They are the last stage and climax of a gradual process of compilation and crystallization, so to speak, of unwritten church custom; and a short account of this process will show their real importance and value.

Origin and real nature.

These documents are the outcome of a tendency which is found in every society, religious or secular, at some point in its history. The society begins by living in accordance with its fundamental principles. By degrees these translate themselves into appropriate action. Difficulties are faced and solved as they arise; and when similar circumstances recur they will tend to be met in the same way. Thus there grows up by degrees a body of what may be called customary law. Plainly, there is no particular point of time at which this customary law can be said to have begun. To all appearance it is there from the first in solution and gradually crystallizes out; and yet it is being continually modified as time goes on. Moreover, the time comes when the attempt is made, either by private individuals or by the society itself, to put this "customary law" into writing. Now when this is done, two tendencies will at once show themselves. (*a*) This "customary law" will at once become more definite: the very fact of putting it into writing will involve an effort after logical completeness. There will be a tendency on the part of the writer to fill up gaps; to state local customs as if they obtained universally; to introduce his personal equation, and to add to that which is the custom that which, in his opinion, *ought* to be. (*b*) There will be a strong tendency to fortify that which has been written with great names, especially in days when there is no very clear notion of literary property. This is done, not always with any deliberate consciousness of fraud (although it must be clearly recognized that truth is not one of the "natural virtues," and that the sense of the obligations of truthfulness was far from strong), but rather to emphasize the importance of what was written, and the fact that it was no new invention of the writer's. In a non-literary age fame gathers about great names; and that which, *ex hypothesi*, has gone on since the beginning of things is naturally attributed to the founders of the society. Then come interpolations to make this ascription more probable, and the prefixing of a title, then or subsequently, which states it as a fact. This is precisely the way in which the Apostolical Constitutions and other kindred documents have come into being. They are attempts, made in various places and at different times, to put into writing the order and discipline and character of the Church; in part for private instruction and edification, but in part also with a view to actual use; frequently even with an actual reference to particular circumstances. In this lies their importance, to a degree which is only just being adequately realized. They contain evidence of the utmost value as to the order of the Church in early days; evidence, however, which needs to be sifted with the greatest care, since the personal preferences of the writer and the customs of the local church to which he belongs are continually mixed up with things which have a wider prevalence. It is only by careful investigation, by the method of comparisons, that these elements can be disentangled; but as the number of documents of this class known to us is continually increasing, their value increases even more than proportionately. And whilst their local and fugitive character must be fully recognized and allowed for, is it unjustifiable to set them aside or leave them out of account as heretical, and therefore negligible.

Other collections.

It will be sufficient here to mention shortly the chief collections of this kind which came into existence during the first four centuries; generally as the work of private individuals, and having, at any rate, no more than a local authority of some kind, (*a*) The earliest known to us is the *Didachē* or *Teaching of the Twelve Apostles*, itself compiled from earlier materials, and dating from about 120 (see Didachē). (*b*) *The Apostolic Church Order* (*apostolische Kirchenordnung* of German writers); *Ecclesiastical Canons of the Holy Apostles* of one MS.; *Sententiae Apostolorum* of Pitra: of about 300, and emanating probably from Asia Minor. Its earlier part, cc. 1-14, depends upon the *Didachē*, and the rest of it is a book of discipline in which Harnack has attempted to distinguish two older fragments of church law (*Texte u. Unters.* ii. 5). (*c*) The so-called *Canones Hippolyti*, probably Alexandrian or Roman, and of the first half of the 3rd century. It will be observed that these make no claim to apostolic authorship; but otherwise their origin is like that of the rest, unless indeed, as has been suggested, they represent the work of an actual Roman synod, (*d*) The so-called *Egyptian Church Order*, in Coptic from a Greek pre-Nicene original (*c.* 310). It is part of the Egyptian Heptateuch and contains neither communion nor ordination forms, (*e*) The *Ethiopic Church Order*, perhaps twenty years later than (*d*), and forming part of the *Ethiopic Statutes*. (*f*) The *Verona Latin Fragments*, discovered and published by Hauler, portions of a form akin to (*e*), which may be dated *c.* 340, though possibly earlier. It has a preface which refers to a treatise *Concerning Spiritual Gifts* as having immediately preceded it. (*g*) The recently discovered *Testament of the Lord*, which is somewhat later in date (*c.* 350), and likewise depends upon the *Canones Hippolyti*. (*h*) The so-called *Canons of Basil*. This is an Arabic work perhaps based on a Coptic and ultimately on a Greek original, embodying with modifications large portions of the Canons of Hippolytus. (On the relations between the six

last-named, see Hippolytus, Canons of.)

> Here also may be noticed the *Didascalia Apostolorum*, originally written in Greek, but known through a Syriac version and a fragmentary Latin one published by Hauler. It is of the middle of the 3rd century—in fact, a passage in the Latin translation seems to give us the date A.D. 254. It emanates from Palestine or Syria, and is independent of the documents already mentioned; and upon it the *Constitutions* themselves very largely depend. It is a mixture of moral and ecclesiastical instruction. The *Sacramentary of Serapion* (*c.* 350), *The Pilgrimage of Etheria* (*Silvia*) (*c.* 385), and *The Catechetical Lectures of Cyril of Jerusalem* (348) are also of value in this connexion. In the (so-called) *Constitutions through Hippolytus* we have possibly a preliminary draft of the famous 8th book of the *Apostolical Constitutions*.[2]

Contents.

The Constitutions themselves fall into three main divisions. (i.) The first of these consists of books i.-vi., and throughout runs parallel to the *Didascalia*. Bickell, indeed, held that this latter was an abbreviated form of books i.-vi.; but it is now agreed on all hands that the Constitutions are based on the *Didascalia* and not vice versa. (ii.) Then follows book vii., the first thirty-one chapters of which are an adaptation of the *Didachē*, whilst the rest contain various liturgical forms of which the origin is still uncertain, though it has been acutely suggested by Achelis, and with great probability, that they originated in the schismatical congregation of Lucian at Antioch. (iii.) Book viii. is more composite, and falls into three parts. The first two chapters, περὶ χαρισμάτων, may be based upon a lost work of St Hippolytus, otherwise known only by a reference to it in the preface of the *Verona Latin Fragments*; and an examination shows that this is highly probable. The next section, cc. 3-27, περὶ χειροτονιῶν, and cc. 28-46, περὶ κανόνων, is twofold, and is evidently that upon which the writer sets most store. The apostles no longer speak jointly, but one by one in an apostolic council, and the section closes with a joint decree of them all. They speak of the ordination of bishops (the so-called Clementine Liturgy is that which is directed to be used at the consecration of a bishop, cc. 5-15), of presbyters, deacons, deaconesses, sub-deacons and lectors, and then pass on to confessors, virgins, widows and exorcists; after which follows a series of canons on various subjects, and liturgical formulae. With regard to this section, all that can be said is that it includes materials which are also to be found elsewhere—in the *Egyptian Church Order* and other documents already spoken of—and that the precise relation between them is at present not determined. The third section consists of the Apostolic Canons already referred to, the last and most significant of which places the Constitutions and the two epistles of Clement in the canon of Scripture, and omits the Apocalypse. They are derived in part from the preceding Constitutions, in part from the canons of the councils of Antioch, 341, Nicaea, 325, and possibly Laodicaea, 363.

A comparison of the Constitutions with the material upon which they are based will illustrate the compiler's method. (*a*) To begin with the *Didascalia* already mentioned. It is unmethodical and badly digested, homiletical in style, and abounding in biblical quotations. There is no precise arrangement; but the subjects, following a general introduction, are the bishop and his duties, penance, the administration of the offerings, the settlement of disputes, the divine service, the order of widows, deacons and deaconesses, the poor, behaviour in persecution, and so forth. The compiler of the Constitutions finds here material after his own heart. He is even more discursive and more homiletical in style; he adds fresh citations of the Scriptures, and additional explanations and moral reflexions; and all this with so little judgment that he often leaves confusion worse confounded (*e.g.* in ii. 57, where, upon a symbolical description of the Church as a sheepfold, he has superimposed the further symbolism of a ship). (*b*) Passing on to books vii. and viii., we observe that the compiler's method of necessity changes with his new material. In the former book he still makes large additions and alterations, but there is less scope for his prolixity than before; and in the latter, where he is no longer dealing with generalities, but making actual definitions, the Constitutions of necessity become more precise and statutory in form. Throughout he adopts and adapts the language of his sources as far as possible, "only pruning in the most pressing cases," but towards the end he cannot avoid making larger alterations from time to time. And his alterations throughout are not made aimlessly. Where he finds things which would obviously clash with the customs of his own day, he unhesitatingly modifies them. An account of the Passion, with a curiously perverted chronology, the object of which was to justify the length of the Passion-tide fast, is entirely revised for this reason (v. 14); the direction to observe Easter according to the Jewish computation is changed into the exact contrary for the same reason (v. 17); and where his archetype lapses into speaking of a lull in persecution he naïvely informs us that the Romans have now given up persecuting and have adopted Christianity (vi. 26), forgetting altogether that he is speaking in the character of the apostles. Above all, he both magnifies the office of the Christian ministry as a whole and alters what is said of it in detail (for example, the deaconess loses rank not a little), to make it agree with the circumstances of his day in general, and with his own ideas of fitness in particular. It is here that his evidence is at once most valuable and needs to be used with the greatest care. To give one striking example of the value of these documents. The *Canones Hippolyti* (vi. 43) provide that one who has been a confessor for the faith may be received as a presbyter by virtue of his confessorship and not by the laying on of the bishop's hands; but if he be chosen a bishop, he is to be ordained. This provision passes on into the Egyptian *Ecclesiastical Canons* and other kindred documents, and even into the *Testamentum Domini*. But the corresponding passage in the Apostolical Constitutions (viii. 23) entirely reverses it: "A confessor is not ordained, for he is so by choice and patience, and is worthy of great honour.... But if there be occasion, he is to be ordained either a bishop, priest, or deacon. But if any one of the confessors who is not ordained snatches to himself any such dignity upon account of his confession, let the same person be deprived and rejected; for he is not in such an office, since he has denied the constitution of Christ, and is worse than an infidel."

Authorship, place, and date.

Who, then, is the author of the Constitutions, and what can be inferred with regard to him? (i.) By separating off the sources which he used from his own additions to them, it at once becomes clear that the latter are the work of one man: the style is unmistakable, and the method of working is the same throughout. The compiler of books i.-vi. is also the compiler of books vii., viii. (ii.) As to his theological position, different views have been held. Funk suggests Apollinarianism, which is the refuge of the destitute; and Achelis inclines in the same direction. But the affinities of the author are quite otherwise, the most pronounced of them being a strong subordinationist tendency, denial of a human soul to Christ, and the like, which suggest not indeed Arianism

but an inclination towards Arianism. Above all, his polemic is directed against the dying heresies of the 3rd century; and he writes with an absence of constraint which is not the language of one who lives amidst violent controversies or who is conscious of being in a minority. All this points to the position of a "conservative" or semi-Arian of the East, one who belongs, perhaps, to the circle of Lucian of Antioch and writes before the time of Julian. It is hard to think of any other time or circumstances in which a man could write like this, (iii.) The indications of *time* have been held to point to a different conclusion. On the one hand, the fact that the attempt to rebuild the temple by Julian in 363 is not mentioned in vi. 24 points to an earlier date; and the fact that the κοπιᾶται are not mentioned amongst the church officers points in the same direction, for elsewhere they are first mentioned in a rescript of Constantius in A.D. 357. On the other hand, in the cycle of feasts occur the names of several which are probably of later date—*e.g.* Christmas and St Stephen, which were introduced at Antioch *c.* A.D. 378 and 379 respectively. Again, Epiphanius (*c.* A.D. 374) appears to be unacquainted with it; he still quotes from the *Didascalia*, and elaborately explains it away where it is contrary to the usages of his own day. But as regards the former point, it is possible that the Apostolical Constitutions constantly gave rise to these festivals; or, on the other hand, that the two passages were subsequently introduced either by the writer himself or by some other hand, when the last book of the Constitutions was being used as a law-book. And as regards the latter, the fact that Epiphanius does not use the Constitutions is no proof that they had not yet been compiled. (iv.) As to the region of composition there is no real doubt. It was clearly the East, Syria or Palestine. Many indications are against the latter, and Syria is strongly suggested by the use of the Syro-Macedonian calendar. Moreover, the writer represents the Roman Clement as the channel of communication between the apostles and the Church. This fact both supplies him with the name by which he is commonly known, Pseudo-Clement, and also furnishes corroboration of his Syrian birth; since the other spurious writings bearing the name of Clement, the *Homilies* and *Recognitions*, are likewise of Syrian origin. Moreover, the spurious Ignatian epistles, which are also Syrian, depend throughout upon the Constitutions, (v.) But this is not all. It was long ago noticed that Pseudo-Clement bears a very close resemblance to Pseudo-Ignatius, the interpolator of the Ignatian Epistles in the longer Greek recension. Usher, as we have seen, identified them, and modern criticism accepts this identification as a fact (Lagarde, Harnack, Funk, Brightman). Lightfoot, indeed, still hesitated (*Ap. Fathers*, II. i. 266 n.) on the ground that Pseudo-Ignatius occasionally misunderstands the Constitutions, that the two writings give the Roman succession differently, and that Pseudo-Clement shows no knowledge of the Christological controversies of Nicaea. But as regards the first of these, it is rather a case of condensed citation than of misinterpretation; the second is explained by the writer's carelessness as shown in other passages, and all are solved if a considerable interval of time elapsed between the compilation of the Constitutions and the spurious Ignatian epistles.

It seems clear then that the compiler was a Syrian, and that he also wrote the spurious Ignatian epistles; he was likewise probably a semi-Arian of the school of Lucian of Antioch. His date is given by Harnack as A.D. 340-360, with a leaning to 340-343; by Lightfoot as the latter half of the 4th century; by Brightman, 370-380; by Maclean, 375; and by Funk as the beginning of the 5th century.

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(W. E. CO.)

1 Why he did not go on to give the remaining thirty-five is not clear; they belong to the same date as, and are not inferior to, the first fifty.

2 At a later date various collections were made of the documents above mentioned, or some of them, to serve as law-books in different churches—*e.g.* the Syrian Octateuch, the Egyptian Heptateuch, and the Ethiopic Sīnōdōs. These, however, stand on an entirely different footing, since they are simply collections of existing documents, and no attempt is made to claim apostolic authorship for them.

APOSTOLIC CANONS, a collection of eighty-five rules for the regulation of clerical life, appended to the eighth book of the *Apostolical Constitutions* (*q.v.*). They are couched in brief legislative form though on no definite plan, and deal with the vexed questions of ecclesiastical discipline as they were raised towards the end of the 4th century. At least half of the canons are derived from earlier constitutions, and probably not many of them are the actual productions of the compiler, whose aim was to gloss over the real nature of the *Constitutions*, and secure their incorporation with the Epistles of Clement in the New Testament of his day. The *Codex Alexandrinus* does indeed append the Clementine Epistles to its text of the New Testament. The Canons may be a little later in date than the preceding *Constitutions*, but they are evidently from the same Syrian theological circle.

APOSTOLIC FATHERS, a term used to distinguish those early Christian writers who were believed to have been the personal associates of the original Apostles. While the title “Fathers” was given from at least the beginning of the 4th century to church writers of former days, as being the parents of Christian belief and thought for later times, the expression “Apostolic Fathers” dates only from the latter part of the 17th century. The idea of recognizing these “Fathers” as a special group exists already in the title “Patres aevi apostolici, sive SS. Patrum qui temporibus apostolicis floruerunt ... opera,” under which in 1672 J.B. Cotelier published at Paris the writings current under the names of Barnabas, Clement of Rome, Hermas, Ignatius and Polycarp. But the name itself is due to their next editor, Thomas Ittig (1643-1710), in his *Bibliotheca Patrum Apostolicorum* (1699), who, however, included under this title only Clement, Ignatius and Polycarp. Here already appears the doubt as to how many writers can claim the title, a doubt which has continued ever since, and makes the contents of the “Apostolic Fathers” differ so much from editor to editor. Thus the Oratorian Andrea Gallandi (1700-1779), in re-issuing Cotelier’s collection in his *Bibliotheca Veterum Patrum* (1765-1781), included the fragments of Papias and the Epistle to Diognetus, to which recent editors have added the citations from the “Elders” of Papias’s day found in Irenaeus and, since 1883, the *Didachē*.

The degree of historic claim which these various writings have to rank as the works[1] of Apostolic Fathers varies greatly on any definition of “apostolic.” Originally the epithet was meant to be taken strictly, viz. as denoting those whom history could show to have been personally connected, or at least coeval, with one or more apostles; and an effort was made, as by Cotelier, to distinguish the writings rightly and wrongly assigned to such. Thus editions tended to vary with the historical views of editors. But the convenience of the category “Apostolic Fathers” to express not only those who might possibly have had some sort of direct contact with apostles—such as “Barnabas,” Clement, Ignatius, Papias, Polycarp—but also those who seemed specially to preserve the pure tradition of apostolic doctrine during the sub-apostolic age, has led to its general use in a wide and vague sense.

Conventionally, then, the title denotes the group of writings which, whether in date or in internal character, are regarded as belonging to the main stream of the Church’s teaching during the period between the Apostles and the Apologists (*i.e.* to c. A.D. 140). Or to put it more exactly, the “Apostolic Fathers” represent, chronologically in the main and still more from the religious and theological standpoint, the momentous process of transition from the type of teaching in the New Testament to that which meets us in the early Catholic Fathers, from the last quarter of the 2nd century onwards. The Apologists no doubt show us certain fresh factors entering into this development; but on the whole the Apostolic Fathers by themselves go a long way to explain the transition in question, so far as knowledge of this *saeculum obscurum* is within our reach at all. It is true that they do not include the whole even of the ecclesiastical literature of the sub-apostolic age, not to mention what remains of Gnostic and other minority types. The *Preaching and Apocalypse* of Peter, for instance, are quite typical of the same period, and help us to read between the lines of the Apostolic Fathers. Yet they do not really add much to what is there already, and they have the drawbacks of pseudonymity; they lack concrete and personal qualities; they are general expressions of tendencies which we cannot well locate or measure, save by means of the Apostolic Fathers themselves or of their earliest Catholic successors.

(A) In *external features* the group is far from homogeneous, a fact which has led to their being disintegrated as a group in certain histories of early Christian literature (*e.g.* those of Harnack and Krüger), and classed each under its own literary type—so sacrificing to outer form, which is quite secondary in primitive Christian writings, the more significant fact of religious affinity. Its original members, those still best entitled to their name in any strict sense, are epistles, and in this respect also most akin to Apostolic writings. Indeed Ignatius takes pleasure in saluting his readers “after the apostolic stamp” (*ad Troll.* inscr.), while yet disclaiming all desire to emulate the apostolic manner in other respects, being fully conscious of the gulf between himself and apostles like Peter and Paul in claim to authority (*ib.* in. 3, *ad Rom.* iv. 3). The like holds of Polycarp, who, in explaining that he writes to exhort the Philippians only at their own request, adds, “for neither am I, nor is any other like me, able to follow the wisdom of the blessed and glorious Paul” (in. 2). Clement’s epistle, indeed, conforms more to the elaborate and treatise-like form of the Epistle to the Hebrews, on which it draws so largely; and the same is true of “Barnabas.” But one and all are influenced by study of apostolic epistles, and witness to the impression which these produced on the men of the next generation. Unconsciously, too, they correspond to the apostolic type of writing in another respect, viz. their occasional and practical character. They are evoked by pressing needs of the hour among some definite body of Christians and not by any literary motive.[2] This is a universal trait of primitive Christian writings; so that to speak of primitive Christian “literature” at all is hardly accurate, and tends to an artificial handling of their contents. These sub-apostolic epistles are veritable “human documents,” with the personal note running through them. They are after all personal expressions of Christianity, in which are discernible also specific types of local tradition. To such spontaneous actuality a large part of their interest and value is due.

Nor is this pre-literary and vital quality really absent even from the writing which is least entitled to a place among “Apostolic Fathers,” the Epistle to Diognetus. This beautiful picture of the Christian life as a realized ideal, and of Christians as “the soul” of the world, owes its inclusion to a double error: first, to the accidental attachment at the end of another fragment (§ ii), which opens with the writer’s claim to stand forth as a teacher as being “a disciple of apostles”; and next, to mistaken exegesis of this phrase as implying personal relations with apostles, rather than knowledge of their teaching, written or oral. Whether in form addressed to Diognetus, the tutor of Marcus Aurelius, as a typical cultured observer of Christianity, or to some other eminent person of the same name in the locality of its origin, or, as seems more likely, to cultured Greeks generally, personified under the significant name “Diognetus” (“Heaven-born,” of. Acts xvii. 28 along with § iii. 4)—the epistle is in any case an “open letter” of an essentially literary type. Further, its opening seems modelled on the lines of the preface to Luke’s Gospel, to which, along with Acts, it may owe something of its very conception as a reasoned appeal to the lover of truth. But while literary in form and conception, its appeal is in spirit so personal a testimony to what the Gospel has done for the writer and his fellow Christians, that it is akin to the piety of the Apostolic Fathers as a group. It is true that it has marked affinities, *e.g.* in its natural theology, with the earliest Apologists, Aristides and Justin, even as it is itself in substance an apology addressed not to the State, but to thoughtful public opinion. But this only means that

we cannot draw a hard and fast line between groups of early Christian writings at a time when practical religious interests overshadowed all others.

If thus related to the Apologists of the middle of the 2nd century, the Epistle to Diognetus has also points of contact with one of the most practical and least literary writings found among our Apostolic Fathers, viz. the homily originally known as the Second Epistle of Clement (for this ascription, as for other details, see Clementine Literature). The recovery of its concluding sections in the same MS. which brought the *Didachē* to light, proves beyond question that we have here the earliest extant sermon preached before a Christian congregation, about A.D. 120-140 (so J.B. Lightfoot). Its opening section, recalling to its hearers the passing of the mists of idolatry before the revelation in Jesus Christ, is markedly similar in tone and tenor to passages in the Epistle to Diognetus. Far closer, however, are the affinities between the homily and the *Shepherd of Hermas*, "the first Christian allegory," which as a literary whole dates from about A.D. 140, but probably represents a more or less prolonged prophetic activity on the part of its author, the brother of Pius, the Roman bishop of his day (*c.* 139-154). In both the primary theme is repentance, as called for by serious sins, after baptism has placed the Christian on his new and higher level of responsibility. Thus both are hortatory writings, the one argumentative in form, the other prophetic, after the manner of later Old Testament prophets whose messages came in visions and similitudes. This prophetic and apocalyptic note, which characterizes Hermas among the Apostolic Fathers (though there are traces of it also in the *Didachē* and in Ignatius, *ad Eph.* xx.), is a genuinely primitive trait and goes far to explain the vogue which the *Shepherd* enjoyed in the generations immediately succeeding, as also the influence of its disciplinary policy, which is its prophetic "burden" (see Hermas, Shepherd of).

We come finally to the anonymous *Teaching of the Twelve Apostles* and Papias's *Exposition of Oracles of the Lord*, so far as this is known to us. The former, besides embodying catechetical instruction in Christian conduct (the "Two Ways"), which goes back in substance to the early apostolic age and is embodied also in "Barnabas," depicts in outline the fundamental usages of church life as practised in some conservative region (probably within Syria) about the last quarter of the 1st century and perhaps even later. The whole is put forth as substantially the apostolic teaching (*Didachē*) on the subjects in question. This is probably a *bona fide* claim. It expresses the feeling common to the Apostolic Fathers and general in the sub-apostolic age, at any rate in regions where apostles had once laboured, that local tradition, as held by the recognized church leaders, did but continue apostolic doctrine and practice. Into later developments of this feeling an increasing element of illusion entered, and all other written embodiments of it known to us take the form of literary fictions, more or less bold. It is in contrast to these that the *Didachē* is justly felt to be genuinely primitive and of a piece with the Apostolic Fathers. Thus while its form would by analogy tend *per se* to awaken suspicion, its contents remove this feeling; and we may even infer from this surviving early formulation of local ecclesiastical tradition, that others of somewhat similar character came into being in the sub-apostolic age, but failed to survive save as embodied in later local teaching, oral or written, very much as if the *Didachē* had perished and its literary offspring alone remained (see Didachē).

As regards Papias's *Exposition*, which Lightfoot describes as "among the earliest forerunners of commentaries, partly explanatory, partly illustrative, on portions of the New Testament," we need here only remark that, whatever its exact form may have been—as to which the extant fragments still leave room for doubt—it was in conception expository of the historic meaning of Christ's more ambiguous Sayings, viewed in the light of definitely ascertained apostolic traditions bearing on the subject. The like is true also of the fragments of the Elders preserved in Irenaeus (so far as these do not really come from Papias). Both bodies of exposition represent the traditional principle at work in the sub-apostolic age, making for the preservation in relative purity, over against merely subjective interpretations—those of the Gnostics in particular—of the historic or original sense of Christ's teaching, just as Ignatius stood for the historicity of the facts of His earthly career in their plain, natural sense.

(B) Here the question of external form passes readily over into that of the *internal character and spirit*. Indeed much has already been said or suggested bearing on these. The relation of these writers to the apostolic teaching generally has become pretty evident. It is one of absolute loyalty and deference, as to the teaching of inspiration. They are conscious, as are we in reading them, that they are not moving on the same level of insight as the Apostles; they are sub-apostolic in that sense also. Hence there appear constant traces of study of the Apostolic writings, so far as these were accessible in the locality of each writer at his date of writing (for the details of this subject, and its bearing on the history of the Canonical Scriptures of the New Testament, see *The New Testament in the Apostolic Fathers*, Oxford, 1905). As Lightfoot points out (*Apostolic Fathers*, pt. i. vol. i. p. 7), however, personality, with its variety of temperament and emphasis, largely colours the Apostolic Fathers, especially the primary group. Clement has all the Roman feeling for duly constituted order and discipline; Ignatius has the Syrian or semi-oriental passion of devotion, showing itself at once in his mystic love for his Lord and his over-strained yearning to become His very "disciple" by drinking the like cup of martyrdom; Polycarp is, above all things, steady in his allegiance to what had first won his conscience and heart, and his "passive and receptive character" comes out in the contents of his epistle. Of the rest, whose personalities are less known to us, Papias shares Polycarp's qualities and their limitations, the anonymous homilist and Hermas are marked by intense moral earnestness, while the writer to Diognetus joins to this a profound religious insight. These personal traits determine by selective affinity, working under conditions given by the special local type of tradition and piety, the elements in the Apostolic writings which each was able to assimilate and express—though we must allow also for variety in the occasions of writing. Thus one New Testament type is echoed in one and another in another; or it may be several in turn. The latter is the case in Clement, Ignatius and Polycarp; perhaps also in "Barnabas." In Hermas there is special affinity to the language and thought of the epistle of James, and in the homilist to those of Paul. Yet their very use of the same terms or ideas makes us the more aware of "a marked contrast to the depth and clearness of conception with which the several Apostolic writers place before us different aspects of the Gospel" (Lightfoot). While Apostolic phrases are used, the sense behind them is often different and less evangelic. They have not caught the Apostolic meaning, because they have not penetrated to the full religious experience which gave to the words, often words with long and varied history both in the Septuagint and in ordinary Greek usage, their specific meaning to each apostle and especially to Paul. This phenomenon was noted particularly by E. Reuss,

in his *Histoire de la théologie chrétienne an siècle apostolique* (3rd ed., 1864). Take for instance Clement. Lightfoot, indeed, dwells on the all-round "comprehensiveness" with which Clement, as the mouthpiece of the early Roman Church, utters in succession phrases or ideas borrowed impartially from Peter and Paul and James and the Epistle to Hebrews. He admits, however, that such mere co-ordination of the language of Paul and James, for instance, as appears in his twice bracketing "faith and hospitality" as grounds of acceptance with God (the cases are those of Abraham and Rahab, in chs. x. and xii.), is "from a strictly dogmatic point of view" his weakness. But the weakness is more than a dogmatic one; it is one of religious experience, as the source of spiritual insight. It is not merely that "there is no *dogmatic system* in Clement" or in any other of the Apostolic Fathers; that may favour, not hinder, religious insight. There is a want of depth in Christian experience, in the power of realizing relative spiritual values in the light of the master principle involved in the distinctively Christian consciousness, such as could raise Clement above a verbal eclecticism, rather than comprehensiveness, in the use of Apostolic language. As R.W. Dale remarks, in a note on Reuss's too severe words (Eng. trans. ii. 295): "The vital force of the Apostolic convictions gave to Apostolic thought a certain organic and consistent form." It is lack of this organic quality in the thought, not only of Clement but also of the Apostolic Fathers generally—with the possible exception of Ignatius, who seems to share the Apostolic experience more fully than any other, to which Reuss rightly directs attention. In virtue of this defect, due largely to the failure to enter into the Apostolic experience of mystic union with Christ, he can rightly speak of "an immense retrogression" in theology visible "at the end of the century, and in circles where it might have been least expected" (ii. p. 294, cf. 541).

In fact the perspective of the Gospel was seriously changed and its most distinctive features obscured. This was specially the case with the experimental doctrines of grace. Here the central glory of the Cross as "the power of God unto salvation" suffered some eclipse, although the passion of Christ was felt to be a transcendent act of Divine Grace in one way or another. But even more serious was the loss of an adequate sense of the contrast between "grace" and "works" as conditions of salvation. There was little or no sense of the danger of the *legal principle*, as related to human egoism and the instinct to seek salvation as a reward for merit. The passages in which these things are laid bare by Paul's remorseless analysis of his own experience "under Law" seem to have made practically no impression on the Apostolic Fathers as a whole. Gentile Christians had not felt the fang of the Law as the ex-Pharisee had occasion to feel it. Even if first trained in the Hellenistic synagogues of the Dispersion, as was often the case, they apprehended the Law on its more helpful and less exacting side, and had not been brought "by the Law to die unto the Law," that they might "live unto God." The result was too great a continuity between their religious conceptions before and after embracing the Gospel. Thus the latter seemed to them simply to bring forgiveness of past sins for Christ's sake, and then an enhanced moral responsibility to the New Law revealed in Him. Hence a new sort of legalism, known to recent writers as Moralism, underlies much of the piety of the Apostolic Fathers, though Ignatius is quite free from it, while Polycarp and "Barnabas" are less under its influence than are the *Didachē*, Clement, the Homilist and Hermas. It conceives salvation as a "wages" (μισθός) to be earned or forfeited; and regards certain good works, such as prayer, fasting, alms—especially the last—as efficacious to cancel sins. The reality of this tendency, particularly at Rome, betrays itself in Hermas, who teaches the supererogatory merit of alms gained by the self-denial of fasting (*Sim*. v. 3. 3 ff.). Marcion's reaction, too, against the Judaic temper in the Church as a whole, in the interests of an extravagant Paulinism, while it suggests that Paul's doctrines of grace generally were inadequately realized in the sub-apostolic age, points also to the prevalence of such moralism in particular.

(C) In attempting a final estimate of the value of the Apostolic Fathers for the historian to-day, we may sum up under these heads: ecclesiastical, theological, religious. (*a*) As a mine of materials for reconstructing the history of Church institutions, they are invaluable, and that largely in virtue of their spontaneous and "esoteric" character, with no view to the public generally or to posterity. (*b*) Theologically, as a stage in the history of Christian doctrine, their value is as great negatively as positively. Impressive as is their witness to the persistence of the Apostolic teaching in its essential features, amidst all personal and local variations, perhaps the most striking thing about these writings is the degree in which they fail to appreciate certain elements of the Apostolic teaching as embodied in the New Testament, and those its higher and more distinctively Christian elements.[3] This negative aspect has a twofold bearing. Firstly, it suggests the supernormal level to which the Apostolic consciousness was raised at a bound by the direct influence of the Founder of Christianity, and justifies the marking-off of the Apostolic writings as a Canon, or body of Christian classics of unique religious authority. To this principle Marcion's Pauline Canon is a witness, though in too one-sided a spirit. Secondly, it means that the actual development of ecclesiastical doctrine began, not from the Apostolic consciousness itself, but from a far lower level, that of the inadequate consciousness of the sub-apostolic Church, even when face to face with their written words. This theological "retrogression" is of much significance for the history of dogma, (*c*) On the other hand, there is great religious and moral continuity, beneath even theological discontinuity, in the life working below all conscious apprehension of the deeper ideas involved (E. von Dobschutz, *Christian Life in the Primitive Church*, 1905). There is continuity in character; the Apostolic Fathers strike us as truly good men, with a goodness raised to a new type and power. This is what the Gospel of Christ aims chiefly at producing as its proper fruit; and the Apostolic Fathers would have desired no better record than that they were themselves genuine "epistles of Christ."

Literature.—This is too large to indicate even in outline, but is given fully in the chief modern editions, viz. of Gebhardt, Harnack and Zahn jointly (1875-1877), J.B. Lightfoot (1885-1890) and F.X. Funk (1901); also in O. Bardenhewer, *Gesch. der altkirchlichen Litteratur* (1902), Band i., and in *Neutestamentliche Apokryphen*, with *Handbuch* thereto, edited by E. Hennecke (Tübingen, 1904). The fullest discussion in English of the teaching of Barnabas, Clement, Ignatius and Polycarp is by J. Donaldson, *The Apostolical Fathers* (1874), which, however, suffers from the imperfect state of the texts when he wrote. The most useful edition for ready reference, containing critical texts (up to date) and good translations, is Lightfoot's one-volume edition, *The Apostolic Fathers* (London, 1891).

(J. V. B.)

1 Cotelier included the Acts of Martyrdom of Clement, Ignatius and Polycarp; and those of Ignatius and Polycarp are still often printed by editors.

2 See G.A. Deissmann, *Bible Studies*, pp. 1-60, for this distinction between the genuine "letter" and the literary "epistle," as applied to the New Testament in particular.

3 One result is their inability to form a true theory of Judaism and of the Old Testament in relation to the Gospel, a matter of great moment for them and for their successors.

APOSTOLICI, Apostolic Brethren, or Apostles, the names given to various Christian heretics, whose common doctrinal feature was an ascetic rigidity of morals, which made them reject property and marriage. The earliest Apostolici appeared in Phrygia, Cilicia, Pisidia and Pamphylia towards the end of the 2nd century or the beginning of the 3rd. According to the information given by Epiphanius (*Haer.* 61) about the doctrines of these heretics, it is evident that they were connected with the Encratites and the Tatianians. They condemned individual property, hence the name sometimes given to them of *Apotactites* or *Renuntiatores*. They preserved an absolute chastity and abstained from wine and meat. They refused to admit into their sect those Christians whom the fear of martyrdom had once restored to paganism. As late as the 4th century St Basil (*Can.* 1 and 47) knew some Apostolici. After that period they disappeared, either becoming completely extinct, or being confounded with other sects (see St Augustine, *Haer.* 40; John of Damascus, *Haer.* 61).

Failing a more exact designation, the name of Apostolici has been given to certain groups of Latin heretics of the 12th century. It is the second of the two sects of Cologne (the first being composed very probably of Cathari) that is referred to in the letter addressed in 1146 by Everwin, provost of Steinfeld, to St Bernard (Mabillon, *Vet. Anal.* iii. 452). They condemned marriage (save, perhaps, first marriages), the eating of meat, baptism of children, veneration of saints, fasting, prayers for the dead and belief in purgatory, denied transubstantiation, declared the Catholic priesthood worthless, and considered the whole church of their time corrupted by the "negotia saecularia" which absorbed all its zeal (of. St Bernard, *Serm.* 65 and 66 *in Cantic.*). They do not seem to have been known as Apostles or Apostolici: St Bernard, in fact, asks his hearers: "Quo nomine istos titulove censebis?" (*Serm. 66 in Cantic.*). Under this designation, too, are included the heretics of Perigueux in France, alluded to in the letter of a certain monk Heribert (Mabillon, *Vet. Anal.* iii. 467). Heribert says merely: "Se dicunt apostolicam vitam ducere." It is possible that they were Henricians (see Henry of Lausanne). During his mission in the south-east of France in 1146-1147 St Bernard still met disciples of Henry of Lausanne in the environs of Périgueux. The heretics of whom Heribert speaks condemned riches, denied the value of the sacraments and of good works, ate no meat, drank no wine and rejected the veneration of images. Their leader, named Pons, gathered round him nobles, priests, monks and nuns.

In the second half of the 13th century appeared in Italy the *Order of the Apostles* or *Apostle Brethren* (see especially the *Chron.* of Fra Salimbene). This was a product of the mystic fermentation which proceeded from exalted Franciscanism and from Joachimism (see Fraticelli and Joachim). It presents great analogies with groups of the same character, *e.g.* Sachets, Bizocchi, Flagellants, &c. The order of the Apostles was founded about 1260 by a young workman from the environs of Parma, Gerard Segarelli, who had sought admission unsuccessfully to the Franciscan order. To make his life conform to that of Christ, his contemporaries say that he had himself circumcised, wrapped in swaddling clothes and laid in a cradle, and that he then, clad in a white robe and bare-footed, walked through the streets of Parma crying "Penitenz agite!" ("Poenitentiam agite!"). He was soon followed by a throng of men and women, peasants and mechanics. All had to live in absolute poverty, chastity and idleness. They begged, and preached penitence. Opizo, bishop of Parma, protected them until they caused trouble in his diocese. Their diffusion into several countries of Christendom disturbed Pope Honorius IV., who in 1286 ordered them to adhere to an already recognized rule. On their refusal, the pope condemned them to banishment and Opizo imprisoned Segarelli. The councils of Würzburg (1287) and Chichester (1289) took measures against the Apostles of Germany and England. But in 1291 the sect reappeared, sensibly increased, and Pope Nicholas IV. published anew the bull of Honorius IV. From that day the Apostles, regarded as rebels, were persecuted pitilessly. Four were burned in 1294, and Segarelli, as a relapsed heretic, went to the stake at Parma in 1300.

They had had close relations with the dissident Franciscans, but the Spirituals often disavowed them, especially when the sect, which in Segarelli's time had had no very precise doctrinal character, became with Dolcino frankly heterodox. Dolcino of Novara was brought up at Vercelli, and had been an Apostle since 1291. Thrice he fell into the hands of the Inquisition, and thrice recanted. But immediately after Segarelli's death he wrote an epistle, soon followed by a second, in which he declared that the third Joachimite age began with Segarelli and that Frederick of Sicily was the expected conqueror (*Hist. Dulcini* and *Addit. ad Hist. Dulcini* in Muratori, *Scriptores*, vol. ix.). He gave himself out as an angel sent from God to elucidate the prophecies. Soon he founded an *Apostolic congregation* at whose head he placed himself. Under him were his four lieutenants, his "mystic sister," Margherita di Franck, and 4000 disciples. He taught almost the same principles of devotion as Segarelli, but the Messianic character which he attributed to himself, the announcement of a communistic millennial kingdom, and, besides, an aggressive anti-sacerdotalism, gave to Dolcino's sect a clearly marked character, analogous only to the theocratic community of the Anabaptists of Münster in the 16th century. On the 5th of June 1305 Pope Clement V., recognizing the impotence of the ordinary methods of repression, issued bulls for preaching a crusade against the Dolcinists. But four crusades, directed by the bishop of Vercelli, were required to reduce the little army of the heresiarch, entrenched in the mountains in the neighbourhood of Vercelli. Not till the 23rd of March 1307 were the sectaries definitively overcome. The Catholic crusaders seized Dolcino in his entrenchments on Mount Rubello, and the pope at once announced the happy event to King Philip the Fair. At Vercelli Dolcino suffered a horrible punishment. He was torn in pieces with red-hot pincers—the torture lasting an entire day—while Margherita was burned at a slow fire. Dante mentions Dolcino's name (*Inferno*, c. xxviii.), and his memory is not yet completely effaced in the province of Novara. The Apostles continued their propaganda in Italy, Languedoc, Spain and Germany. In turn they were condemned by the councils of Cologne (1306), Treves

(1310) and Spoleto (1311). The inquisitor of Languedoc, Bernard Gui, persecuted them unremittingly (see Gui's *Practica Inquisitionis*). From 1316 to 1323 the condemnations of Apostles increased at Avignon and Toulouse. They disappeared, however, at a comparatively late date from those regions (council of Lavaur, 1368; council of Narbonne, 1374). In Germany two Apostles were burned at Lübeck and Wismar at the beginning of the 15th century (1402-1403) by the inquisitor Eylard.

Several controversialists, including Gotti, Krohn and Stockmann, have mentioned among the innumerable sects that have sprung from Anabaptism a group of individuals whose open-air preaching and rigorous practice of poverty gained them the name of Apostolici. These must be carefully distinguished from the *Apostoolians*, Mennonites of Frisia, who followed the teachings of the pastor Samuel Apostool (1638-beginning of 18th century). In the Mennonite church they represent the rigid, conservative party, as opposed to the Galenists, who inclined towards the Arminian latitudinarianism and admitted into their community all those who led a virtuous life, whatever their doctrinal tendencies.

(P. A.)

APOSTOLIC MAJESTY, a title borne by the kings of Hungary. About A.D. 1000 it was conferred by Pope Silvester II. upon St Stephen (975-1038), the first Christian king of Hungary, in return for his zeal in seeking the conversion of the heathen. It was renewed by Pope Clement XIII. in 1758 in favour of the empress Maria Theresa and her descendants. The emperor of Austria bears the title of apostolic king of Hungary.

APOSTOLIUS, MICHAEL (d. *c.* 1480), a Greek theologian and rhetorician of the 15th century. When, in 1453, the Turks conquered Constantinople, his native city, he fled to Italy, and there obtained the protection of Cardinal Bessarion. But engaging in the great dispute that then raged between the upholders of Aristotle and Plato, his zeal for the latter led him to speak so contemptuously of the more popular philosopher and of his defender, Theodorus Gaza, that he fell under the severe displeasure of his patron. He afterwards retired to Crete, where he earned a scanty living by teaching and by copying manuscripts. Many of his copies are still to be found in the libraries of Europe. One of them, the *Icones* of Philostratus at Bologna, bears the inscription: "The king of the poor of this world has written this book for his living." Apostolius died about 1480, leaving two sons, Aristobulus Apostolius and Arsenius. The latter became bishop of Malvasia (Monemvasia) in the Morea.

Of his numerous works a few have been printed: Παροιμίαι (Basel, 1538), now exceedingly rare; a collection of proverbs in Greek, of which a fuller edition appeared at Leiden, "Curante Heinsio," in 1619; "Oratio Panegyrica ad Fredericum III." in Freher's *Scriptores Rerum Germanicarum*, vol. ii. (Frankfort, 1624); Georgii Gemisthi Plethonis et Mich. Apostolii *Orationes funebres duae in quibus de Immortalitate Animae exponitur* (Leipzig, 1793); and a work against the Latin Church and the council of Florence in Le Moine's *Varia Sacra*.

APOSTROPHE (Gr. ἀποστροφή, turning away; the final *e* being sounded), the name given to an exclamatory rhetorical figure of speech, when a speaker or writer breaks off and addresses some one directly in the vocative. The same word (representing, through the French, the Greek ἀπόστροφος προσῳδία, the accent of elision) means also the sign (') for the omission of a letter or letters, *e.g.* in "don't." In physiology, "apostrophe" is used more precisely in connexion with its literal meaning of "turning away," *e.g.* for movement away from the light, in the case of the accumulation of chlorophyll-corpuscles on the cells of leaves.

APOTACTITES, or APOTACTICI (from Gr. ἀποτακτός, set apart), a sect of early Christians, who renounced all their worldly possessions. (See APOSTOLICI *ad init.*)

APOTHECARY (from the Lat. *apothecarius*, a keeper of an *apotheca*, Gr. ἀποθήκη, a store), a word used by Galen to denote the repository where his medicines were kept, now obsolete in its original sense. An apothecary was one who prepared, sold and prescribed drugs, but the preparing and selling of drugs prescribed by others has now passed into the hands of duly qualified and authorized persons termed

“chemists and druggists,” while the apothecary, by modern legislation, has become a general medical practitioner, and the word itself, when used at all, is applied, more particularly in the United States and in Scotland, to those who in England are called “pharmaceutical chemists.” The Apothecaries’ Society of London is one of the corporations of that city, and both by royal charters and acts of parliament exercises the power of granting licences to practise medicine. The members of this society do not possess and never have possessed any exclusive power to deal in or sell drugs; and until 1868 any person whatever might open what is called a chemist’s shop, and deal in drugs and poisons. In that year, however, the Pharmacy Act was passed, which prohibits any person from engaging in this business without being registered.

From early records we learn that the different branches of the medical profession were not regularly distinguished till the reign of Henry VIII., when separate duties were assigned to them, and peculiar privileges were granted to each. In 1518 the physicians of London were incorporated, and the barber-surgeons in 1540. But, independently of the physicians and the surgeons, there were a great number of irregular practitioners, who were more or less molested by their legitimate rivals, and it became necessary to pass an act in 1543 for their protection and toleration. As many of these practitioners kept shops for the sale of medicines, the term “apothecary” was used to designate their calling.

In April 1606 James I. incorporated the apothecaries as one of the city companies, uniting them with the grocers. On their charter being renewed in 1617 they were formed into a separate corporation, under the title of the “Apothecaries of the City of London.” These apothecaries appear to have prescribed medicines in addition to dispensing them, and to have claimed an ancient right of acting in this double capacity; and it may be mentioned that Henry VIII., after the grant of the charter to the College of Physicians, appointed an apothecary to the Princess Mary, who was delicate and unhealthy, at a salary of 40 marks a year, “*pro meliore cura, et consideratione sanitatis suae*.” During the 17th century, however, there arose a warm contest between the physicians and the apothecaries,—the former accusing the latter of usurping their province, and the latter continuing and justifying the usurpation until the dispute was finally set at rest by a judgment of the House of Lords in 1703 (*Rose v. College of Physicians*, 5 Bro. P. C. 553), when it was decided that the duty of the apothecary consisted not only in compounding and dispensing, but also in directing and ordering the remedies employed in the treatment of disease. In 1722 an act was obtained empowering the Apothecaries’ Company to visit the shops of all apothecaries practising in London, and to destroy such drugs as they found unfit for use. In 1748 great additional powers were given to the company by an act authorizing them to appoint a board of ten examiners, without whose licence no person should be allowed to dispense medicines in London, or within a circuit of 7 m. round it. In 1815, however, an act of parliament was passed which gave the Apothecaries’ Society a new position, empowering a board, consisting of twelve of their members, to examine and license all apothecaries throughout England and Wales. It also enacted that, from the 1st of August of that year, no persons except those who were so licensed should have the right to act as apothecaries, and it gave the society the power of prosecuting those who practised without such licence. But the act expressly exempted from prosecution all persons who were then in actual practice, and it distinctly excluded from its operation all persons pursuing the calling of chemists and druggists. It was also provided that the act should in no way interfere with the rights or privileges of the English universities, or of the English College of Surgeons or the College of Physicians; and indeed a clause imposed severe penalties on any apothecaries who should refuse to compound and dispense medicines on the order of a physician, legally qualified to act as such. It is therefore clear that the act contemplated the creation of a class of practitioners who, while having the right to practise medicine, should assist and co-operate with the physicians and surgeons.

Before this act came into operation the education of the medical practitioners of England and Wales was entirely optional on their own part, and although many of them possessed degrees or licences from the universities or colleges, the greater number possessed no such qualification, and many of them were wholly illiterate and uneducated. The court of examiners of the Apothecaries’ Society, being empowered to enforce the acquisition of a sufficient medical education upon its future licentiates, specified from time to time the courses of lectures or terms of hospital practice to be attended by medical students before their examination, and in the progress of years regular schools of medicine were organized throughout England.

As it was found that, notwithstanding the stringent regulations as to medical acquirements, the candidates were in many instances deficient in preliminary education, the court of examiners instituted, about the year 1850, a preliminary examination in arts as a necessary and indispensable prerequisite to the medical curriculum, and this provision has been so expanded that, at the present day, all medical students in the United Kingdom are compelled to pass a preliminary examination in arts, unless they hold a university degree. An act of parliament, passed in 1858, and known as the Medical Act, made very little alteration in the powers exercised by the Apothecaries’ Society, and indeed it confirmed and in some degree amplified them, for whereas by the act of 1815, the licentiates of the society were authorized to practise as such only in England and Wales, the new measure gave them the same right in Scotland and Ireland. The Medical Act 1886 extended the qualifications necessary for registration under the medical acts, by making it necessary to pass a qualifying examination in medicine, surgery and midwifery. (See Medical Education.)

An act, passed in 1874, related exclusively to the Apothecaries’ Society, and is termed the Apothecaries’ Act Amendment Act. By this measure some provisions of the act of 1815, which had become obsolete or unsuitable, were repealed, and powers were given to the society to unite or co-operate with other medical licensing bodies in granting licences to practise. The act of 1815 had made it compulsory on all candidates for a licence to have served an apprenticeship of five years to an apothecary, and although by the interpretation of the court of examiners of the society this term really included the whole period of medical study, yet the regulation was felt as a grievance by many members of the medical profession. It was accordingly repealed, and no apprenticeship is now necessary. The restriction of the choice of examiners to the members of the society was also repealed, and the society was given the power (which it did not before possess) to strike off from the list of its licentiates the names of disreputable persons. The act of 1874 also specified that the society was not deprived of any right or obligation they may have to admit women to examination, and to enter their names on the list of licentiates if they acquit themselves satisfactorily.

The Apothecaries' Society is governed by a master, two wardens and twenty-two assistants. The members are divided into Three grades, yeomanry or freemen, the livery, and the court. Women are not, however, admitted to the freedom. The hall of the society, situated in Water Lane, London, and covering about three-quarters of an acre, was acquired in 1633. It was destroyed by the great fire, but was rebuilt about ten years later and enlarged in 1786. This is the only property possessed by the society. In 1673, the society established a botanic and physic garden at Chelsea, and in 1722 Sir Hans Sloane, who had become the ground owner, gave it to the society on the condition of presenting annually to the Royal Society fifty dried specimens of plants till the number should reach 2000. This condition was fulfilled in 1774. Owing to the heavy cost of maintenance and other reasons, the "physic garden" was handed over in 1902, with the consent of the Charity Commissioners, to a committee of management, to be maintained in the interests of botanical study and research.

See C.R.B. Barrett, *The History of the Society of Apothecaries of London* (1905).

APOTHEOSIS (Gr. ἀποθεοῦν, to make a god, to deify), literally deification. The term properly implies a clear polytheistic conception of gods in contrast with men, while it recognizes that some men cross the dividing line. It is characteristic of polytheism to blur that line in several ways. Thus the ancient Greek religion was especially disposed to belief in heroes and demigods. Founders of cities, and even of colonies, received worship; the former are, generally speaking, mythical personages and, in strictness, heroes. But the worship after death of historical persons, such as Lycurgus, or worship of the living as true deities, *e.g.* Lysander and Philip II. of Macedon, occurred sporadically even before Alexander's conquests brought Greek life into contact with oriental traditions. It was inevitable, too, that ancient monarchies should enlist polytheistic conceptions of divine or half-divine men in support of the dynasties; "*Seu deos regesve canit deorum Sanguinem*," Horace (*Odes*, iv. 2, II. 12, 13) writes of Pindar; though the reference is to myths, yet the phrase is significant. In the East all such traits are exaggerated, a result perhaps rather of the statecraft than of the religions of Egypt and Persia. Whatever part vanity or the flattery of courtiers may have played with others, or with Alexander, it is significant that the dynasties of Alexander's various successors all claim divine honours of some sort (see Ptolemies, Seleucid Dynasty, &c.). Theocritus (*Idyll* 17) hails Ptolemy Philadelphus as a demigod, and speaks of his father as seated among the gods along with Alexander. Ancestor worship, or reverence for the dead, was a third factor. It may work even in Cicero's determination that his daughter should enjoy "ἀποθέωσις"— as he writes to Atticus—or receive the "honour" of *consecratia* (fragment of his *De Consolatione*). Lastly, we need not speak of mere sycophancy. Yet it was common; Verres was worshipped before he was impeached!

The Romans had, up to the end of the Republic, accepted only one official apotheosis; the god Quirinus, whatever his original meaning, having been identified with Romulus. But the emperor Augustus carried on the tradition of ancient statecraft by having Julius Caesar recognized as a god (*divus Julius*), the first of a new class of deities proper (*divi*). The tradition was steadily followed and was extended to some ladies of the imperial family and even to imperial favourites. Worship of an emperor during his lifetime, except as the worship of his *genius*, was, save in the cases of Caligula and Domitian, confined to the provinces. Apotheosis after his death, being in the hands of the senate, did not at once cease, even when Christianity was officially adopted. The Latin term is *consecratio*, which of course has a variety of senses, including simple burial. (Inscription in G. Boissier, *La Religion romaine*; Renier, *Inscriptions d'Algiers*, 2510.) The Greek term Apotheosis, probably a coinage of the Hellenistic epoch, becomes more nearly technical for the deification of dead emperors. But it is still used simply for the erection of tombs (clearly so in some Greek inscriptions, *Corpus Inscript. Graec.* 2831, 2832, quoted in Pauly-Wissowa, *s.v. Apotheosis*). Possibly there is a trace of ancestor worship even here; but the two usages have diverged. The squib of the philosopher Seneca on the memory of Claudius (d. A.D. 54), *Apocolocyntosis* ("pumpkinification"), is evidence that, as early as Seneca's lifetime, apotheosis was in use for the recognition of a departed emperor as a god. It also indicates how much contempt might be associated with this pretended worship. The people, says Suetonius (*Jul. Caes.* c. 88), fully believed in the divinity of Julius Caesar, hinting at the same time that this was by no means the case with the majority of the apotheoses subsequently decreed by the senate. Yet we learn from Capitolinus that Marcus Aurelius was still worshipped as a household divinity in the time of Diocletian, and was believed to impart revelations in dreams (Vit. M. Ant. c. 18). Antinous, the favourite of Hadrian, was adored in Egypt a century after his death (Origen, *Contra Celsum*, iii. 36), though, according to Boissier, his worship never had official sanction. The ceremonies attendant on an imperial apotheosis are very fully described by Herodianus (bk. iv. c. 2) on occasion of the obsequies of Severus, which he appears to have witnessed. The most significant was the liberation, at the moment of kindling the funeral pyre, of an eagle which was supposed to bear the emperor's soul to heaven. Sharp-sighted persons had actually beheld the ascension of Augustus (Suet. *August*, c. 100), and of Drusilla, sister of Caligula. Representations of apotheoses occur on several works of art; the most important are the apotheosis of Homer on a relief in the Townley collection of the British Museum, that of Titus on the arch of Titus, and that of Augustus on a magnificent cameo in the Louvre.

In China at the present day many Taoist gods are (or are given out as) men deified for service to the state. This again may be statecraft. In India, the (still unexplained) rise of the doctrine of transmigration hindered belief. Apotheosis can mean nothing to those who hold that a man may be reborn as a god, but still needs redemption, and that men on earth may win redemption, if they are brave enough. Curiously, Buddhism itself is ruled by the ghost or shadowy remainder of belief in transmigration—Karma.

Apotheosis may also be used in wider senses. (*a*) Some (*e.g.* Herbert Spencer) hold that most gods are deified men, and most myths historical traditions which have been grotesquely distorted. This theory is known as Euhemerism (see Euhemerus). It is needless to say that the attitude of those holding the Euhemerist theory is at the farthest pole from belief in apotheosis. According to the latter, some men may become gods.

According to the former, all gods are but men; or, some men have been erroneously supposed to become gods. The Euhemerist theory mainly appeals to ancestor worship—a fact of undoubted importance in the history of religion, especially in China and in ancient Rome. In India, too, a dead person treated with funeral honours becomes a guardian spirit—if neglected, a tormenting demon. But whether the great gods of polytheism were really transfigured ancestors is very doubtful. (*b*) Again, there is a tendency to offer something like worship to the founders of religions. Thus more than human honour is paid to Zoroaster and Buddha and even to the founders of systems not strictly religious, *e.g.* to Confucius and Auguste Comte. It is noticeable that this kind of worship is not accorded in rigidly monotheistic systems, *e.g.* to Moses and Mahomet. Nor is it accurate to speak of apotheosis in cases where the founder is in his lifetime regarded as the incarnation of a god (cf. Ali among Shi'ite Mahommedans; the Báb in Babism; the Druse Hakim). Most Christians on this ground repudiate the application of the term to the worship of Jesus Christ. Curiously, *Apotheosis* is used by the Latin Christian poet, Prudentius (*c.* 400), as the title of a poem defending orthodox views on the person of Christ and other points of doctrine—the affectation of a decadent age. (*c*) The worship paid to Saints, in those Christian churches which admit it, is formally distinguished as *dulia* (δουλεία) from true worship or *latria* (λατρεία). Even the Virgin Mary, though she is styled Mother of God and Queen of Heaven, receives only *dulia* or at most *hyperdulia*.

(R. G.; R. Ma.)

APPALACHIAN MOUNTAINS, the general name given to a vast system of elevations in North America, partly in Canada, but mostly in the United States, extending as a zone, from 100 to 300 m. wide, from Newfoundland, Gaspé Peninsula and New Brunswick, 1500 m. south-westward to central Alabama. The whole system may be divided into three great sections: the *Northern*, from Newfoundland to the Hudson river; the *Central*, from the Hudson Valley to that of New river (Great Kanawha), in Virginia and West Virginia; and the *Southern*, from New river onwards. The northern section includes the Shickshock Mountains and Notre Dame Range in Quebec, scattered elevations in Maine, the White Mountains and the Green Mountains; the central comprises, besides various minor groups, the Valley Ridges between the Front of the Allegheny Plateau and the Great Appalachian Valley, the New York-New Jersey Highlands and a large portion of the Blue Ridge; and the southern consists of the prolongation of the Blue Ridge, the Unaka Range, and the Valley Ridges adjoining the Cumberland Plateau, with some lesser ranges.

The Chief Summits.—The Appalachian belt includes, with the ranges enumerated above, the plateaus sloping southward to the Atlantic Ocean in New England, and south-eastward to the border of the coastal plain through the central and southern Atlantic states; and on the north-west, the Allegheny and Cumberland plateaus declining toward the Great Lakes and the interior plains. A remarkable feature of the belt is the longitudinal chain of broad valleys—the Great Appalachian Valley—which, in the southerly sections divides the mountain system into two subequal portions, but in the northernmost lies west of all the ranges possessing typical Appalachian features, and separates them from the Adirondack group. The mountain system has no axis of dominating altitudes, but in every portion the summits rise to rather uniform heights, and, especially in the central section, the various ridges and intermontane valleys have the same trend as the system itself. None of the summits reaches the region of perpetual snow. Mountains of the Long Range in Newfoundland reach heights of nearly 2000 ft. In the Shickshocks the higher summits rise to about 4000 ft. elevation. In Maine four peaks exceed 3000 ft., including Katahdin (5200 ft.), Mount Washington, in the White Mountains (6293 ft.), Adams (5805), Jefferson (5725), Clay (5554), Monroe (5390), Madison (5380), Lafayette (5269); and a number of summits rise above 4000 ft. In the Green Mountains the highest point, Mansfield, is 4364 ft.; Lincoln (4078), Killington (4241), Camel Hump (4088); and a number of other heights exceed 3000 ft. The Catskills are not properly included in the system. The Blue Ridge, rising in southern Pennsylvania and there known as South Mountain, attains in that state elevations of about 2000 ft.; southward to the Potomac its altitudes diminish, but 30 m. beyond again reach 2000 ft. In the Virginia Blue Ridge the following are the highest peaks east of New river: Mount Weather (about 1850 ft.), Mary's Rock (3523), Peaks of Otter (4001 and 3875), Stony Man (4031), Hawks Bill (4066). In Pennsylvania the summits of the Valley Ridges rise generally to about 2000 ft., and in Maryland Eagle Rock and Dans Rock are conspicuous points reaching 3162 ft. and 2882 ft. above the sea. On the same side of the Great Valley, south of the Potomac, are the Pinnacle (3007 ft.) and Pidgeon Roost (3400 ft.). In the southern section of the Blue Ridge are Grandfather Mountain (5964 ft.), with three other summits above 5000, and a dozen more above 4000. The Unaka Ranges (including the Black and Smoky Mountains) have eighteen peaks higher than 5000 ft., and eight surpassing 6000 ft. In the Black Mountains, Mitchell (the culminating point of the whole system) attains an altitude of 6711 ft., Balsam Cone, 6645, Black Brothers, 6690, and 6620, and Hallback, 6403. In the Smoky Mountains we have Clingman's Peak (6611), Guyot (6636), Alexander (6447), Leconte (6612), Curtis (6588), with several others above 6000 and many higher than 5000.

In spite of the existence of the Great Appalachian Valley, the master streams are transverse to the axis of the system. The main watershed follows a tortuous course which crosses the mountainous belt just north of New river in Virginia; south of this the rivers head in the Blue Ridge, cross the higher Unakas, receive important tributaries from the Great Valley, and traversing the Cumberland Plateau in spreading gorges, escape by way of the Cumberland and Tennessee rivers to the Ohio and Mississippi, and thus to the Gulf of Mexico; in the central section the rivers, rising in or beyond the Valley Ridges, flow through great gorges (water gaps) to the Great Valley, and by south-easterly courses across the Blue Ridge to tidal estuaries penetrating the coastal plain; in the northern section the water-parting lies on the inland side of the mountainous belt, the main lines of drainage running from north to south.

Geology.—The rocks of the Appalachian belt fall naturally into two divisions; ancient (pre-Cambrian) crystallines, including marbles, schists, gneisses, granites and other massive igneous rocks, and a great succession of Paleozoic sediments. The crystallines are confined to the portion of the belt east of the Great

Valley where Paleozoic rocks are always highly metamorphosed and occur for the most part in limited patches, excepting in New England and Canada, where they assume greater areal importance, and are besides very generally intruded by granites. The Paleozoic sediments, ranging in age from Cambrian to Permian, occupy the Great Valley, the Valley Ridges and the plateaus still farther west. They are rarely metamorphosed to the point of recrystallization, though locally shales are altered to roofing slates, sandstones are indurated, limestones slightly marblized, and coals, originally bituminous, are changed to anthracite in northern Pennsylvania, and to graphite in Rhode Island. Igneous intrusions consist only of unimportant dikes of trap. The most striking and uniformly characteristic geologic feature of the mountains is their internal structure, consisting of innumerable parallel, long and narrow folds, always closely appressed in the eastern part of any cross-section (Piedmont Plateau to Great Valley), less so along a central zone (Great Valley and Valley Ridges), and increasingly open on the west (Allegheny and Cumberland Plateaus). Asymmetry of the folds is a marked characteristic in the zones of closer folding, the anticlines having long gently inclined easterly limbs, and short, steep and even overturned limbs upon the west. The effect of such folds is often exaggerated by thrusts, and faulting of this sort is prominent in the southern section, where the existence of over-thrusts measured by several miles has been established.

What may be termed the ancestral Appalachian system was formed during the post-carboniferous revolution, though certain of its elements had been previously outlined, and perhaps at different dates. Folding of the rocks resulted from the operation of great compressive forces acting tangentially to the figure of the earth. Extensive and deep-seated crumpling was necessarily accompanied by vertical uplift throughout the zone affected, but once at least since their birth the mountains have been worn down to a lowland, and the mountains of to-day are the combined product of subsequent uplift of a different sort, and dissection by erosion. Produced by long-continued subaerial decay and erosion, in later Cretaceous times this lowland extended from the Atlantic Ocean well toward the interior of North America; since then the whole continent has been generally elevated, and by successive steps the Appalachian belt has been raised to form a wide but relatively low arch. The crosswise courses of the greater rivers result from the rivers being older than the mountains, which indeed have been produced by circumdenudation. The master streams of the present have inherited their channels from the drainage systems of the Cretaceous lowland, and though raised athwart the courses of the lowland trunk streams the great arch was developed so slowly that these channels could be maintained through *pari passu* deepening. Former tributaries have given place to others developed with reference to the distribution of more or less easily eroded strata, the present longitudinal valleys being determined by the out-crop of soft shales or soluble limestones, and the parallel ridges upheld by hard sandstones or schists. Parallelism of mountain ridges and intervening valleys is thus attributable to the folding of the rocks, but the origin of the interior structure of the mountains is to be kept distinct from the origin of the mountains as features of topography.

Flora and Fauna.—Much of the region is covered with forest yielding quantities of valuable timber, especially in Canada and northern New England. The most valuable trees for lumber are spruce, white pine, hemlock, cedar, white birch, ash, maple and basswood; all excepting pine and hemlock and poplar in addition are ground into wood pulp for the manufacture of paper. In the central and southern parts of the belt oak and hickory constitute valuable hard woods, and certain varieties of the former furnish quantities of tan bark. The tulip tree produces a good clear lumber known as white wood or poplar, and is also a source of pulp. In the south both white and yellow pine abounds. Many flowering and fruit-bearing shrubs of the heath family add to the beauty of the mountainous districts, rhododendron and kalmia often forming impenetrable thickets. Bears, mountain lions (pumas), wild cats (lynx) and wolves haunt the more remote fastnesses of the mountains; foxes abound; deer are found in many districts and moose in the north.

Influence on History.—For a century the Appalachians were a barrier to the westward expansion of the English colonies; the continuity of the system, the bewildering multiplicity of its succeeding ridges, the tortuous courses and roughness of its transverse passes, a heavy forest and dense undergrowth all conspired to hold the settlers on the seaward-sloping plateaus and coastal plains. Only by way of the Hudson and Mohawk valleys, and round about the southern termination of the system were there easy routes to the interior of the country, and these were long closed by hostile aborigines and jealous French or Spanish colonists. In eastern Pennsylvania the Great Valley was accessible by reason of a broad gateway between the end of South Mountain and the Highlands, and here in the Lebanon Valley settled German Moravians, whose descendants even now retain the peculiar patois known as “Pennsylvania Dutch.” These were late comers to the New World forced to the frontier to find unclaimed lands. With their followers of both German and Scotch-Irish origin, they worked their way southward and soon occupied all of the Virginia Valley and the upper reaches of the Great Valley tributaries of the Tennessee. By 1755 the obstacle to westward expansion had been thus reduced by half; outposts of the English colonists had penetrated the Allegheny and Cumberland plateaus, threatening French monopoly in the transmontane region, and a conflict became inevitable. Making common cause against the French to determine the control of the Ohio valley, the unsuspected strength of the colonists was revealed, and the successful ending of the French and Indian War extended England’s territory to the Mississippi. To this strength the geographic isolation enforced by the Appalachian mountains had been a prime contributor. The confinement of the colonies between an ocean and a mountain wall led to the fullest occupation of the coastal border of the continent, which was possible under existing conditions of agriculture, conducing to a community of purpose, a political and commercial solidarity, which would not otherwise have been developed. As early as 1700 it was possible to ride from Portland, Maine, to southern Virginia, sleeping each night at some considerable village. In contrast to this complete industrial occupation, the French territory was held by a small and very scattered population, its extent and openness adding materially to the difficulties of a disputed tenure. Bearing the brunt of this contest as they did, the colonies were undergoing preparation for the subsequent struggle with the home government. Unsupported by shipping, the American armies fought toward the sea with the mountains at their back protecting them against Indians leagued with the British. The few settlements beyond the Great Valley were free for self-defence because debarred from general participation in the conflict by reason of their position.

See the separate articles on the states, and also the following references:—Topographic maps and Geologic Folios of the United States Geological Survey; Bailey Willis, “The Northern Appalachians,” and C.W. Hayes,

"The Southern Appalachians," both in *National Geographic Monographs*, vol. i.; and chaps, iii., iv. and v. of Miss E.C. Semple's *American History and its Geographic Conditions* (Boston, 1903).

(A. C. Sp.)

APPANAGE, or Apanage (a French word from the late Lat. *apanagium*, formed from *apanare, i.e. panem porrigere*, to give bread, *i.e.* sustenance), in its original sense, the means of subsistence given by parents to their younger children as distinct from the rights secured to the eldest born by the custom of primogeniture. 209 In its modern usage it is practically confined to the money endowment given to the younger children of reigning or mediatized houses in Germany and Austria, which reverts to the state or to the head of the family on the extinction of the line of the original grantee. In English history the system of appanages never played any great part, and the term is now properly applied only to the appanages of the crown: the duchy of Cornwall, assigned to the king's eldest son at birth, or on his father's accession to the crown, and the duchy of Lancaster. In the history of France, however, the appanage was a very important factor. The word denotes in very early French law the portion of lands or money given by fathers and mothers to their sons or daughters on marriage, and usually connotes a renunciation by the latter of any future inheritance; or it may denote the portion given by the eldest son to his brothers and sisters when he was sole inheritor. The word *apanage* is still employed in this sense in French official texts of some *Customs*; but it was in old public law that it received its definite meaning and importance. Under the kings of the third dynasty, the division of the kingdom among the sons of the dead monarch which had characterized the Merovingian and Carolingian dynasties, ceased. The eldest son alone succeeded to the crown; but at the same time a custom was established by which the king made territorial provision suitable to their rank for his other children or for his brothers and sisters; custom forbade their being left landless. Lands and lordships thus bestowed constituted the appanages, which interfered so greatly with the formation of ancient France. While the persevering policy of the Capets, which aimed at reuniting the great fiefs, duchies, countships, baronies, &c., to the domain of the crown, gradually reconstructed for their benefit a territorial sovereignty over France, the institution of the appanage periodically subtracted large portions from it. Louis XI., in particular, had to struggle against the appanaged nobles. The old law, however, never abolished this institution. The edict of Moulins (1566) maintained it, as one of the exceptions to the inalienability of the crown-lands; only it was then decided that daughters of France should be appanaged in money, or that if, in default of coin, lands were assigned to them, these lands should be redeemable by the crown in perpetuity. The efforts of the kings to minimize this evil, and of the old jurisprudence to deal with the matter, resulted in two expedients: (1) the reversion of the appanage to the crown was secured as far as possible, being declared inalienable and transmissible only to male descendants in the male line of the person appanaged; (2) originally the person appanaged had possessed all the rights of a duke or count—that is to say, in the middle ages nearly all the attributes of sovereignty; the more important of these attributes were now gradually reserved to the monarch, including public authority over the inhabitants of the appanage in all essential matters. However, it is evident from the letters of appanage, dated April 1771, in favour of the count of Provence, how many functions of public authority an appanaged person still held. The Constituent Assembly, by the law dated the 22nd of November 1790, decided that in future there should be no appanages in real estate, and that younger sons of monarchs, married and over twenty-five years of age, should be provided for by yearly grants (*rentes apanagères*) from the public funds. The laws of the 13th of August and the 21st of December 1790 revoked all the existing appanages, except those of the Luxembourg Palace and the Palais Royal. To each person hitherto appanaged an annual income of one million *livres* was assigned, and two millions for the brothers of the king. All this came to an end with the monarchy. Napoleon, by the *sénatus-consulte* of the 30th of January 1810, resolved to create appanages for the emperor's princely descendants, such appanages to consist for the most part of lands on French soil. The fall of the empire again annulled this enactment. The last appanage known in France was that enjoyed by the house of Orleans. Having been re-established, or recognized as still existing, by the Restoration, it was formally confirmed by the law of the 15th of January 1825. On the accession of Louis Philippe it was united to the national property by the law of the 2nd of March 1832.

For appanages in ancient law see the *Essai sur les apanages ou mémoires historiques de leur établissement*, attributed to Du Vaucel, about 1780.

(J. P. E.)

APPAREL (from O. Fr. *aparail*, *aparailler*, mod. *appareil*, from Low Lat. *adpariculare*, to make fit or equal), equipment, outfit, things furnished for the proper performance of anything, now chiefly used of dress. The word is also applied to the "orphreys," *i.e.* embroidered strips or borders, on ecclesiastical vestments.

APPARITIONS. An apparition, strictly speaking, is merely an appearance (Lat. *apparere*, to appear), the result of perception exercised on any stimulus of any of the senses. But in ordinary usage the word apparition denotes a perception (generally through the sense of sight) which cannot, as a rule, be shown to be occasioned by an object in external nature. We say "as a rule" because many so-called apparitions are merely

illusions, *i.e.* misconstructions of the perceptive processes, as when a person in a bad light sees a number of small children leading a horse, and finds, on nearer approach, that he sees two men carrying bee-hives suspended from a pole. Again, Sir Walter Scott's vision of Byron, then lately dead, proved to be a misconstruction of certain plaids and cloaks hanging in the hall at Abbotsford, or so Sir Walter declared. Had he not discovered the physical basis of this illusion (which, while it lasted, was an apparition, technically speaking), he and others might have thought that it was an apparition in the popular sense of the word, a ghost. In popular phraseology a ghost is understood to be a phantasm produced in some way by the spirit of a dead person, the impression being usually visual, though the ghost, or apparition, may also affect the sense of hearing (by words, knocks, whistles, groans and so forth), or the sense of touch, or of weight, as in the case of the "incubus." In ordinary speech an apparition of a person not known to the percipient to be dead is called a wraith, in the Highland phrase, a spirit of the living. The terms *ghost* and *wraith* involve the hypothesis that the false perceptions are caused by spirits, a survival of the archaic animistic hypothesis (see Animism), an hypothesis as difficult to prove as to disprove. Apparitions, of course, are not confined to anthropomorphic phantasms; we hear of phantom coaches (sometimes seen, but more frequently heard), of phantom dogs, cats, horses, cattle, deer, and even of phantom houses.

Whatever may be the causes of these and other false perceptions,—most curious when the impression is shared by several witnesses,—they may best be considered under the head of hallucination (*q.v.*). Hallucinations may be pathological, *i.e.* the result of morbid conditions of brain or nerve, of disease, of fever, of insanity, of alcoholism, of the abuse of drugs. Again, they may be the result of dissociation, or may occur in the borderland of sleep or waking, and in this case they partake of the hallucinatory nature of dreams (*q.v.*). Again, hallucinations may, once or twice in a lifetime, come into the experience of the sane, the healthy, and, as far as any tests can be applied, of the wide-awake. In such instances the apparition (whether it take the form of a visual phantasm, of a recognized voice, of a touch, or what not) may be coincidental or non-coincidental. The phantasm is called coincidental if it represents a known and distant person who is later found to have been dying or in some other crisis at the moment of the percipient's experience. When the false perception coincides with nothing of the sort, it is styled non-coincidental. Coincidental apparitions have been explained by the theory of telepathy (*q.v.*), one mind or brain impressing another in some unknown way so as to beget an hallucinatory apparition or phantasm. On the evidence, so far as it has been collected and analysed, it seems that the mind which, on the hypothesis, begets the hallucinations, usually does so without *conscious* effort (see Subliminal Self). There are, however, a few cases in which the experiment of begetting, in another, an hallucination from a distance, is said to have been experimentally and consciously made, with success.

If the telepathic theory of coincidental hallucinations be accepted, we have still to account for the much more common non-coincidental apparitions of the living who do not happen to be in any particular crisis. In these instances it cannot be demonstrated that telepathy has *not* been at work, as when a person is seen at a place which he thought of visiting, but did not visit. F.W. Myers even upheld a theory of psychorhagy, holding that the spirits of some persons have a way of manifesting themselves at a distance by a psychic invasion. This involves, as he remarked, paleolithic psychology, and the old savage doctrine of animism, rather than telepathy (see Myers, *Human Personality*). Of belief in coincidental hallucinations or wraiths among savages, records are scanty; the belief, however, is found among Maoris and Fuegians (see Lang, *Making of Religions*). The perception of apparitions of distant but actual scenes and occurrences is usually called clairvoyance (*q.v.*). The belief is also familiar under the name of second sight (see Second Sight), a term of Scots usage, though the belief in it, and the facts if accepted, are of world-wide diffusion. The apparitions may either represent actual persons and places, or may be symbolical, taking the form of phantasmic lights, coffins, skeletons, shrouds and so forth. Again, the appearances may either represent things, persons and occurrences of the past (see Retrocognition), or of the present (clairvoyance), or of the future (see Premonition). When the apparitions produce themselves in given rooms, houses or localities, and are exhibited to various persons at various times, the locality is popularly said to be haunted by spirits, that is, of the dead, on the animistic hypothesis (see Hauntings). Like the other alleged facts, these are of world-wide diffusion, or the belief in them is world-wide, and peculiar to no race, age, or period of culture. A haunted place is a centre of permanent possibilities of hallucinations, or is believed to be so. A distinct species of hauntings are those in which unexplained sounds and movements of objects, apparently untouched, occur. The German term *Poltergeist* (*q.v.*) has been given to the supposed cause of these occurrences where the cause is not ascertained to be sportive imposture. In the performances of modern spiritualists the Poltergeist appears, as it were, to be domesticated, and to come at the call of the medium.

An intermittent kind of ominous haunting attached, not to places, but to families, is that of the banshee (Celtic) or family death omen, such as the white bird of the Oxenhams, the Airlie drummer, the spectral rider of Clan Gilzean, the rappings of the Woodde family. These apparitions, with fairies and *djinns* (the Arab form of fairy), haunt the borderland between folk-lore and psychical research.

So far we have been concerned with spontaneous apparitions, or with the belief in them. Among induced apparitions may be reckoned the materialized forms of spiritual *séances*, which have a material basis of veils, false moustaches, wigs and the *corpus vile* of the medium. It is also possible that mere expectancy and suggestion induce hallucinatory perceptions among the members of the circle. That apparitions of a sort can be induced by hypnotic and posthypnotic suggestion is certain enough (see Hypnotism). Savages produce apparitions in similar ways by suggestion, accompanied by dances, fumigations, darkness, fasting, drugs, and whatever can affect the imaginations of the onlookers (see Magic). Both in savage and civilized life, some persons can provoke themselves into beholding apparitions usually fantastic, but occasionally coincidental, by sedulously staring into any clear deep water, a fragment of rock crystal, a piece of polished basalt or obsidian, a mirror, a ring, a sword blade, or a glass of sherry (see Crystal Gazing). Indeed any object, a wall, the palm of the hand, the shoulder-blade-bone of a sheep, may be, and has been used to this end (see Divination).

Almost all known apparitions may accommodate themselves to one or other of the categories given, whether they be pathological, coincidental or spontaneous, induced, permanently localized, or sporadic.

See generally, Spiritualism and Psychical Research.

(A. L.)

APPARITOR, or Apparator (Latin for a servant of a public official, from *apparere*, to attend in public), an attendant who executed the orders of a Roman magistrate; hence a beadle in a university, a pursuivant or herald; particularly, in English ecclesiastical courts, the official who serves the processes of the court and causes defendants to appear by summons.

APPEAL, in law. In the old English common law the term "appeal" was used to describe a process peculiar to English criminal procedure. It was a right of prosecution possessed as a personal privilege by a party individually aggrieved by a felony, a privilege of which the crown could not directly or indirectly deprive him, since he could use it alike when the prisoner was tried and acquitted, and when he was convicted and pardoned. It was chiefly known in practice as the privilege of the nearest relation of a murdered person. When in 1729 (after Colonel Oglethorpe's inquiry and report on the London prisons) Banbridge and other gaolers were indicted for their treatment of prisoners, but were acquitted for deficiency of evidence, appeals for murder were freely brought by relatives of deceased prisoners. In the case of Slaughterford (1708) the accused was charged with murdering a woman whom he had seduced; the evidence was very imperfect, and he was acquitted on indictment. But public indignation being aroused by the atrocities alleged to have been perpetrated, an appeal was brought, and on conviction he was hanged, as his execution was a privilege belonging to the prosecutor, of which the crown could not deprive him by a pardon. In 1818 an appeal was ingeniously met by an offer of battle, since if the appellee were an able-bodied man he had the choice between combat or a jury (see Wager). This neutralizing of one obsolete and barbarous process by another called the attention of the legislature to the subject, and appeal in criminal cases, along with trial by battle, was abolished in 1819. The history of this appeal is fully dealt with in Pollock and Maitland, *History of English Law*, 1898.

In its usual modern sense the term appeal is applied to the proceeding by which the decision of a court of justice is brought for review before another tribunal of higher authority. In Roman jurisprudence it was used in this and in other significations; it was sometimes equivalent to prosecution, or the calling up of an accused person before a tribunal where the accuser appealed to the protection of the magistrate against injustice or oppression. The derivation from *appellare* ("call") suggests that its earliest meaning was an urgent outcry or prayer against injustice. During the republic the magistrate was generally supreme within his sphere, and those who felt themselves outraged by injustice threw themselves on popular protection by *provocatio*, instead of looking to redress from a higher official authority. Under the empire different grades of jurisdiction were established, and the ultimate remedy was an appeal to the emperor; thus Paul, when brought before Festus, appealed unto Caesar. Such appeals were, however, not heard by the emperor in person but by a supreme judge representing him. In the *Corpus Juris* the appeal to the emperor is called indiscriminately *appellatio* and *provocatio*. A considerable portion of the 49th book of the *Pandects* is devoted to appeals; but little of the practical operation of the system is to be deduced from the propositions there brought together.

During the middle ages full scope was afforded for appeals from the lower to the higher authorities in the church. In matters ecclesiastical, including those matrimonial, testamentary and other departments, which the church ever tried to bring within the operation of the canon law, there were various grades of appeal, ending with the pope. The claims of the church to engross appeals in matters trenching on the temporal rights of princes led to continual conflicts between church and state, terminated in England at the reformation by the suppression in 1534 of appeals to Rome, which had previously been discouraged by legislation of Edward III. and Richard II.

In temporal, as distinct from spiritual matters, it became customary for ambitious sovereigns to encourage appeals from the courts of the crown vassals to themselves as represented by the supreme judges, and Charlemagne usually enjoys the credit of having set the example of this system of centralization by establishing *missi dominici*. It is not improbable that his claim was suggested or justified by the practice of the Roman empire, to the sovereignty whereof he claimed to be successor.

England.—When the royal authority in England grew strong as against that of the tenants *in capite*, the king's courts in England were more effectively organized, and their net swept wider so as to draw within their cognizance matters previously adjudged in courts baron or courts leet or in the county court, and they acquired authority to supervise and review the decisions of the inferior and local courts, to control and limit their claims to exercise jurisdiction, and to transfer causes from the local to the royal courts. The machinery by which this process was usually effected, under the common law, was not by what is now known as appeal, but by the process of *certiorari* or writs of error or prohibition. Recourse was also had against the decisions of the royal courts by appeal to the great council of the king, or to parliament as a whole. The supremacy of the king's courts over all causes, as well ecclesiastical as civil, has been completely established since the reign of Henry VIII., and they have effectually asserted the power to regulate and keep within their proper jurisdiction all other tribunals within the realm. Since that date the organization of judicial tribunals has gradually been changed and improved with the object (1) of creating a judicial hierarchy independent of executive control; (2) of ensuring that all decisions on questions of law shall be co-ordinated and rendered systematic by correction of the errors and vagaries of subordinate tribunals; and (3) of securing so far as

possible uniformity in the judicial interpretation and administration of the law, by creating a supreme appellate tribunal to whose decisions all other tribunals are bound to conform. It would be undesirable to detail at length the history of appellate jurisdiction in England, involving as it would the discussion in great detail of the history and procedure of English law, and it may suffice to indicate the system of appeals as at present organized, beginning with the lowest courts.

Justices of the Peace.—The decisions of justices of the peace sitting as courts of summary jurisdiction are subject to review on questions of law only by the High Court of Justice. This review is in a sense consultative, because it is usually effected by means of a case voluntarily stated by the justices at the request of the aggrieved party, in which are set forth the facts as determined by the justices, the questions of law raised and their decision thereon, as to the correctness whereof the opinion of the High Court is invited. The procedure is equally open in criminal and civil matters brought before the justices. But when the justices decline to state a case for the opinion of the High Court, the latter, if review seems desirable, may order the justices to state a case. And the High Court has also power to control the action of justices by prohibiting them from acting in a case beyond their jurisdiction, ordering them to exercise jurisdiction where they have improperly declined (*mandamus*), or bringing up for review and quashing orders or convictions which they have made in excess of jurisdiction, or in cases in which interested or biassed justices have adjudicated (*certiorari*). None of these regulative processes exactly corresponds to what is popularly known as an appeal, but in effect if not in form an appeal is thus given.

There is also another form of appeal, in the fullest sense of the term, from the decision of justices sitting as a court of summary jurisdiction to the justices of the same county sitting in general or quarter sessions, or in the case of a borough to the recorder as judge of the borough court of quarter sessions. This form of appeal is in every case the creation of statute: and even in text-books it is hardly possible to find a really complete list of the matters in respect of which such appeal lies. But as regards criminal cases there is an approximately general rule, given by § 19 of the Summary Jurisdiction Act 1879, viz. that an appeal to quarter sessions lies from the conviction or order of a court of summary jurisdiction directing imprisonment without the option of a fine as a punishment for an offence, or for failing to do or to abstain from doing any act required to be done or left undone other than an order for the payment of money, or to find sureties or give security or to enter into a recognizance, or a conviction made on a plea of guilty or admission of the truth of the matter of complaint.

As a general rule, subject to particular statutory exceptions, appeals of this kind are by way of rehearing, *i.e.* the actor or prosecutor must before the appellate tribunal call his witnesses and prove his case just as if no previous hearing had taken place before the court appealed from (Pritchard, *Quarter Sessions Practice*, 2nd ed., 461). The only limit is that the appellant must confine himself to the grounds of appeal stated in the notice of appeal given by him.

Justices in Quarter Sessions.—This tribunal has under the commission of the peace and under statute power to refer questions of difficulty arising before it for decision to the High Court. The old mode of exercising this power was by sending on to assizes indictments raising difficult questions which had been presented at quarter sessions. The High Court has *ex officio* power to transfer such indictments where the nature of the case and the demands of justice call for such transfer. The quarter sessions had also power under statute on trying an indictment to refer to the court for crown cases reserved (Crown Cases Act 1848), abolished by the Criminal Appeal Act 1907, questions of law which had arisen at the trial, and in all civil cases the quarter sessions has power of its own volition and subject to no direct compulsion to consult the High Court on legal questions of difficulty which have arisen. Until 1894 this jurisdiction was regarded as consultative only. It was and is exercised by stating the facts, of which the court of quarter sessions is the sole judge, and indicating the questions of law arising on the facts, and the view of quarter sessions thereon, and inviting the opinion of the High Court. Under the Judicature Act 1894 cases stated in this way are now treated as “appeals” in the popular sense.

Inferior Courts of purely Civil Jurisdiction.—An appeal also lies as a general rule to the High Court from the judgment of a county court or of any inferior tribunal having civil jurisdiction.

(*a*) County Courts. Any party to an action or matter in a county court who is dissatisfied with the determination or direction of the judge in law or equity, or upon the admission or rejection of any evidence, may appeal against the decision in the following cases: (1) if the amount of claim or counter-claim in the proceeding exceeds £20; or (2) in all equity matters or cases in which an injunction has been given; or (3) in actions to recover possession of land where questions of title are involved (County Courts Act 1888, § 120). In the case of a claim below £20 no appeal lies except by the leave of the county court. The old practice of appeal by way of special case as in appeals from justices has been abolished, and the present procedure is by notice of motion (R.S.C. O. LIX. rr. 10-18).

These appeals are heard in the king’s bench division, except in the case of appeals from judgments of a county court sitting in the exercise of admiralty jurisdiction, which are heard by two or more judges sitting in the probate, divorce and admiralty division. The chancery division has never sat to hear “appeals” from a county court exercising equity jurisdiction; but at times, by *prohibition* or *certiorari*, has, in effect, reviewed or restrained excess of jurisdiction by county courts in equity matters.

The decision of the High Court on county court appeals is final unless an appeal to the court of appeal is brought by leave of that court or of the High Court (Judicature Act 1894, § 1, sub. sect. 5; Judicature Act 1873, § 45).

(*b*) Other inferior courts of civil jurisdiction. Appeals from the local courts of record which still survive in certain cities, towns and districts are in a somewhat anomalous position. The general rule is that, unless a statute regulates such appeal, it may be brought in the king’s bench division of the High Court on notice of motion in any case in which, before the Judicature Acts, the court of king’s bench could have reviewed the decision of the inferior court by writ of error. The history of this question is dealt with in *Darlow* v. *Shuttleworth*, 1902, 1 K.B. 721.

In the case of the mayor's court of London, under the local and general statutes regulating that court, the appeal is usually to the king's bench division, but where there is what is termed "error" on the face of the proceedings of the mayor's court, the appeal lies direct to the court of appeal as successor of the court of exchequer chamber. Appeals from the Liverpool court of passage and from the chancery courts of the duchies of Lancaster and Durham lie by statute direct to the court of appeal.

High Court of Justice.—Until the Supreme Court of Judicature Acts of 1873 and 1875 came into operation, the superior courts in England were imperfectly co-ordinated both as to jurisdiction and appeals. The effect of these acts was to create a Supreme Court of Judicature divided into two main branches, the High Court of Justice, which is an appellate court with respect to the inferior courts already mentioned, and to certain other special courts and persons; and the court of appeal, which is mainly concerned with appeals from the High Court of Justice.

The High Court of Justice acts as an appellate court or court of consultation with reference to courts of summary jurisdiction or quarter sessions and to county courts and other inferior courts of civil jurisdiction in the cases already indicated. The three divisions of the court are somewhat differently placed with reference to appeals.

In the chancery division (made up, in 1908, of six single judge courts) no appeals are heard except from subordinate officials (masters) of the court, or an occasional interference by *certiorari* or *prohibition* with a county court.

In the probate, divorce and admiralty division, besides the supervision which may be exercised by a single judge over the subordinate officers of the court (registrars), divisional courts (of two judges) hear appeals from decisions of the county court in admiralty causes, and appeals from justices in cases between husband and wife under the Summary Jurisdiction (Married Women) Act 1895, as amended by the Licensing Act 1902. In the first of these cases the appeal is on law only as in the case of other county court appeals; in the second, the procedure is by rehearing, or reconsideration of the facts as minuted in the court appealed from, and of the law there applied to these facts.

The bulk of the appellate work of the High Court is conducted in the king's bench division—which, as successor of the old court of king's bench in the duties of *custos morum* of the realm, still retains supervisory power over all inferior courts in all cases in which that supervision has not been transferred to the other divisions of the High Court or to the court of appeal, or to the court of criminal appeal.

The king's bench division exercises appellate jurisdiction in the following cases.

With respect to decisions of justices of the peace sitting at quarter sessions, or as a court of summary jurisdiction, except in the case above stated, the subject matter of appeal is for the most part of a criminal or quasi-criminal character, the civil jurisdiction of justices being comparatively limited. The appeal in such cases is as to matters of law only, the justices' decision on facts not being subject to review.

In the case of the courts above named, the appeal is brought by writ of *certiorari*, where the jurisdiction of quarter sessions to give the judgment challenged is denied *in toto*, or in some cases by writ of *habeas corpus*, where the appellant is in custody under an order of the court appealed from (Judicature Act 1894, § 2). The best example of this is the right of a fugitive criminal committed for extradition to challenge the legality of the decision of the committing magistrate by writ of *habeas corpus*. Save in cases of want of jurisdiction or refusal to exercise it, no appeal lies from quarter sessions except by consent of the court appealed from, which states the facts as ascertained by the inferior court, and invites the review of the superior court upon the questions of law raised by the facts as found.

Decisions of justices sitting in the exercise of summary jurisdiction are subject to review by a special case in which the justices state the facts found by them and their decision on the points of law, and invite the review of the appellate court on these grounds. Such cases for appeal are usually stated by consent of the justices, but in the event of their refusal the appellate court may order that a case shall be stated.

Decisions of justices in the exercise of summary jurisdiction may also be challenged by writ of *certiorari* as having been wholly outside their jurisdiction; and in such proceeding the appellate tribunal may review the evidence taken below so far as to ascertain whether the justices have by an erroneous finding of fact enabled themselves to assume a jurisdiction which upon the true facts they did not possess.

Where the decision appealed from is in a criminal cause or matter the decision of the High Court is final. Where it is in a civil matter a further appeal also lies to the court of appeal by leave of the High Court or of the court of appeal (Judicature Act 1873, § 45).

Appeals in criminal cases tried on indictment, criminal information or coroner's inquisition, stand on a different footing from other appeals.

For many years the question of criminal appeal in general had been a matter of great controversy. As early as 1844 a bill had been unsuccessfully introduced for the purpose of establishing appeal in criminal cases, and from that time up to 1906 nearly thirty bills were brought forward with the same object, but none succeeded in passing. In 1892 the question was referred to the council of judges and favourably reported upon by them. It may be remarked that England was practically the only civilized country in which there was no appeal in criminal cases. It is true there was an appeal on questions of law arising at the trial. But the procedure was intricate and technical, being either (1) by writ of error, issued by the consent of the attorney-general (expressed by his *fiat*), to review errors of law appearing in the record of the trial, or (2) by special case, stated by the judge presiding at the trial, with respect to a question of law raised at the trial. These appeals were heard by the king's bench division. Meanwhile there had been a considerable development of public opinion in favour of the establishment of criminal appeal, a development undoubtedly hastened by the report of a committee of inquiry in the case of Adolf Beck (1904), showing clearly that the home office was not a satisfactory tribunal of final appeal. In 1906 the lord chancellor (Lord Loreburn) introduced another criminal appeal bill, which passed the House of Lords, but was dropped in the House of Commons after a first

reading. The next year the act (Criminal Appeal Act 1907), which was ultimately carried, was introduced into the House of Commons. By this act a court is established consisting of the lord chief justice and eight judges of the king's bench division, the jurisdiction of the court for crown cases reserved being transferred to the new court. The court to be duly constituted must consist of not less than three judges and of an uneven number of judges. The court may sit in two or more divisions if the lord chief justice so directs. Its sittings are held in London unless special directions are given by the lord chief justice that it shall sit at some other place. The opinion of the majority of those hearing the case determines any question before the court, and judgment is pronounced by the president (who is the lord chief justice or senior member present), unless in questions of law, when, if it is convenient that separate judgments should be pronounced by the members of the court, they may be so pronounced. The judgment of the court of criminal appeal is final, except where the decision involves a point of law of exceptional public importance, and a certificate must be obtained from the attorney-general to that effect. The court of criminal appeal is a superior court of record. An appeal may be made either against conviction or against sentence. A person convicted on indictment may appeal either on a question of law alone or of fact alone, or on a question of mixed law and fact. On a point of law a prisoner has an unqualified right of appeal, on a question of fact or of mixed law and fact there is a right of appeal only if leave be obtained from the court of criminal appeal or a certificate be granted by the judge who tried the prisoner that it is a fit case for appeal. The court is given a wide discretion as to whether a conviction may be sustained or set aside. The court may allow the appeal if they think that the verdict of the jury should be set aside because it is unreasonable, or because it cannot be supported having regard to the evidence, or that the judgment should be set aside on the ground of a wrong decision on any point of law, or that on any ground there was a miscarriage of justice. Power is given to the court to dismiss the appeal if they consider that no substantial miscarriage of justice has occurred, even though they are of opinion that the point raised in the appeal might be decided in favour of the appellant. The sentence passed at the trial may be quashed by the appeal court and such other sentence (whether more or less severe) warranted in law by the verdict substituted. Notice of appeal or notice of application for leave to appeal must be given within ten days of the date of conviction; where a conviction involves sentence of death or corporal punishment the sentence must not be executed until after the expiration of ten days, and, if notice of appeal is given, not until after the determination of the appeal or the final dismissal of the application for leave to appeal. The act gives the court power to order any witnesses who would have been compellable witnesses at the trial to attend and be examined before the court, and to receive the evidence, if tendered, of any witness who is a competent but not compellable witness. If any question arises on the appeal involving prolonged examination of documents or accounts or any scientific or local investigation, which the court thinks cannot be conveniently conducted before it, the matter may be referred to a special commissioner appointed by the court, and the court may act on the report of that commissioner if it thinks fit. An appellant is given the right to be present on the hearing of his appeal, if he desires it, except where the appeal is on some ground involving a question of law alone, but rules of court may provide for his presence in such a case, or the court may give him leave. The act requires shorthand notes to be taken of the proceedings at the trial of any person, who, if convicted, would have a right to appeal under the act. Nothing in the act affects the prerogative of mercy, and the home secretary may, if he thinks fit, at any time refer a case to the court of criminal appeal.

The Court of Appeal.—The court of appeal, constituted under the Judicature Acts, is one of the two permanent divisions of the Supreme Court of Judicature. As now constituted the court consists of *ex officio* members and five ordinary members, styled lords justices of appeal. The *ex officio* members are the lord chancellor, every person who has held that office, the lord chief justice, the master of the rolls, and the president of the probate, &c., division.

The ordinary business of the court is carried on by the lords justices under the presidency of the master of the rolls, who in 1881 ceased to be a judge of the High Court (Judicature Act 1881, § 2). The court usually sits in two divisions of three judges, but on occasion a third court can be formed, with the assistance of the other *ex officio* judges, in the absence of the ordinary judges from illness or public engagements, or to deal with arrears of business. The quorum for final appeals is three, for interlocutory appeals two judges.

The court of appeal has succeeded to the appellate authority exercised (1) in the case of equity and bankruptcy matters by the lord chancellor and the lords justices of appeal in chancery (Judicature Act 1873, § 18); (2) in the case of common law matters, by the court of exchequer chamber, as a court of error, and the superior courts of common law sitting to review the decisions of single judges of these courts sitting with or without a jury at first instance in civil actions; (3) in the case of divorce or probate causes by the full court of divorce (Judicature Act 1881, § 9); (4) in the case of admiralty causes by the king in council or the judicial committee of the privy council; (5) in the case of applications for new trials in jury actions by the king's bench division (Judicature Act 1890, § 1).

The court never had jurisdiction to hear an appeal in any criminal cause or matter, but was able to review by writ of error decisions of the king's bench division in such cases, unless the court for crown cases reserved had dealt with the question under the Crown Cases Act 1848. This procedure has been abolished by the Criminal Appeal Act 1907. Instances of procedure by writ of error were rare. Those best worth notice are the cases of the Tichborne claimant on his conviction of perjury, and the case of C. Bradlaugh on the sufficiency of the indictment against him for publishing the *Fruits of Philosophy*.

The appellate jurisdiction of the court as now exercised entitles the court to hear and determine (1) appeals from every judgment or decree of every division of the High Court in all civil cases in which such judgment is not declared final by statute; (2) applications for a new trial in civil cases tried in the king's bench division by judge and jury which, until 1890, were dealt with by two or more judges in that division; (3) appeals in matters of civil practice and procedure from decisions of a single judge in chambers, which, until 1894, were dealt with in a divisional court or by a judge in open court; (4) appeals from the chancery courts of Durham (Palatine Court of Durham Act 1889) and Lancaster (act of 1890, c. 23) and the Liverpool court of passage (*Anderson v. Dean*, 1894, 2 Q.B. 222), and on error in a record of the mayor's court of London (*Le Blanche* v. *Heaton Telegram Co.*, 1876, 1 Ex.D. 408); and from county courts under the Agricultural Holdings Acts and Workmen's Compensation Acts; (5) appeals on questions of law from decisions of the railway commissioners in England (Railway and Canal Traffic Act 1888).

The court of appeal also exercises the lunacy jurisdiction of the lord chancellor, but in regard to this the jurisdiction of the court is for the most part original and not appellate.

The jurisdiction of the court of appeal is excluded or limited in the following cases:—(1) judgments of the High Court—(*a*) where its jurisdiction is consultative only; (*b*) where there is an appeal to the High Court from an inferior court of civil jurisdiction; (*c*) where there is an appeal to the High Court from any court of person, unless in cases (*b*) and (*c*) leave be obtained of the court by which the order is made, or of the court of appeal; (2) orders of the High Court in registration and election cases except with the like leave; (3) orders made by consent of parties, or as to costs only which by law are left to the discretion of the court; (4) certain interlocutory orders mentioned in § 1 of the Supreme Court of Judicature (Procedure) Act 1894, except by leave of the judge appealed from or of the court of appeal (5) orders of the admiralty division in cases of prize, the appeal from which lies to His Majesty in Council; (6) where the decision of any court whose jurisdiction was transferred to the High Court is declared by statute to be final; (7) matters which from their nature were not appealable to any court before the Judicature Acts, or in which the court of appeal has no means of enforcing or executing its judgment. For example, it was held in the House of Lords, in *Cox* v. *Hakes*, 1890, 15 A.C. 506, that no appeal lies from the order of a judge discharging a prisoner under a writ of *habeas corpus*. "If," said Lord Herschell, "the contention of the respondent is to prevail, the statute has effected a grave constitutional change"; and later, "if" the High Court "has inherited the combined powers of the courts whose functions were transferred to it, but none of them had any jurisdiction or authority to review a discharge by a competent court under a writ of *habeas corpus*, or to enforce the arrest of one thus freed from custody ... it seems to me to follow, that however wrong the court of appeal might think a discharge to have been, it would have been powerless to order a rearrest, or at least to enforce such an order."

The procedure of the court of appeal is regulated by the rules of the Supreme Court. A distinction is drawn between appeals from a final judgment or order (which, unless the parties consent to a smaller quorum, must be heard by three judges) and an appeal from an interlocutory order (which may be determined by two judges of the court of appeal).

In the case of appeals from a final or interlocutory "judgment," or from an order, including applications for a new trial, the appeal must be brought within three months from the time when the judgment or order is signed, entered or otherwise perfected, or in the case of refusal of an application from the date of refusal. The appeal is by notice of motion, which except in cases of application for a new trial, need not state the grounds of appeal. Fourteen clear days' notice of the motion must be given by the appellant to the other party, the respondent.

In the case of appeals from an interlocutory order, or from a final order, or from an order made in any matter which is not an action, or from an order made in chambers, the appeal must be brought within fourteen days by motion, of which four clear days' notice must be given by the appellant to all parties directly affected by the appeal. Controversies have arisen as to the meaning of the term "interlocutory," which (in the absence of any authoritative definition) the court of appeal settles as they arise. The test most generally accepted is that a judgment or order is final if, as made, it finally disposes of the rights of the parties in a manner equally conclusive between them. The court may by special leave allow appeals of either class to be brought after the time above limited. The respondent may by proper notice bring a cross appeal against any portion of the judgment or order made below with which he is dissatisfied. The court has power to order the appellant to find security for the costs of an appeal, if special circumstances, such as insolvency or poverty or foreign domicile or the like, make the giving of security desirable. The court of appeal "rehears" the case. Under ordinary circumstances it does not permit a new case to be set up inconsistent with the case as presented below; and it is content with the judges' notes, or a transcript of the evidence given below, and with a note or transcript of the judgment appealed from, but has power on special grounds to receive fresh evidence either *viva voce* or on affidavit. The court may call in for its assistance assessors who are experts on the matters of fact or science involved in the appeal, and usually does so in cases arising out of collisions at sea.

The court of appeal may make any order which it deems just as to the costs of the whole or any part of an appeal, except possibly in the case of certain appeals in matters on the crown side of the High Court, as to which some doubt still exists. In practice the costs follow the event, unless the court in a particular case makes an order to the contrary.

A decision of the court of appeal is final in appeals from the High Court in bankruptcy, unless leave be given to appeal to the House of Lords (§ 104, Bankruptcy Act 1883), and in divorce appeals, except where the decision either is upon the grant or refusal of a decree for dissolution or nullity of marriage, or for a declaration of legitimacy, or is upon any question of law on which the court gives leave to appeal (Supreme Court of Judicature Act 1881, § 9); but no further appeal to the House of Lords lies, even with leave of the court of appeal, on appeals from the High Court sitting as a court of appeal from county courts in bankruptcy. With these exceptions there is now a right of appeal from every order of the court of appeal to the House of Lords.

The House of Lords.—The House of Lords has for centuries been the court of last resort, and is still the final court of appeal from the chief courts in the United Kingdom. The origin of the appellate jurisdiction of the House of Lords was undoubtedly of that partly feudal and partly popular character already alluded to, which made the suitor seek from the high court of parliament the justice denied elsewhere in the baronial courts or by the king's judges. The lords exercised the mixed function of jurymen and judges, and, as in judgments on impeachment, might be influenced by private or party considerations, debating and dividing on the question before the House. A revolution was silently accomplished, however, by which the function of reviewing the decisions of the courts fell entirely to the lawyers raised to the peerage, while the unprofessional lords only attended to give the sanction of a quorum to the proceedings, and the House has always had the right to invoke the assistance of the judges of the superior courts to advise on the questions of law raised by an appeal. The letters and memoirs, so late as Queen Anne's reign, show that party or personal influence and persuasion were employed to procure votes on appeals, as they have been in later times on railway or other local bills. The last instance probably in which a strong division of opinion was manifested among the

unprofessional lords was the celebrated Douglas cause in 1769, when the House was addressed by the dukes of Newcastle and Bedford, but was led by the authoritative opinion of Lord Mansfield on the effect of the evidence—an opinion which was treated rather as that of a political partisan than of a judge. The case of Daniel O'Connell and others, brought up on writ of error from the queen's bench in Ireland in 1844, may be said to have finally established the precedent that the judgments of the House of Lords were to be given solely by the law lords. On that occasion there was a difference of opinion among the law lords themselves. The judgment of the majority of the House was strongly against the political feeling of the government and of the peers as a body, while the law lords who carried the decision had been appointed by previous governments opposed in politics to the existing cabinet. But all these temptations to a party vote by the unprofessional members were resisted.

By § 20 of the act of 1873, the appellate jurisdiction of the House of Lords (so far as it affects England) was abolished, but this section was repealed by the Appellate Jurisdiction Act 1876. Under that act and an amending act of 1887, the appellate business of the House of Lords is conducted solely by the law lords, though lay peers may still sit (*Bradlaugh* v. *Clarke*, 1882, 8 App. Cas. 354). No appeal may be heard or determined except in the presence of not less than three of the following persons:—(1) the lord chancellor; (2) the lords of appeal, four of whom are appointed under the act from among persons who hold, or have held, high judicial office, or, at the date of appointment, have been in practice for not less than fifteen years as barristers in England or Ireland, or as advocates in Scotland; (3) such peers of parliament as hold, or have held, high judicial office. By "high judicial office" is meant the office of lord chancellor of Great Britain or Ireland, lord of appeal in ordinary, paid judge of the judicial committee or member of that committee, or judge of one of the superior courts of Great Britain or Ireland.

An appeal lies to the House of Lords (1) from any order or judgment of the court of appeal in England except as above stated; (2) from a judgment or order of any court in Scotland or Ireland from which error or an appeal to the House of Lords lay by common law or statute immediately before the 1st of November 1876. No appeals are heard from the decision of courts in criminal cases. The House of Lords has an indirect power by standing orders to admit appeals from Scotland or Ireland which under former law or practice could not be admitted (Appellate Jurisdiction Act 1876, § 12). The procedure on appeals is regulated by standing orders of the House. The proceedings are commenced by petition of appeal, which must be lodged with the clerk of the parliaments within one year from the date of the last judgment it appealed from. Security for costs (£200) must be given by bond or lodgment of the money, unless dispensed with by the House on the ground of poverty (act of 1893). Each party lodges a printed case signed and certified by counsel, containing a resumé of the matters to be discussed and of the contentions for or against the allowance of the appeal. The hearing is before three or more law lords, who may call in nautical assessors in admiralty cases (acts of 1893 and 1894). It is not public in the full sense of the term, as persons not concerned in the appeal can attend only by consent of the House. The House pronounces the judgment which in the opinion of the majority of the law lords should have been pronounced below, and has jurisdiction in the case of all appeals to give or refuse costs to the successful party. The costs of the appeal if given are taxed by the officers of the House. The jurisdiction as to costs does not directly arise under any statute (see *West Ham Guardians* v. *Bethnal Green Churchwardens*, 1896, A.C. 477).

Appeals to the King in Council.—The decisions of ecclesiastical courts when acting within the limits of their jurisdiction, and the decisions of courts in the king's dominions outside the United Kingdom, and of courts in foreign countries set up under the Foreign Jurisdiction Acts, cannot be dealt with by the House of Lords or any of the ordinary tribunals of any part of the United Kingdom. The power once claimed by the court of king's bench in England to control the courts of Ireland has lapsed, and its power to intervene in colonial cases is limited to the grant of the writ of *habeas corpus* to a possession in which no court exists having power to issue that writ or one of like effect (Habeas Corpus Act 1862). As regards all British possessions, the appeal to the king in council is in its origin and nature like that of the provincials unto Caesar, and flows from the royal prerogative to admit appeals. With the growth of the British empire it has been found necessary to create a comparatively constant and stable tribunal to advise the king in the exercise of this prerogative. For this purpose the judicial committee of the privy council was created in 1833. In 1851, and again in 1870, it was reorganized, and by acts of 1876, 1887 and 1898 it received its present form. The committee consists of the president of the council, and of the following persons, if privy councillors—the lord chancellor and ex-chancellors of Great Britain and of Ireland, the four lords of appeal in ordinary, the lords justices of appeal in England or retired lords justices of appeal in England, and persons who hold or have held the office (*a*) of judge of the High Court of Justice or the court of appeal in England or Ireland, or of the court of session in Scotland; (*b*) any person who is or has been chief justice or a judge of the Supreme Court of Canada or of a superior court of any province of Canada, of any of the Australian states (except Fiji and Papua), or of New Zealand or the Cape of Good Hope or Natal. The number of persons of this class who may be members at once is limited to five (1895, c. 44); (*c*) provision is also made for the payment of two privy councillors who have been judges in India who attend the privy council.

Numerous as are the members of the committee, the quorum is three. One or more of the lords of appeal in ordinary usually attend at every hearing, but the composition of the committee is very fluctuating. Appeals from the British dominions abroad lie in criminal as well as civil matters. The right of appeal is regulated as to most possessions by order in council, and in some cases is limited by imperial or colonial statute. Appeals are on fact as well as on law, but the committee rarely if ever disturbs the concurrent judgments on facts of two colonial courts. In the case of admiralty appeals from colonial or consular courts, naval assessors may be called in. The committee also hears (with the aid of ecclesiastical assessors) appeals from ecclesiastical courts. The judgment of the committee is in the form of a report and advice to the king, which is read by one of the members sitting, and no indication is given as to whether the members present are unanimous. Effect is given to the advice by orders in council dismissing or allowing the appeal, and giving direction as to the payment of costs and as to the further proceedings to be taken in the colonial courts.

The procedure of the committee is on the same lines as that on appeals to the House of Lords; no well-arranged code of practice existed however up to the end of 1908, and new rules were then being proposed on the subject. The appeal is commenced by a petition of appeal, and by the giving of security for costs. In

colonial appeals printed cases are lodged containing a summary of the contentions of the parties, and with this a printed copy of the record of the proceedings and documents used in the courts appealed from. The hearing is in the privy council chamber and is not public. When an appeal is called on, the counsel and parties are summoned into the chamber, and when the arguments are concluded they are requested to retire. The appeals to the king in council from colonial states having a federal constitution, like Canada and Australia, stand in an exceptional position. The act creating the Supreme Court of Canada purports to make the decision of that court final. But it is still the practice to admit by special leave a prerogative appeal from the court, and to entertain appeals from courts of the provinces of Canada direct to the king in council, without requiring them to go to the Supreme Court. The constitution of the Australian Commonwealth contemplates (§ 73) the possibility of restricting appeals to the king in council from the supreme courts of Australia, and sec. 74 forbids appeals to the king in council except by leave of the High Court of Australia from decision of that court on any question however arising as to the limits *inter se* of the constitutional powers of the commonwealth and those of any state or states, or as to the limits *inter se* of the constitutional powers of any two or more states. The exact effect of these enactments and of Australian legislation under § 73 is a matter of controversy.

Scotland.—In Scotland the ordinary appellate tribunal for decisions of inferior courts and of the lords ordinary is the court of session, which for appellate purposes sits in two divisions. Appeals from inferior tribunals in criminal cases go before the judges of the court of session sitting in the High Court of Justiciary. The court of session was in its original constitution a committee of parliament for the performance of its judicial functions, and an appeal to parliament was consequently anomalous. In the reign of Charles II., however, the courts grew so intolerably corrupt that a determined effort was made to have their judgments overturned, by an appeal which was strictly of the old character of a cry for protection against flagrant injustice. It was called a “protest for remeid of law,” and was inserted as one of the national claims in the Petition of Right at the revolution. The treaty of union is silent as to appeals, though definitely excluding the right of English courts to interfere with Scottish courts or cases. The House of Lords has since the Union acted without challenge as the final appellate tribunal for Scotland in civil causes; but has always declined jurisdiction in Scottish criminal cases.

Ireland.—The Supreme Court of Judicature (Ireland) Acts have remodelled the courts and appellate system of Ireland on the same lines as those of England. The High Court of Justice in Ireland now consists of two divisions only, the chancery division, which has little or no appellate functions, and the king’s bench division, which has for Ireland substantially the same power of reviewing and correcting the decisions of inferior courts as has the corresponding court in England. To this there is one exception, that appeals from a county court in Ireland may be heard on circuit by a single judge of assize. In Ireland there is also a court of appeal, created in 1877, whose jurisdiction and procedure follow the same lines as that of the English court of appeal.

France.—The court of last resort in France for all cases, whether civil or criminal (*en matière criminelle, correctionnelle et de police*), is the *cour de cassation*, which sits in Paris. It is a court of error for the review of all judgments of tribunals of last resort (except *juges de paix* in certain cases), and for the transfer of causes from one court to another when justice so demands, and to determine conflicts of jurisdiction (Law 1 Dec. 1790). Ordinarily it is confined to errors of law and procedure, but where evidence not available below is brought before the court, it may send the case back for retrial or give the appropriate final judgment, as in the case of Dreyfus (1906). It also hears appeals from courts martial.

Next to the *cour de cassation* are the courts of appeal, which have jurisdiction to hear appeals (1) in civil matters from courts of first instance, *juges de paix*, and where the amount in dispute exceeds £60 from commercial courts, *tribunaux de commerce* (Civil Proc. Code, arts. 443-475); (2) in criminal matters from *tribunaux correctionnels* (Com. Proc. Code, arts. 202-235). The appeal is both on fact and on law, and applies to interlocutory or preparatory as well as to final judgments.

Spain.—In Spain the jurisdiction and procedure with reference to appeals is on the same lines as in France. As regards civil matters it is regulated by title 21 of the Civil Procedure Code. The appeal to the supreme court is for the most part on questions of law (*por infraccion de ley o de doctrina*); but the court has also power to review judgments on materials not available at the first hearing (arts. 1796, 1801).

British India.—In British India complete and systematic provision is made for appeals both in civil and in criminal cases by the Procedure Codes (Civil of 1882, with subsequent amendments, and Criminal of 1898), and also to some extent by the charters of the high courts of Calcutta, Bombay and Madras (see Ilbert, *Government of India*, Oxford, 1898, p. 137). In addition, the decisions of subordinate tribunals may be revised by a superior tribunal *proprio motu*, or reviewed in a proper case by the tribunal which has given them; and provision is made for the consultation of a superior by an inferior tribunal in cases of legal difficulty. The policy of admitting so many appeals has been criticized. But with an enormous population which has no representative institutions it has been deemed wise to provide ample means of correcting judicial errors at the instance not only of the aggrieved person but also at the instance of the supervising judicial authorities, as a means of ensuring regularity and propriety in the conduct of judicial business by subordinate judges in out-of-the-way districts.

Civil Appeals.—(1) Except where otherwise expressly provided by the Civil Procedure Code, or by any other law for the time being in force, an appeal lies from the whole or part of any decree, whether made *ex parte* or *inter partes*, of a court exercising original jurisdiction (Civil Procedure Code, § 540). By “decree” is meant the final expression of an adjudication upon a right claimed or defence set up in a civil court, when such adjudication, so far as regards the court expressing it, decides the suit (§ 2). The appeal is both on facts and on law. The procedure on the appeal is prescribed by c. 41 of the Civil Procedure Code, and the directions of the code deal even with the language of the judgment on appeal and the matters to be stated therein. (2) Decrees passed on an appeal to any court in India subordinate to a High Court are as a general rule subject to appeal to the High Court on the grounds (*a*) that they are contrary to a specified law, or usage having the force of law; (*b*) that they have failed to determine some material issue of law, or usage having the force of law; (*c*) of substantial error or defect in procedure prescribed by the code or other law which might possibly

have produced error or defect in the decision of the case upon the merits (§ 584). The procedure on these appeals is regulated by c. 42 of the Civil Procedure Code. (3) Appeals from orders which do not fall within the definition of decrees are allowed in the cases specified in § 588 of the code. The procedure with respect to these appeals is on the same lines as that on appeals against decrees (§ 590). Provision is made (by c. 44) for allowing appeals *in forma pauperis* after certain preliminary inquiries. In the High Courts appeals lie from the decision of one judge to two or more judges of the High Court, whose decision has effect as a judgment of the full court. Appeals, in civil cases, from the courts of India to the king in council are regulated by c. 45 of the Civil Procedure Code. The appealable amount is for most cases Rs. 10,000 or a claim or question as to property of like amount.

Besides the provisions stated as to appeals, Indian courts have power in certain contingencies to review their own decisions (§ 623). An inferior court may also refer cases of difficulty to the High Court on a statement of the facts as found in the referring court and of the opinion thereon of that Court (§§ 617-620); and in cases in which no appeal lies to the High Court, that court may call for the record of any case in which the court below appears to have acted without jurisdiction or failed to exercise its jurisdiction, or to have exercised its jurisdiction illegally or with material illegality (§ 622).

Criminal Matters.—Criminal jurisdiction in India is exercised by magistrates of the first, second and third class, by sessions courts, and the high or chief courts of the presidencies or provinces (Criminal Procedure Code of 1898). The higher judges in a district have the power of revising those decisions which are not absolutely summary of the judges of the classes below them in the same district; *i.e.* the sessions judge can revise the decisions of a first-class magistrate, and the High Court those of a sessions judge (§ 435). Inferior tribunals can also refer questions of law to the High Court (§§ 432, 433); and where a sentence of death is passed, or a sessions judge differs from the jury (§ 307), the matter must be referred to the High Court. On matters of reference or revision the parties have no right to be heard.

Provision is also made for appeals by c. 31 of the Code. Appeals from second- or third-class magistrates are dealt with by the district (first-class) magistrate (§ 407). Persons convicted on trial by assistant sessions judges or first-class magistrates, except in cases where the punishment is very small, have an appeal to the sessions judge (§§ 408, 413). A person convicted on trial by the sessions judge has an appeal to the High Court (§ 410), but where he has pleaded guilty the only point on which appeal is open is the legality or extent of sentence (§ 412). Special provision is made as to appeals by persons born in Europe (whether British subjects or not) and Americans (§§ 408, 415, and c. 33).

In criminal cases there is a right of appeal to the king in council in certain cases provided for by the charters of the chartered high courts (see Ilbert, *Government of India*, Oxford, 1898, p. 137).

An appeal also lies in certain cases from the courts of British officers in feudatory states of India to a high court in India, and from the courts of Aden and Zanzibar and British East Africa to the High Court of Bombay. Appeals do not lie from the courts of native states to British courts in India, though in some cases there is an appeal of a political rather than judicial nature from the judicial tribunals of feudatory states; *e.g.* in the case of Kathiawar (*Hemchand Derchand* v. *Azam Sakarlal*; 1906. L.R. A.C. 212).

Canada.—In Canada each province has the regulation of its own courts of justice. In Ontario the judiciary are organized, under the Provincial Judicature Acts, in much the same manner as in England; and the review of decisions of inferior courts (by appeal or other proceedings based on English practice) is in the hands of the High Court of Justice, subject to appeal to the provincial court of appeal. In Quebec the highest court (king's bench), besides its original jurisdiction, has appellate jurisdiction over the superior court (see Quebec Civil Procedure Code, art. 1114 *et seq.*). The jurisdiction is exercised by writ of error or by appeal, according to the nature of the decision appealed from. The judges of the superior court have also, under art. 494, power to review before three judges decisions of a judge of that court or of a circuit court (arts. 494-504). Nova Scotia, New Brunswick, Manitoba and British Columbia have supreme courts with appellate authority over decisions of single judges of the court and over inferior tribunals in the province. Appeals lie from the highest courts of each province, in civil matters, to the Supreme Court of Canada, or to the king in council in cases falling within the orders in council applying to each province, but in criminal matters to the king in council. From the Supreme Court of Canada no appeal lies as of right to the king in council (Dominion Act 1875, 38 Vic. c. 11, § 47), and the royal prerogative of granting special leave to appeal is sparingly exercised. The principles on which the judicial committee acts in advising for or against the grant of special leave in civil case& are stated in *Daily Telegraph Newspaper Co.* v. *M'Laughlin*, 1904, L.R. A.C. 776. It is, however, as before, quite common for appeals to be brought direct to the privy council from the provincial courts without resort to the Dominion court (see Wheeler, *Privy Council Law*, p. 955).

Australia.—Each of the states of the Australian Commonwealth has its own supreme court. The Commonwealth parliament constituted in 1903 a High Court for Australia, which, besides its original federal jurisdiction, is also a court of appeal from the supreme courts of the constitutional states, or from any state court from which an appeal lay to the king in council at the establishment of the Commonwealth. The jurisdiction of the court is defined by the Judiciary Act of 1903, by which it is created. The right of appeal is given both as to criminal and civil matters.

South Africa.—In Cape Colony and Natal the appellate courts are the supreme courts, subject to further appeal in certain cases to the king in council. The superior courts of Cape Colony are empowered to review the proceedings of all inferior courts in the colony and its dependencies in cases where no appeal lies. There was for a time an appeal from the High Court of Orange River Colony to the supreme court of the Transvaal, and from that court (whether acting for its own colony or on appeal from the Orange Colony), an appeal to the king in council. In other colonies the provisions as to appeal follow more or less closely the lines of English law and procedure as to appeals, and in all cases the ultimate appeal is to the king in council.

United States.—In the American courts the term "appeal" covers (1) a removal of a cause to a higher court for retrial on all the questions of law or fact involved, or (2) taking up points of law only by proceedings in error, for revision by a higher court. Decrees in admiralty, bankruptcy and equity, in the federal courts, are

the subjects of an appeal; judgments in actions at law, of a writ of error. On an equity appeal the evidence taken at the original hearing is reported at length to the appellate court, and it has the right to review the conclusions of fact reached by the court below and come to different ones. This, however, is seldom done, the appeal being almost always decided on points of law based upon the conclusions of fact reached in the original hearing. In admiralty appeals the conclusions of fact reached by the trial court are specially set forth, and are final.

"Appeal" in many of the states is the general term for reviewing any judgment of an inferior court on assignments of error. It is also often used to signify a mode of reviewing proceedings of municipal bodies, affecting the interests of particular persons, *e.g.* in matters of licences or assessments.

In criminal prosecutions an appeal, or writ of error on points of law, is almost everywhere allowed by statute to the defendant, and often to the state. (*United States* v. *Sanges*, 144 United States Reports, 310; *State* v. *Lee*, 65 Connecticut Reports, 265.)

By the constitution of the United States the Supreme Court is vested with "appellate jurisdiction, both as to law and fact, with such exceptions, and under such regulations, as the Congress shall make." This provision is held not to create but only to authorize the creation of the jurisdiction. In the words of Chancellor Kent, "If congress had not provided any rule to regulate the proceedings in appeal, the court could not exercise an appellate jurisdiction: and, if a rule be provided, the court could not depart from it." In pursuance of this principle, the Supreme Court decided in *Clarke* v. *Bazadone* that a writ of error did not lie to that court from a court of the United States territory north-west of the Ohio, because the act had not authorized an appeal or writ of error from such a court (*Commentaries*, i. 324). The appellate jurisdiction of the court is now regulated by title 13 chap. ii. of the Revised Statutes of the United States (1873), §§ 690-710; and by the acts enumerated at p. 901 of the Revised Statutes, United States, 1873 to 1891. Under these statutes the Supreme Court may entertain appeals from the highest court of a state of the Union, but only (1) where the state court has decided against the validity of a treaty or statute of the United States, or of an authority exercised under the United States; (2) where a state court has affirmed the validity of a statute, or of an authority exercised which has been challenged on the ground of repugnance to the constitution, laws or treaties of the United States; (3) where the state court has decided against the existence of a title, right, privilege, or immunity claimed or set up under the constitution of, or under any statute, treaty, commission or authority of the United States.

The appeal from state courts is by writ of error, *i.e.* on law only; and applies as well in criminal as in civil cases. The Supreme Court will not act unless the federal question was raised in the court below (*Chicago U.S. Mail Co.* v. *McGuire*, 1904, 196, U.S. 128). The circuit court of appeals, established in 1891, deals with appeals from the district and circuit courts of the United States, except where other provision is made, *e.g.* where the jurisdiction of the court appealed from is in question; in prize causes and convictions of capital crimes (U.S. Statutes, 1801, c. 54. § 5); in cases involving the construction or application of the constitution; in cases arising in district or circuit courts involving the constitutional questions already stated as subject of appeal from state courts.

The review by the circuit court of appeals is effected by appeal or by writ of error, and its decision is final, with certain exceptions but with power to certify cases to the Supreme Court for instructions (1891, c. 511, § 6).

The Supreme Court hears appeals from the circuit court of appeals within the limits above stated, and appeals from the circuit and district courts in cases in which an appeal does not lie to the circuit court of appeals, and has power to issue a *certiorari* to transfer a case from the circuit court of Appeals.

(W. F. C.)

APPEARANCE (from Lat. *apparere*, to appear), in law, the coming into court of either of the parties to a suit; the formal act by which a defendant submits himself to the jurisdiction of the court. The defendant in an action in the High Court of England enters his appearance to the writ of summons by delivering, either at the central office of the Supreme Court, or a district registry, a written memorandum either giving his solicitor's name or stating that he defends in person. He must also give notice to the plaintiff of his appearance, which ought, according to the time limited by the writ, to be within eight days after service; a defendant may, however, appear any time before judgment. The *Rules of the Supreme Court*, orders xii. and xiii., regulate the procedure with respect to the entering of an appearance, the giving of notice, the limit of time, the setting aside and the general effect of default of appearance. In county courts there is no appearance other than the coming into court of the parties to the suit. In criminal cases the accused appears in person. In civil cases infants appear by their guardians *ad litem*; lunatics by their committee; companies by a solicitor; friendly societies by the trustee or other officer appointed to sue or be sued on behalf thereof.

APPENDICITIS, the modern medical term for inflammation of that part of the intestine which is known as the "appendix." Though not a new disease, there can be no doubt that it is far commoner than it used to be, though the explanation of this increased frequency is not yet forthcoming. Amongst the virulent micro-organisms associated with the disease no one specific germ has hitherto been found. It may be remarked that the theories that influenza, or the use of preserved foods, may be connected with the disease as cause and

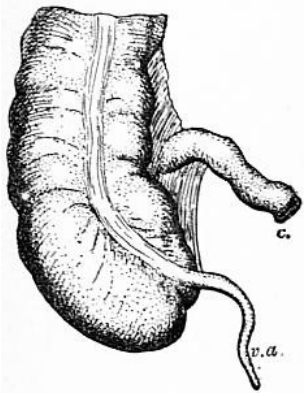
effect, have supporters. Sometimes the disease is due to the impaction of a pin, shot-corn, tooth-brush bristle, or fish-bone in the appendix, which has set up inflammation and ulceration. In many cases a patch of mortification with perforation of the appendix is caused by the presence of a hard faecal concretion, or "stercolith," which from its size, shape and appearance has been mistaken by a casual observer for a date-stone or cherry-stone.

Apart from the fact of the more frequent occurrence of appendicitis, the disease is now better understood and more promptly recognized. It was formerly included under the term "perityphlitis"—that is, inflammation connected with the caecum or *blind* portion of the large intestine. But in the vast majority of cases the inflammation begins in the appendix, not in the intestine proper. It is apt to extend and set up a localized peritonitis, which in the worst cases may become general.

Appendicitis is more often met with in the young than the old, and in boys rather than girls; and in some families there is a strange predisposition towards it. It is often started by a chill, or by over-exertion, and sometimes the attack follows a blow or strain, or some other direct injury, after which the virulent micro-organisms seize on the mucous membrane and involve the appendix in acute inflammation.

The appendix is a narrow tube, about the size of a goose-quill, with an average length of 3 in. It terminates in a blunt point, and from its worm-like shape is called *vermiformis*. It is an appendage of the large intestine, into which it opens, and is regarded as the degenerate relic, surviving in man and other mammals, of an earlier form of intestine. Foreign bodies passing down the intestinal canal may find their way into the appendix and lodge there. Frequently the diseased appendix is found blocked by hard faeces or undigested particles of food, such as nuts, fibrous vegetable matter, and other imperfectly masticated substances; inflammation may occur, however, without the presence of any impacted material. The appendix may be twisted, bent, or otherwise strangulated, or its orifice may be blocked, so that the tube is distended with mucus which can find no outlet; or ulceration of tuberculous or malignant origin may occur. Inflammation started in the appendix is liable to spread to the peritoneum, and herein lies the gravity of the affection and the indication for treatment. The symptoms vary from "indigestion," and slight pain and sickness, which pass off in a few short days, to an exceedingly violent illness, which may cause death in a few hours. Pain is usually first felt in the belly, low down on the right side or across the region of the navel; sometimes, however, it is diffuse, and at other times it is scarcely complained of. There is some fever, the temperature rising to 101° or 102° F., with nausea, and very likely with vomiting. The abdomen is tender to pressure, and the tenderness may be referred to the spot mentioned above. Some swelling may also be made out in that region. The attack may last for two, three or four days, and then subside. There are, however, other cases less well defined, in which the mischief pursues a latent course, producing little more than a vague abdominal uneasiness, until it suddenly advances into a violent stage. In some chronic cases the trouble continues, on and off, for months or even for years.

On paper it is easy to arrange cases of appendicitis into three classes—catarrhal, ulcerative and mortifying—but in actual practice this is neither desirable nor possible. Such classification is based upon the symptoms, and in appendicitis symptoms may be actually misleading. The three conditions to which the surgeon chiefly looks for guidance are the aspect of the patient, the rate of his pulse and the degree of fever as shown by the thermometer. But in certain cases of appendicitis, though the surgeon knows intuitively, or, at least, suspects, that the general condition is extremely serious, the patient looks fairly well and says that he is not in pain, his pulse-rate being but little quickened and his temperature being but slightly above normal. Nevertheless, when the surgeon has opened the belly in the appendix region, he finds the appendix swollen, perforated and mortified, and lying in a stinking abscess, whilst inflammation has already spread to the neighbouring coils of intestine. Unfortunately, the surgeon can no more tell what he is going to find at his operation in some of these cases than he can foretell the course which any particular case is going to run.



Large Intestine showing Vermiform Appendix (*v.a.*) and Caecum (*c*).

We may most usefully give here the symptoms as they are likely to be found in an ordinary case of appendicitis, and as they may be observed by one who is not a member of the medical profession, in a way that may prove helpful to him when circumstances have awakened his interest in the disease.

The case taken shall be that of a boy at school, for, as already stated, boys are more prone to the disease than girls. The boy has had, may be, occasional attacks of "indigestion" which have duly passed away under the influence of aperient medicines, and, being heated at play, he has sat down upon the cold ground. Or he has got wet through or over-tired during a long walk or ride. At any rate, his vital powers have been suddenly lowered, and the micro-organisms teeming in his bowel have seized upon the lining membrane of the appendix. He feels out of sorts, and if he manages to eat a meal he very likely vomits it soon after, for the whole nervous system of his abdomen is disturbed by the local inflammation. The act of vomiting gives slight relief, however, and probably he begins to complain of pains in his head as well as in his abdomen, and possibly he has an attack of shivering—the result of disturbance of his general nervous system. By this time he may be attacked with intense pain in the part of his abdomen a little above the middle of the right groin, and at that spot there may be a tenderness, and a feeling of resistance may be made out by the gentle pressure of the finger. In order to relax the pressure upon the tender area he probably lies with his right thigh slightly bent. By this time he may look ill, his face being slightly flushed, or pale and anxious. If the clinical thermometer is placed under his tongue, the index may rise a degree or two, perhaps several degrees, above normal, and his pulse may be quickened to 90 or 100 beats a minute. Perhaps it is a good deal quicker than this. Later, the skin of the lower part of the right side of the abdomen may be flushed or reddened.

This clinical picture leaves no room for doubt. The boy has an attack of acute septic inflammation of his appendix. Let it be that the symptoms have come on quickly, and that the affection is not more than ten or

twelve hours old; no one can tell precisely what course the disease is going to run. It may be that with rest in bed, constant fomentations, and absolute starvation, the inflammation will subside; but it is just as likely that in spite of this judicious treatment the symptoms will go from bad to worse, and that a belated operation will fail to rescue the boy from a general peritonitis which may end fatally. But at present, so far as one can tell, the disease is still limited to the appendix. And what, at this moment, is the best line of treatment? Some practitioners would answer—"Let the acute attack settle down, and then, after a week or ten days, when everything is quiet, remove the appendix, for statistics show that when the operation is done in the quiet interval the results are extremely favourable, whilst if it is done in the acute stage the outlook is not so bright." This is quite right. But one cannot be sure that the "quiet interval" will ever arrive. The case in question may be one of those which rapidly go on from bad to worse, and mortification and perforation of the appendix having taken place over some hard faecal concretion, general peritonitis is inevitable, with distension of the bowel and hopeless blood-poisoning. If it were certain that the attack of appendicitis would subside and become quiescent, it would be wise to wait. But it too often happens that the first attack is, indeed, the last. Acute appendicitis is one thing; relapsing appendicitis is another. The latter condition is very manageable.

Inasmuch, then, as it is impossible to know what direction the disease will take, whether to quiescence or to disaster, it is for the greatest good in the greatest number of cases that the inflamed appendix be removed by operation whilst the disease is still limited to the appendix. It is highly probable that if every available hospital surgeon were asked if he had ever had cause to regret having advised early operation in a case of appendicitis the answer would be "No"; on the other hand, every surgeon would be able to recall cases in which delay had been followed by disaster—which an early resort to operation would, in all probability, have prevented.

If the disease is going to assume the severe form, all the symptoms, as a rule, increase in severity. The facial expression becomes more anxious, and the accumulation of gas in the paralysed intestine causes an increase in the abdominal distension, so that the patient lies with his knees drawn up. The vomiting continues. The pulse quickens to 120 or 140 a minute, and the temperature rises, perhaps to 104° F. The swelling and tenderness increase on the right side of the abdomen, and if the abscess does not find escape externally it probably bursts into the general peritoneal cavity, and the patient becomes bathed in profuse sweat, the result of blood-poisoning. Death is likely to follow within two days, the result of blood-poisoning and exhaustion.

Catarrhal and Relapsing Appendicitis.—Some cases of appendicitis run a mild course, giving rise to no worse symptoms, perhaps, than those of "indigestion" and nausea, with a feeling of general discomfort in the abdomen, and, probably, some local tenderness. The attack may be preceded or accompanied by constipation. The administration of a mild aperient or an enema, rest, starvation and fomentation will probably put matters right again—at any rate for a time.

This form of the disease may be due to the presence of "bolted," unchewed or indigestible food in that part of the large intestine into which the appendix opens. And these mild recurrent attacks may sometimes be got rid of altogether by having the teeth put in order, and by inducing the individual to choose his food with discretion, to chew it carefully, to take his meals regularly and to eat slowly.

Obviously, these attacks are very different from those of the acute septic form of the disease described above, though there is no telling that one of them may not develop into the acute form. Some of the mild attacks are due to a kink in the appendix, or to some other condition which temporarily prevents the secretions of the appendix from finding their way into the large intestine. Others of them are caused by a passing catarrhal inflammation of the lining of the appendix and have a distant resemblance to a recurring "sore throat."

After undergoing one or two of these mild attacks the patient would be well advised to have his appendix removed when it has once more got into the "quiet stage." Experience abundantly shows that the operation can then be performed with but slight disturbance of the patient, and with the smallest possible amount of risk. And until his vulnerable appendix has been removed he is never safe.

In the *chronic* form of the disease though the patient is never desperately ill he is never quite well. He has pains and discomfort in the abdomen, with slight tenderness and nausea, with "indigestion," as he may call it. And as one can never tell when the smouldering inflammation may break out into conflagration, he is well advised to submit himself to operation without further delay. To carry about a diseased appendix is to run the constant risk of being laid up at a time most inconvenient, as when travelling or when staying in some place where skilled assistance is far distant or absolutely unobtainable. But having made up his mind that the appendix had better be removed, the patient can choose time, place and surgeon, and, having undergone a week's careful training for the ordeal, can safely count on being back at work again in a month or six weeks' time.

As regards *treatment*, the greatest safety consists in the prompt removal of the inflamed appendix, and statistics show that if the operation can be done in the first or second day of even an acute attack, the result is generally favourable—that is to say, if the appendix can be removed whilst the disease is still shut up within its tissues. But in some cases ulceration and perforation, or mortification, may have taken place over a hard faecal concretion within the first twenty-four or forty-eight hours, and, the septic germs having been let loose, peritonitis may have already set in, and operation may be followed by disappointment. Still, if the case had been left unoperated on, no other result could have been expected. It was not to the operation, but to the intensely acute disease that the calamity must be attributed.

Nature is marvellously clever in some of these cases in shutting off the area of the disease by glueing together the neighbouring coils of intestine, the limited local peritonitis causing the tissues to build themselves into a wall which securely shuts in the abscess cavity. But in other cases she seems helpless, no barrier being formed for limiting the area of disturbance. In such a case it is inevitable that disappointment must result from the surgeon delaying operation in the hope that delimitation might take place. And when at

last he makes his incision he sees that the disease has had so long a start that his own chance of success is but a poor one. In a less severe attack, under the influence of rest, starvation and fomentation, and in cases of chronic and of relapsing disease, the surgeon may watch and wait and choose his own time for operating. But when the symptoms are steadily increasing in severity he should urge an immediate incision. When, as often happens, the inflammation begins suddenly and severely, and, under the influence of treatment, steadily quiets down, the surgeon does well to delay operation. But in a fortnight or so, when everything has become once more quiet, he will urge the removal of the appendix, for this one attack is more than likely to be the forerunner of other attacks if the diseased appendix is left.

The most serious cases are those in which the aspect, the pulse, and the temperature of the patient fail to give warning of a very advanced state of disease. Every surgeon of experience has met with cases in which, though there is nothing pointing to the fact that the patient is on the brink of a disaster, the operation has shown that the appendix is mortified, and that it is surrounded with abundant foul matter. It is then that he regrets not having operated a day or two earlier. Consequently it is a good rule to operate in all doubtful cases. In cases in which one happens to know that previous attacks have passed off under palliative treatment, there is no need for immediate operation; the quiet interval may be safely waited for. But in cases in which there is “no history,” and in which the surgeon has nothing to guide him, the greatest safety is in prompt operation.

If an attack of acute appendicitis is allowed to take its course unoperated on, abscess forms in the peritoneal cavity in the region of the appendix, but if already inflammation has happily glued the intestines together around that area, the pus is confined within definite limits. But as the abscess increases in size the demand for its evacuation becomes urgent. The pus, under the influence of a natural law, seeks its escape by the path of least resistance; sometimes this is into the intestine, and occasionally into the bladder. The most satisfactory course which it can take is through the wall of the abdomen and out above the right groin. As it is making its way in this direction the skin over that part becomes red, swollen, hot and tender, and the tissues between it and the skin become swollen and brawny. Rarely is *fluctuation* to be made out until the pus has worked its way close to the surface. Later, ulceration takes place in the undermined skin, and the stinking contents of the abscess escape, greatly to the relief of the patient. But long before this could happen the surgeon should have made an incision through the inflamed tissues in order to give nature some greatly needed help. For in many cases she allows the pus blindly to discover that the course of least resistance is not towards the surface of the abdomen but through the inflammatory barrier formed by the adherent coils of bowel, and so into the general peritoneal cavity. This unfortunate issue may give temporary relief to the patient, so that he says that he feels much better, and that his pain has nearly gone. But though his temperature may fall, his pulse is apt to quicken—an ominous coupling of symptoms; the paralysed bowels become further distended, so that the lungs are pressed upon and breathing is embarrassed; hiccough comes on; and whether operation is now resorted to or not, a fatal end is highly probable. In other cases, the escaping pus finds its way up towards the liver and forms an abscess below the base of the lungs.

If operation is performed when appendicitis has run on to the formation of abscess, and the diseased appendix presents itself, it should of course be removed; but if it does not present itself the surgeon should abstain from making a determined search for it, as in so doing he may break down the barrier which nature has provided, and thus himself become the means of spreading a septic peritonitis. Nor should he attempt to make clean the foul abscess cavity. All that he should do is to provide for efficient drainage. A large proportion of these cases do extremely well with incision and drainage, and in the subsequent healing of the cavity the wreckage of the appendix either undergoes disintegration or is rendered harmless for further anxiety.

In some cases, however, the damaged appendix remains as a smouldering ember, ready at any moment to cause further conflagration. This is made manifest by lingering pains, and by tenderness and warnings after the abscess has healed, and the patient will be well advised to have what is left of the appendix removed by operation at a time of quiescence. The operation, however, may turn out to be a very difficult one. Sometimes the wound by which the abscess has been evacuated, by nature or by art, refuses to heal completely, a little discharge of a faecal odour continuing to escape. The small wound leads into a faecal fistula, and a bent probe passed along it would probably find its way into the bowel. The wound is likely to close of itself in due course; but if after many weeks of disappointment it still continues to discharge, the surgeon may advise an operation for its obliteration.

It occasionally happens that after operation the scar of the wound in the abdominal wall yields under the pressure from within, and a bulging of the intestines beneath the skin occurs. This is called a *ventral hernia*, and if the patient cannot be made comfortable by wearing a truss with a large flat pad, an operation may be deemed advisable.

If, in a case of appendicitis, for one reason or another operation is to be delayed, what treatment should be resorted to? The patient should be put to bed with his knees resting over a pillow, and a large fomentation under oil silk should be laid over the lower part of the abdomen. No food should be given beyond an occasional sip of hot water. Purgatives should not be administered, as this would be to set in movement an inflamed piece of bowel. If the case is not acute, a large enema of soap and water with turpentine may be given, or, possibly, a dose of castor oil by the mouth. As a rule, however, it is unwise to set the bowels in vigorous action until the diseased appendix has been removed. No opium should be given.

Acute intestinal obstruction, cancer of the intestine, inflammation of the ovary, typhoid fever and renal and gallstone colic, are affections which are apt to be mistaken for appendicitis. The first of these resembles it most closely, and diagnosis is sometimes impossible without resort to operation. And it is a fortunate thing that, when error of diagnosis has been made, the operation which was designed for dealing with an inflamed appendix may be directed with equal advantage to the morbid condition which is found on opening the abdomen. In typhoid fever the characteristic temperature, the general condition of the patient, and the presence of delirium are differentiating signs of importance; in renal and gallstone colic the situation and the more paroxysmal character of the pain are usually distinctive.

(E. O.*)

APPENDICULATA, a zoological name introduced by E. Ray Lankester (preface to the English edition of C. Gegenbaur's *Comparative Anatomy*), and employed by the same writer in the 9th edition of this encyclopaedia (article "Zoology") to denote the eighth phylum, or major division, of coelomate animals. The animals thus associated, the Rotifera, Chaetopoda and Arthropoda, are composed of a larger or smaller number of hollow rings, each ring possessing typically a pair of hollow lateral appendages, moved by intrinsic muscles and penetrated by blood-spaces.

APPENDINI, FRANCESCO MARIA (1768-1837), Italian historian and philologist, was born at Poirino, near Turin, on the 4th of November 1768. Educated at Rome, he took orders and was sent to Ragusa, where he was appointed professor of rhetoric. When the French seized Ragusa, Napoleon placed Appendini at the head of the Ragusan academy. After the Austrian occupation he was appointed principal of a college at Zara, where he died in 1837. Appendini's chief work was his *Notizie Istorico-critiche sulle Antichità, Storia, e Letteratura dei Ragusci* (1802-1803).

APPENZELL, one of the cantons of north-east Switzerland, entirely surrounded by the canton of St Gall; both were formed out of the dominions of the prince abbots of St Gall, whence the name Appenzell (*abbatis cello*). It is an alpine region, particularly in its south portion, where rises the Alpstein limestone range (culminating in the Säntis, 8216 ft.), though towards the north the surface is composed rather of green hills, separating green hollows in which nestle neat villages and small towns. It is mainly watered by two streams that descend from the Säntis, the Urnasch joining the Sitter (on which is the capital, Appenzell), which later flows into the Thur. There are light railways from Appenzell to St Gall either (12½ m.) past Gais or (20½ m.) past Herisau, as well as lines from St Gall to Trogen (6 m.) and from Rorschach to Heiden (4¼ m.). Since 1597 it has been divided, for religious reasons, into two half-cantons, which are quite independent of each other, and differ in many points.

The north and west portion or *Ausser Rhoden* has a total area of 93.6 sq. m. (of which 90.6 are classed as "productive"; forests covering 22·5 sq. m. and glaciers .038 sq. m.), with a population (in 1900) of 55,281, mainly German-speaking, and containing 49,797 Protestants as against 5418 Romanists. Its political capital is Trogen (*q.v.*), though the largest town is Herisau (*q.v.*), while Teufen has 4595 inhabitants, and Heiden (3745 inhabitants) in the north-east corner is the most frequented of the many goats' whey cure resorts for which the entire canton is famous (Urnäsch and Gais are also in Ausser Rhoden). This half-canton is divided into three administrative districts, comprising twenty communes, and is mainly industrial, the manufacture of cotton goods, muslins, and embroidery being very flourishing. It sends one member (elected by the *Landsgemeinde*) to the federal *Ständerath* and three to the federal *Nationalrath* (elected by a direct popular vote).

The south or more mountainous portion of Appenzell forms the half-canton of Appenzell, *Inner Rhoden*. It has a total area of 66.7 sq. m. (of which 62.8 sq. m. are classed as "productive," forests covering 12.8 sq. m. and glaciers .38 sq. m.), and a total population of 13,499, practically all German-speaking, and all but 833 Romanists. Its political capital is Appenzell (*q.v.*), which is also the largest village, while Weissbad (near it) and Gonten are the best-known goats' whey cure resorts. Embroidery and muslins are made in this half-canton, though wholly at home by the work-people. But it is very largely pastoral, containing 168 mountain pastures or "alps," maintaining each summer 4000 cows, and of an estimated capital value of 2,682,955 francs (the figures for Ausser Rhoden are respectively 100 alps, 2800 cows, and 1,749,900 francs). Inner Rhoden is extremely conservative, and has the reputation of always rejecting any federal *Referendum*. For similar reasons it has preserved many old customs and costumes, those of the women being very elaborate and picturesque, while the herdsmen have retained their festival attire of red waistcoats, embroidered braces and canary-coloured shorts. It sends one member (named by the *Landsgemeinde*) to the federal *Ständerath*, and one also to the federal *Nationalrath*, while it forms but a single administrative district, though divided into six communes.

To the outer world the canton of Appenzell is best known by its institution of *Landsgemeinden*, or primitive democratic assemblies held in the open air, in which every male citizen (not being disqualified) over twenty years of age must (under a money penalty) appear personally: each half-canton has such an assembly of its own, that of Inner Rhoden always meeting at Appenzell, and that of Ausser Rhoden in the odd years at Hundwil (near Herisau) and in the even years at Trogen. This institution is of immemorial antiquity, and the meetings in either case are always held on the last Sunday in April. The *Landsgemeinde* is the supreme legislative authority, and elects both the executive (in Inner Rhoden composed of nine members and called *Ständeskommission*, and in Ausser Rhoden of seven members and called *Regierungsrath*) and the president or *Landammann*; in each half-canton there is also a sort of standing committee (composed of the members of the executive and representatives from the communes—in Inner Rhoden one member per 250 or fraction over 125 of the population, and in Ausser Rhoden one member per 1000 of the inhabitants) which prepares business for the *Landsgemeinde* and decides minor matters; in Inner Rhoden it is named the *Grossrath* and in

Ausser Rhoden the *Kantonsrath*. As various old-fashioned ceremonies are observed at the meetings and the members each appear with his girded sword, the sight of a meeting of the *Landsgemeinde* is most striking and interesting. The existing constitution of Inner Rhoden dates mainly from 1872, and that of Ausser Rhoden from 1876.

By the middle of the 11th century the abbots of St Gall had established their power in the land later called Appenzell, which, too, became thoroughly teutonized, its early inhabitants having probably been romanized Raetians. But as early as 1377, this portion of the abbots' domains formed an alliance with the Swabian free imperial cities and adopted a constitution of its own. The repeated attempts of the abbots to put down this independence of their rule were defeated in the battles of Vögelinsegg (1403), north-west of Trogen, and of the Stoss (1405), the pass leading from Gais over to Altstätten in the Rhine valley. In 1411 Appenzell was placed under the "protection" of the Swiss Confederation, of which, in 1452, it became an "allied member," and in 1513 a full member. Religious differences broke up the land after the Reformation into two portions, each called *Rhoden*, a term that in the singular is said to mean a "clearing," and occurs in 1070, long before the final separation. From 1798 to 1803 Appenzell, with the other domains of the abbot of St Gall, was formed into the canton Säntis of the Helvetic Republic, but in 1803, on the creation of the new canton of St Gall, shrank back within its former boundaries. The oldest codes of the laws and customs of the land date from 1409 and 1585, the original MS. of the latter (called the "Silver Book" from its silver clasps) being still used in Inner Rhoden when, at the close of the annual *Landsgemeinde*, the newly elected *Landammann* first takes the oath of office, and the assembled members then take that of obedience to him, in either case with uplifted right hands.

See also *Appenzellische Jahrbücher* (3 series from 1854, Trogen); G. Baumberger, "*Juhu-Juuhu*"—*Appenzellerland und Appenzellerleut* (Einsiedeln, 1903); J.G. Ebel, *Schilderung d. Gebirgsvolker d. Schweiz*, vol. i. (Leipzig, 1798); W. Kobelt, *Die Alpwirthschaft im Kant. App. Inner Rhoden* (Soleure, 1899); I.B. Richman, *Appenzell* (London, 1895); H. Ryffel, *Die schweiz. Landsgemeinden* (Zürich, 1903); J.J. Tobler and A. Strüby, *Die Alpwirthschaft im Kant. App. Ausser Rhoden* (Soleure, 1900); J.C. Zellweger, *Geschichte d. app. Volkes* (to 1597), 6 vols in 11 parts (Trogen, 1830-1838); J.C. Zellweger, junior, *Der Kant. App.*. (Trogen, 1867); A. Tobler, *Das Volkslied im Appenzellerland* (Basel, 1906); J.J. Blumer, *Staats- und Rechtsgeschichte d. schweiz. Demokratien* (3 vols. St Gall, 1850-1859).

(W. A. B. C.)

APPENZELL, the political capital of the Inner Rhoden half of the Swiss canton of Appenzell. It is built in a smiling green hollow on the left bank of the Sitter stream, which is formed by the union of several mountain torrents descending from the Säntis. By light railways it is 12½ m. from St Gall past Gais or 20½ m. past Herisau. Its chief streets are paved, but it is rather a large village than a town, though in 1900 it had 4574 inhabitants, practically all German-speaking and Romanists. It has a stately modern parish church (attached to a Gothic choir), a small but very ancient chapel of the abbots of St Gall (whose summer residence was this village), and two Capuchin convents (one for men, founded in 1588, and one for women, founded in 1613). Among the archives, kept in the sacristy of the church, are several banners captured by the Appenzellers in former days, among them one taken in 1406 at Imst, near Lanedeck, with the inscription *Hundert Teufel*, though popularly this number is multiplied a thousandfold. In the principal square the *Landsgemeinde* (or cantonal democratic assembly) is held annually in the open air on the last Sunday in April. The inhabitants are largely employed in the production of embroidery, though also engaged in various pastoral occupations. About 2½ m. by road south-east of Appenzell is Weissbad, a well-known goat's whey cure establishment, while 1½ hours above it is the quaint little chapel of Wildkirchli, built (1648) in a rock cavern, on the way to the Säntis.

(W. A. B. C.)

APPERCEPTION (Lat. *ad* and *percipere*, perceive), in psychology, a term used to describe the presentation of an object on which attention is fixed, in relation to the sum of consciousness previous to the presentation and the mind as a whole. The word was first used by Leibnitz, practically in the sense of the modern Attention (*q.v.*), by which an object is apprehended as "not-self" and yet in relation to the self. In Kantian terminology apperception is (1) *transcendental*—the perception of an object as involving the consciousness of the pure self as subject, and (2) *empirical*,—the cognition of the self in its concrete existence. In (1) apperception is almost equivalent to self-consciousness; the existence of the ego may be more or less prominent, but it is always involved. According to J.F. Herbart (*q.v.*) apperception is that process by which an aggregate or "mass" of presentations becomes systematized (*apperceptions-system*) by the accretion of new elements, either sense-given or product of the inner workings of the mind. He thus emphasizes in apperception the connexion with the self as resulting from the sum of antecedent experience. Hence in education the teacher should fully acquaint himself with the mental development of the pupil, in order that he may make full use of what the pupil already knows.

Apperception is thus a general term for all mental processes in which a presentation is brought into connexion with an already existent and systematized mental conception, and thereby is classified, explained or, in a word, understood; *e.g.* a new scientific phenomenon is explained in the light of phenomena already analysed and classified. The whole intelligent life of man is, consciously or unconsciously, a process of apperception, inasmuch as every act of attention involves the appercipient process.

See Karl Lange, *Ueber Apperception* (6th ed. revised, Leipzig, 1899; trans. E.E. Brown, Boston, 1893); G.F. Stout, *Analytic Psychology* (London, 1896), bk. ii. ch. viii., and in general text-books of psychology; also PSYCHOLOGY.

APPERLEY, CHARLES JAMES (1777-1843), English sportsman and sporting writer, better known as "Nimrod," the pseudonym under which he published his works on the chase and the turf, was born at Plasgronow, near Wrexham, in Denbighshire, in 1777. Between the years 1805 and 1820 he devoted himself to fox-hunting. About 1821 he began to contribute to the *Sporting Magazine*, under the pseudonym of "Nimrod," a series of racy articles, which helped to double the circulation of the magazine in a year or two. The proprietor, Mr Pittman, kept for "Nimrod" a stud of hunters, and defrayed all expenses of his tours, besides giving him a handsome salary. The death of Mr Pittman, however, led to a law-suit with the proprietors of the magazine for money advanced, and Apperley, to avoid imprisonment, had to take up his residence near Calais (1830), where he supported himself by his writings. He died in London on the 19th of May 1843. The most important of his works are: *Remarks on the Condition of Hunters, the Choice of Horses*, &c. (1831); *The Chase, the Turf, and the Road* (originally written for the *Quarterly Review*), (1837); *Memoirs of the Life of the Late John Mytton* (1837); *Nimrod's Northern Tour* (1838); *Nimrod Abroad* (1842); *The Horse and the Hound* (a reprint from the seventh edition of the *Encyclopaedia Britannica*) (1842); *Hunting Reminiscences* (1843).

APPERT, BENJAMIN NICOLAS MARIE (1797-1847), French philanthropist, was born in Paris on the 10th of September 1797. While a young man he introduced a system of mutual instruction into the regimental schools of the department of the Nord. The success which it obtained induced him to publish a *Manual* setting forth his system. While engaged in teaching prisoners at Montaigu, he fell under the suspicion of having connived at the escape of two of them, and was thrown into the prison of La Force. On his release he resolved to devote the rest of his life to bettering the condition of those whose lot he had for a time shared, and he travelled much over Europe for the purpose of studying the various systems of prison discipline, and wrote several books on the subject. After the revolution of 1830 he became secretary to Queen Marie Amélie, and organized the measures taken for the relief of the needy. He was decorated with the Legion of Honour in 1833.

His brother, FRANÇOIS APPERT (d. 1840), was the inventor of the method of preserving food by enclosing it in hermetically sealed tins; he left a work entitled *Art de conserver les substances animales et végétables*.

APPIAN (Gr. Ἀππιανός), of Alexandria, Roman historian, flourished during the reigns of Trajan, Hadrian and Antoninus Pius. He tells us that, after having filled the chief offices in his native place, he repaired to Rome, where he practised as an advocate. When advanced in years, he obtained, by the good offices of his friend Fronto, the dignity of imperial procurator— it is supposed in Egypt. His work (Ῥωμαικά) in twenty-four books, written in Greek, is rather a number of monographs than a connected history. It gives an account of various peoples and countries from the earliest times down to their incorporation into the Roman empire. Besides a preface, there are extant eleven complete books and considerable fragments. In spite of its unattractive style, the work is very valuable, especially for the period of the civil wars.

Editio princeps, 1551; Schweighäuser, 1785; Bekker, 1852; Mendelssohn, 1878-1905. English translations: by W. B., 1578 (black letter); J. D[avies], 1679; H. White, 1899 (Bohn's Classical Library); bk. i. ed. by J.L. Strachan-Davidson, 1902.

APPIANI, ANDREA (1754-1817), the best fresco painter of his age, was born at Milan. He was made pensioned artist to the kingdom of Italy by Napoleon, but lost his allowance after the events of 1814 and fell into poverty. Correggio was his model, and his best pieces, which are in the church of Santa Maria presso San Celso and the royal palace at Milan, almost rival those of his great master. He also painted Napoleon and the chief personages of his court. Among the most graceful of his oil-paintings are his "Venus and Love," and "Rinaldo in the Garden of Armida." He is known as "the elder," to distinguish him from his great-nephew Andrea Appiani (1817-1865), an historical painter at Rome. Other painters of the same name were Niccolo Appiani (fl. 1510) and Francesco Appiani (1704-1792).

APPIA, VIA, a high-road leading from Rome to Campania and lower Italy, constructed in 312 B.C. by the censor Appius Claudius Caecus. It originally ran only as far as Capua, but was successively prolonged to Beneventum, Venusia, Tarentum and Brundusium, though at what dates is unknown. Probably it was extended as far as Beneventum not long after the colonization of this town in 268 B.C., and it seems to have reached Venusia before 190 B.C. Horace, in the journey to Brundusium described in *Sat.* i. 5, followed the Via Appia as far as Beneventum, but not beyond.

The original road was no doubt only gravelled (*glarea strata*); in 298 B.C. a footpath was laid *saxo quadrato* from the Porta Capena, by which it left Rome, to the temple of Mars, about 1 m. from the gate. Three years later, however, the whole road was paved with *silex* from the temple to Bovillae, and in 191 B.C. the first mile from the gate to the temple was similarly treated. The distance from Rome to Capua was 132 m. For the first few miles the road is flanked by an uninterrupted series of tombs and other buildings (see L. Canina, *Via Appia*, Rome, 1853). As far as Terracina it ran in an almost entirely straight line, even through the Alban Hills, where the gradients are steep. A remarkably fine embankment belonging to it still exists at Aricia. At Forum Appii it entered the Pomptine Marshes; that this portion (19 m. long, hence called Decennovium) belonged to the original road was proved by the discovery at Ad Medias (Mesa) of a milestone of about 250 B.C. (Ch. Hülsen, in *Römische Mitteilungen*, 1889, 83; 1895, 301). A still older road ran along the foot of the Volscian mountains past Cora, Norba and Setia; this served as the post road until the end of the 18th century. At the time of Strabo and Horace, however, it was the practice to travel by canal from Forum Appii to Lucus Feroniae; to Nerva and Trajan were due the paving of the road and the repair of the bridges along this section. Theodoric in A.D. 486 ordered the execution of similar repairs, the success of which is recorded in inscriptions, but in the middle ages it was abandoned and impassable, and was only renewed by Pius VI. The older road crossed the back of the promontory at the foot of which Terracina stands; in imperial times, probably, the rock was cut away perpendicularly for a height of 120 ft. to allow the road to pass. Beyond Fundi it passed through the mountains to Formiae, the engineering of the road being noteworthy; and thence by Minturnae and Sinuessa (towns of the Aurunci which had been conquered in 314 B.C.)[1] to Capua. The remains of the road in this first portion are particularly striking.

Between Capua and Beneventum, a distance of 32 m., the road passed near the defile of Caudium (see Caudine Forks). The modern highroad follows the ancient line, and remains of the latter, with the exception of three well-preserved bridges, which still serve for the modern highroad, are conspicuous by their absence. The portion of the road from Rome to Beneventum is described by Sir R. Colt Hoare, *Classical Tour through Italy*, 57 seq. (London, 1819). He was accompanied on his journey, made in 1789, by the artist Carlo Labruzzi, who executed a series of 226 drawings, the greater part of which have not been published; they are described by T. Ashby in *Mélanges de l'École Française de Rome* (1903), p. 375 seq., and *Atti del Congresso Internazionale per le Scienze Storiche*, vol. v. (Rome, 1904), p. 125 seq.

From Beneventum to Brundusium by the Via Appia, through Venusia and Tarentum, was 202 m. A shorter route, but more fitted for mule traffic, though Horace drove along part of it,[2] ran by Aequum Tuticum, Aecae, Herdoniae, Canusium, Barium, and Gnatia (Strabo vi. 282); it was made into a main road by Trajan, and took the name Via Traiana. The original road, too, adopted in imperial times a more devious but easier route by Aeclanum instead of by Trevicum. This was restored by Hadrian for the 15 m. between Beneventum and Aeclanum. Under Diocletian and Maximian a road (the Via Herculia) was constructed from Aequum Tuticum to Pons Aufidi near Venusia, where it crossed the Via Appia and went on into Lucania, passing through Potentia and Grumentum, and joining the Via Popilia near Nerulum. Though it must have lost much of its importance through the construction of the Via Traiana, the last portion from Tarentum to Brundusium was restored by Constantine about A.D. 315.

> The Via Appia was the most famous of Roman roads; Statius, *Silvae*, ii. 2. 12, calls it *longarum regina viarum*. It was administered under the empire by a curator of praetorian rank, as were the other important roads of Italy. A large number of milestones and other inscriptions relating to its repair at various times are known. See Ch. Hülsen in Pauly-Wissowa, *Realencyclopadie*, ii. 238 seq. (Stuttgart, 1896).
>
> (T. As.)

1 It is important to note how the Romans followed up every victory with a road.

2 From Beneventum he followed the older line of the Via Appia to Trevicum; thence, leaving the main road at Aquilonia, he went to Ausculum ("quod versu dicere non est"), the mod. Ascoli Satriano, by a by-road, for the milestones which have been found there, though they probably belong to the Via Traiana, cannot be in their original position, but must have been transplanted thither (Th. Mommsen in *Corp. Inscrip. Lat.*, ix. 1883, No. 6016)—and on to Herdoniae (why Mommsen says that he left Herdoniae on the left, *op. cit.* p. 592, is not clear), where he joined the line of the later Via Traiana.

APPIN, a coast district of Argyllshire, Scotland, bounded W. by Loch Linnhe, S. by Loch Creran, E. by the districts of Benderloch and Lorne, and N. by Loch Leven. It lies north-east to south-west, and measures 14 m. in length by 7 m. in breadth. The scenery of the coast is extremely beautiful, and inland the country is rugged and mountainous. The principal hills are the double peaks of Ben Vair (3362 ft. and 3284 ft.) and Creag Ghorm (2372 ft.) in the north, and Fraochie (2883 ft.), Meall Ban (2148 ft.) and Ben Mhic na Ceisich (2093 ft.) near the right flank of Glen Creran. The chief streams are the Coe and Laroch, flowing into Loch Leven, the Duror and Salachan flowing into Loch Linnhe, and the lola and Creran flowing into Loch Creran. The leading industries comprise slate and granite quarries and lead mining. Ballachulish, Duror, Portnacroish, Appin and Port Appin are the principal villages. Ballachulish and Port Appin are ports of call for steamers, and the Caledonian railway company's branch line from Connel Ferry to Ballachulish runs through the coast land and has stations at Creagan, Appin, Duror, Kentallen and Ballachulish Ferry. Appin was the country of a branch of

the Stewarts.

APPLAUSE (Lat. *applaudere*, to strike upon, clap), primarily the expression of approval by clapping of hands, &c.; generally any expression of approval. The custom of applauding is doubtless as old and as widespread as humanity, and the variety of its forms is limited only by the capacity for devising means of making a noise. Among civilized nations, however, it has at various times been subject to certain conventions. Thus the Romans had a set ritual of applause for public performances, expressing degrees of approval: snapping the finger and thumb, clapping with the flat or hollow palm, waving the flap of the toga, for which last the emperor Aurelian substituted a handkerchief (*orarium*), distributed to all Roman citizens (see Stole). In the theatre, at the close of the play, the chief actor called out "Valete et plaudite!", and the audience, guided by an unofficial choregus, chaunted their applause antiphonally. This was often organized and paid for (Böttiger, *Über das Applaudieren im Theater bei den Alten*, Leipz., 1822). When Christianity became fashionable the customs of the theatre were transferred to the churches. Eusebius (*Hist. Eccl.* vii. 30) says that Paul of Samosata encouraged the congregation to applaud his preaching by waving linen cloths (ὀθόναις), and in the 4th and 5th centuries applause of the rhetoric of popular preachers had become an established custom. Though, however, applause may provide a healthy stimulus, its abuse has led to attempts at abolishing or restricting it even in theatres. The institution of the *claque*, people hired by performers to applaud them, has largely discredited the custom, and indiscriminate applause has been felt as an intolerable interruption to serious performances. The reverential spirit which abolished applause in church has tended to spread to the theatre and the concert-room, largely under the influence of the quasi-religious atmosphere of the Wagner performances at Baireuth. In Germany (*e.g.* the court theatres at Berlin) applause during the performance and "calling before the curtain" have been officially forbidden, but even in Germany this is felt to be in advance of public opinion. (See also Acclamation and Cheering.)

APPLE (a common Teut. word, A.S. *aepl, aeppel*, O.H.G. *aphul, aphal, apfal*, mod. Ger. *Apfel*), the fruit of *Pyrus Malus*, belonging to the sub-order *Pomaceae*, of the natural order *Rosaceae*. It is one of the most widely cultivated and best-known and appreciated of fruits belonging to temperate climates. In its wild state it is known as the crab-apple, and is found generally distributed throughout Europe and western Asia, growing in as high a latitude as Trondhjem in Norway. The crabs of Siberia belong to different species of *Pyrus*. The apple-tree as cultivated is a moderate-sized tree with spreading branches, ovate, acutely serrated or crenated leaves, and flowers in corymbs. The fruit is too well known to need any description of its external characteristics. The apple is successfully cultivated in higher latitudes than any other fruit tree, growing up to 65° N., but notwithstanding this, its blossoms are more susceptible of injury from frost than the flowers of the peach or apricot. It comes into flower much later than these trees, and so avoids the night frost which would be fatal to its fruit-bearing. The apples which are grown in northern regions are, however, small, hard, and crabbed, the best fruit being produced in hot summer climates, such as Canada and the United States. Besides in Europe and America, the fruit is now cultivated at the Cape of Good Hope, in northern India and China, and in Australia and New Zealand.

Apples have been cultivated in Great Britain probably since the period of the Roman occupation, but the names of many varieties indicate a French or Dutch origin of much later date. In 1688 Ray enumerated seventy-eight varieties in cultivation in the neighbourhood of London, and now it is calculated that about 2000 kinds can be distinguished. According to the purposes for which they are suitable, they can be classed as— 1st, dessert; 2nd, culinary; and 3rd, cider apples. The principal dessert apples are the Pippins (*pepins*, seedlings), of which there are numerous varieties. As culinary apples, besides Rennets and other dessert kinds, Codlins and Biffins are cultivated. In England, Herefordshire and Devonshire are famous for the cultivation of apples, and in these counties the manufacture of cider (*q.v.*) is an important industry. Cider is also extensively prepared in Normandy and in Holland. Verjuice is the fermented juice of crab apples.

A large trade in the importation of apples is carried on in Britain, imports coming chiefly from French, Belgian and Dutch growers, and from the United States and British North America. Dried and pressed apples are imported from France for stewing, under the name of Normandy Pippins, and similarly prepared fruits come also from America.

The apple may be propagated by seeds to obtain stocks for grafting, and also for the production of new varieties. The established sorts are usually increased by grafting, the method called whip-grafting being preferred. The stocks should be at least as thick as the finger; and should be headed back to where the graft is to be fixed in January, unless the weather is frosty, but in any case before vegetation becomes active. The scions should be cut about the same time, and laid in firmly in a trench, in contact with the moist soil, until required.

The tree will thrive in any good well-drained soil, the best being a good mellow calcareous loam, while the less iron there is in the subsoil the better. The addition of marl to soils that are not naturally calcareous very much improves them. The trees are liable to canker in undrained soils or those of a hot sandy nature. Where the soil is not naturally rich enough, it should be well manured, but not to the extent of encouraging over-luxuriance. It is better to apply manure in the form of a compost than to use it in a fresh state or unmixed.

To form an orchard, standard trees should be planted at from 25 to 40 ft. between the rows, according to

the fertility of the soil and other considerations. The trees should be selected with clean, straight, self-supporting stems, and the head should be shapely and symmetrical, with the main branches well balanced. In order to obtain such a stem, all the leaves on the first shoot from the graft or bud should be encouraged to grow, and in the second season the terminal bud should be allowed to develop a further leading shoot, while the lateral shoots should be allowed to grow, but so that they do not compete with the leader, on which the growth of leaves should be encouraged in order that they may give additional strength to the stem below them. The side shoots should be removed gradually, so that the diminution of foliage in this direction may not exceed the increase made by the new branches and shoots of the upper portion. Dwarf pyramids, which occupy less space than open dwarfs, if not allowed to grow tall, may be planted at from 10 to 12 ft. apart. Dwarf bush trees may be planted from 10 to 15 ft. apart, according to the variety and the soil. Dwarf bushes on the Paradise stock are both ornamental and useful in small gardens, the trees being always conveniently under control. These bush trees, which must be on the proper stock—the French Paradise—may be planted at first 6 ft. apart, with the same distance between the rows, the space being afterwards increased, if desired, to 12 ft. apart, by removing every alternate row.

"Cordons" are trees trained to a single shoot, the laterals of which are kept spurred. They are usually trained horizontally, at about 1½ ft. from the ground, and may consist of one stem or of two, the stems in the latter case being trained in opposite directions. In cold districts the finer sorts of apples may be grown against walls as upright or oblique cordons. From these cordon trees very fine fruit may often be obtained. The apple may also be grown as an espalier tree, a form which does not require much lateral space. The ordinary trained trees for espaliers and walls should be planted 20 ft. apart.

The fruit of the apple is produced on spurs which form on the branchlets of two years old and upwards, and continue fertile for a series of years. The principal pruning should be performed in summer, the young shoots if crowded being thinned out, and the superabundant laterals shortened by breaking them half through. The general winter pruning of the trees may take place any time from the beginning of November to the beginning of March, in open weather. The trees are rather subject to the attacks of the American blight, the white cottony substance found on the bark and developed by an insect (*Eriosoma, mali*), somewhat similar to the green-fly of the garden, but not a true aphis. It may be removed by scrubbing with a hard brush, by painting the affected spots with any bland oil, or by washing them with dilute paraffin and soft soap.

The apple-blossom weevil (*Anthonomus pomorum*), a small reddish-brown beetle, often causes serious damage to the flowers. The female bores and lays an egg in the unopened bud, and the maggot feeds on the stamens and pistil. The weevil hibernates in the crannies of the bark or in the soil at the base of the trees, and bandages of tarred doth placed round the stem in spring will prevent the female from crawling up.

The codlin moth (*Carpocapsa pomonana*) lays its eggs in May in the calyx of the flowers. The young caterpillar, which is white with black head and neck, gnaws its way through the fruit, and pierces the rind. When nearly full grown it attacks the core, and the fruit soon drops. The insect emerges and spins its cocoon in a crack of the bark.

To check this disease the apples which fall before ripening should be promptly removed. A loosely made hay-band twisted round the stem about a foot from the ground is of use. The grubs will generally choose the bands in which to make their cocoon; at the end of the season the bands are collected and burned.

The following are a few of the most approved varieties of the apple tree, arranged in order of their ripening, with the months in which they are in use:—

Dessert Apples.

White Juneating	July
Early Red Margaret	Aug.
Irish Peach	Aug.
Devonshire Quarrenden	Aug., Sept.
Duchess of Oldenburg	Aug., Sept.
Red Astrachan	Sept.
Kerry Pippin	Sept., Oct.
Peasgood's Nonesuch	Sept.-Nov.
Sam Young	Oct.-Dec.
King of the Pippins	Oct.-Jan.
Cox's Orange Pippin	Oct.-Feb.
Court of Wick	Oct.-Mar.
Blenheim Pippin	Nov.-Feb.
Sykehouse Russet	Nov.-Feb.
Fearn's Pippin	Nov.-Mar.
Mannington's Pearmain	Nov.-Mar.
Margil	Nov.-Mar.
Ribston Pippin	Nov.-Mar.
Golden Pippin	Nov.-Jan.
Reinette de Canada	Nov.-Apr.
Ashmead's Kernel	Nov.-Apr.
White Winter Calville (grown under glass)	Dec.-Mar.
Braddick's Nonpareil	Dec.-Apr.
Court-pendû Plat	Dec.-Apr.
Northern Spy	Dec.-May
Cornish Gilliflower	Dec.-May
Scarlet Nonpareil	Jan.-Mar.
Cockle's Pippin	Jan.-Apr.
Lamb Abbey Pearmain	Jan.-May
Old Nonpareil	Jan.-May

Duke of Devonshire	Feb.-May
Sturmer Pippin	Feb.-June

Kitchen Apples.

Keswick Codlin	Aug.-Sept.
Lord Suffield	Aug.-Sept.
Manks Codlin	Aug.-Oct.
Ecklinville Seedling	Aug.-Nov.
Stirling Castle	Aug.-Nov.
New Hawthornden	Sept.-Oct.
Stone’s Seedling	Sept.-Nov.
Emperor Alexander	Sept.-Dec.
Waltham Abbey Seedling	Sept.-Jan.
Cellini	Oct., Nov.
Gravenstein	Oct.-Dec.
Hawthornden	Oct.-Dec.
Baumann’s Red Winter Reinette	Nov.-Mar.
Mère de Ménage	Oct.-Mar.
Beauty of Kent	Oct.-Feb.
Yorkshire Greening	Oct.-Feb.
Gloria Mundi	Nov.-Jan.
Blenheim Pippin	Nov.-Feb.
Tower of Glammis	Nov.-Feb.
Warner’s King	Nov.-Mar.
Alfriston	Nov.-Apr.
Northern Greening	Nov.-Apr.
Reinette de Canada	Nov.-Apr.
Bess Pool	Nov.-May
Winter Queening	Nov.-May
Lane’s Prince Albert	Oct.-May
Norfolk Beaufin	Nov.-July

Apples for table use should have a sweet juicy pulp and rich aromatic flavour, while those suitable for cooking should possess the property of forming a uniform soft pulpy mass when boiled or baked. In their uncooked state they are not very digestible, but when cooked they form a very safe and useful food, exercising a gentle laxative influence.

According to Hutchison their composition is as follows:—

	Water.	Proteid.	Ether Extract.	Carbo-hydrate.	Ash.	Cellu-lose.	Acids.
Fresh	82.5	0.4	0.5	12.5	0.4	2.7	1.0
Dried	36.2	1.4	3.0	49.1	1.8	4.9	3.6

Many exotic fruits, having nothing in common with the apple; are known by that name, *e.g.* the Balsam apple, *Momordica Balsamina*; the custard apple (*q.v.*), *Anona reticulata*; the egg apple, *Solanum esculentum*; the rose apple, various species of *Eugenia*; the pineapple (*q.v.*), *Ananas sativus*; the star apple, *Chrysophyllum Cainito*; and the apples of Sodom, *Solanum sodomeum*.

(A. B. R.)

APPLEBY, a market town and municipal borough, and the county town of Westmorland, England, in the Appleby parliamentary division, 276 m. N.N.W. from London, on the Midland and a branch of the North Eastern railways. Pop. (1901) 1764. It is picturesquely placed in the valley of the Eden, which is richly wooded, and flanked on the north-east by spurs of Milburn Forest and Dufton and other fells, which rise up to 2600 ft. On a hill above the town stands the castle, retaining a fine Norman keep and surrounded by a double moat, now partly laid out as gardens. The remainder of the castle was rebuilt as a mansion in the 17th century. It was held for the royalists in the civil wars by Sir Philip Musgrave, and was the residence of Anne, countess of Pembroke, the last of the family of Clifford, which had great estates in this part of England. St Ann’s hospital for thirteen poor women (1654) was of her foundation. The grammar school (1453) was refounded by Queen Elizabeth. The modern incorporation dates from 1885, with a mayor, four aldermen and twelve councillors. Area, 1876 acres.

Appleby is not mentioned in any Saxon records, but after the Conquest it rose to importance as the head of the barony of Appleby which extended over the eastern portion of the present county of Westmorland. This barony formed part of the province of Carlisle granted by Henry I. to Ranulf Meschin, who erected the castle at Appleby and made it his place of residence. Appleby is a borough by prescription, and the old charter of incorporation, granted in the first year of James II., was very shortly abandoned. In 1292 we find the mayor and commonalty claiming the right to elect a coroner and to have tolls of markets and fairs. In 1685 the governing body comprised a mayor, aldermen, a town clerk, burgesses of the common council, a coroner and subordinate officers. An undated charter from Henry II. conceding to the burgesses the customs of York, Was confirmed in 1 John, 16 Henry III., 14 Edward I., and 5 Edward III. John granted the borough to the burgesses for a fee-farm rent. The impoverishment caused by the Scottish raids led to its seizure by Edward II. for

arrears of payment, but Edward III. restored it on the same terms as before. Henry VIII. reduced the fee-farm rent from 20 marks to 2 marks, after an inquisition which found that Appleby was burnt by the Scots in 1388 and that part of it still lay in ruins. The town, however, never seems to have regained its prosperity, and 16th and 17th century writers speak of it as a poor and insignificant village. Appleby returned two members to parliament from 1295 until disfranchised by the Reform Act of 1832. The market and the St Lawrence fair are held by prescription. James I. granted an additional fair on the second Thursday in April. In the early 18th century Appleby was celebrated for the best corn-market in the country.

See *Victoria County History, Westmorland*; W. Hewitson, *Appleby Charters* (Cumberl. and Westm. Antiq. and Archaeol. Soc., Transactions, xi. 279-285; Kendal, 1891).

APPLETON, NATHAN (1770-1861) American merchant and politician, was born in New Ipswich, New Hampshire, on the 6th of October 1779. He was educated in the New Ipswich Academy, and in 1794 entered mercantile life in Boston, in the employment of his brother, Samuel (1766-1853), a successful and benevolent man of business, with whom he was in partnership from 1800 to 1809. He co-operated with Francis C. Lowell and others in introducing the power-loom and the manufacture of cotton on a large scale into the United States, a factory being established at Waltham, Massachusetts, in 1814, and another in 1822 at Lowell, Massachusetts, of which city he was one of the founders. He was a member of the general court of Massachusetts in 1816, 1821, 1822, 1824 and 1827, and in 1831-1833 and 1842 of the national House of Representatives, in which he was prominent as an advocate of protective duties. He died in Boston on the 14th of July 1861.

His son, Thomas Gold Appleton (1812-1884), who graduated at Harvard in 1831, had some reputation as a writer, an artist and a patron of the fine arts, but was better known for his witticisms, one of which, the oft-quoted “Good Americans, when they die, go to Paris,” is sometimes attributed to Oliver Wendell Holmes. He published some poems and, in prose, *Nile Journal* (1876), *Syrian Sunshine* (1877), *Windfalls* (1878), and *Chequer-Work* (1879).

See the memoir of Nathan Appleton by Robert C. Winthrop (Boston, 1861); and Susan Hale’s *Life and Letters of Thomas Gold Appleton* (New York, 1885).

APPLETON, a city and the county-seat of Outagamie county, Wisconsin, U.S.A., on the lower Fox river, about 90 m. N. of Milwaukee. Pop. (1890) 11,869; (1900) 15,085, of whom 3605 were foreign-born; (1910, census) 16,773. It is served by the Chicago & North-Western, and the Chicago, Milwaukee & St Paul railways, and by steamboats on the Fox river, by means of which it meets lake transportation at De Pere and Green Bay. Appleton was one of the first cities in the United States to have an electric street railway line in operation; and electric street railways now traverse the entire Fox river valley as far as Fond du Lac on the south and Green Bay on the north. The city is attractively laid out on high bluffs above the river. It has several beautiful parks, two hospitals, a number of fine churches and school buildings, and a public library. The city is the seat of Lawrence college (changed from university in 1908), an interdenominational (originally a Methodist Episcopal) co-educational institution, founded in 1847 as the Lawrence Institute of Wisconsin and named in honour of Amos Adams Lawrence (1814-1886) of Boston, son of Amos Lawrence, and giver of $10,000 for the founding of the Institute. The college comprises an academy, a college of liberal arts, a school of expression, a school of commerce, schools of music and of art, and a school of correspondence; and in 1907-1908 had 33 instructors, 575 students and a library of 24,400 volumes. The Fox river furnishes about 10,000 h.p., which is largely utilized for the manufacture of paper (of which Appleton is one of the largest producers in the United States), wood-pulp, sulphite fibre, machinery, wire screens, woollen goods, knit goods, furniture, dyes and flour. The total value of factory products in 1905 was $6,672,457, an increase of 72.8% over the product value of 1900. Appleton was first permanently settled in 1833, and was named in honour of Samuel Appleton of Massachusetts, who owned part of the original town plot. It was incorporated as a village in 1853, and received in 1857 a city charter, which was revised in 1887 and in 1905.

APPOGGIATURA (from Ital. *appoggiare*, to lean upon), a musical term for a melodic ornament, a grace-note prefixed to a principal note and printed in small character. The effect is to suspend the principal note, by taking away the time-value of the *appoggiatura* prefixed to it. There are two kinds, the long *appoggiatura*, now usually printed as played, and the short, where the suspension of the principal note is scarcely perceptible; this is often called *acciatura*, a word properly applied to an ornament now obsolete, in which a principal note in a melody is struck together with the note immediately below, the lower note being at once released and the other held on.

APPOINTMENT, POWER OF, in English law, an authority reserved by or limited to a person, to dispose, either wholly or partially, of real or personal property, either for his own benefit or for that of others. Thus if A settle property upon trustees to such uses as B shall by deed or will appoint and in default of and until such appointment to the use of C and his heirs, B, though he has no interest in the property, can at any time appoint the property to any one he pleases, including himself, and C's interest which has hitherto been vested in him will be divested. In the above case A is said to be the donor, B the donee, and the persons in whose favour the appointment is exercised are called the appointees. Such powers are either general or limited. A general power is one which the appointor may exercise in favour of any person he pleases. It is obvious that such a power is very nearly equivalent to ownership, and consequently property which is the subject of a general power has been made to share the liabilities of ownership. By the Judgments Act 1838 all hereditaments over which a judgment debtor has such a power may be seized by the sheriff under a writ of *elegit*, and by the Bankruptcy Act 1883 similar property will vest in the trustees of a bankrupt. By the Finance Act 1894 property of which the deceased had a general power of appointment is subject to the payment of estate duty, even though the power has not been exercised. A limited power is one which can only be exercised in favour of certain specified persons or classes; such a power is frequently inserted in marriage settlements in which after life estates to the husband and wife a power is given to appoint among the children of the marriage. In such a case no appointment to any one but children of the marriage is valid. Formerly it was held that the intention of the donor of such a power was that each of the class which are the objects of the power should take some part of the fund, and from this arose the equitable doctrine of illusory appointments, by which the courts of equity set aside an appointment which was good at law on the ground that a merely nominal share had been appointed to one of the objects. The great difficulty of deciding what was a nominal or illusory share caused the passing of the Illusory Appointments Act of 1830, whereby it was enacted that no appointment should be set aside merely on the ground that a share appointed was illusory. It was still necessary, however, that some share should be appointed to each object, and consequently it was possible in the popular phrase to be "cut off with a shilling," but now by the Powers Amendment Act 1874 the appointor is no longer obliged to appoint a share to each object of the power.

It is a general rule that every circumstance required by the instrument creating the power to accompany the execution of it must be strictly observed. Thus it might be required that the appointment should be by an instrument witnessed by four witnesses, or that the consent in writing of some third party should be signified. The general rule, however, has been modified both by statute and by the rules of equity. By the Wills Act 1837 a will made pursuant to the requirements of that statute shall be a valid execution of a power of appointment by will, notwithstanding that some additional form or solemnity shall have been required by the instrument creating the power, and by the Wills Act 1861 a will made out of the United Kingdom by a British subject according to the forms required by the law of the place where the will was made shall, as regards personal estate, be held to be well executed and admitted to probate; consequently it has been held that an appointment made by such a will is a valid exercise of the power. As regards appointments by deed the Law of Property Amendment Act 1859 enacts that a deed attested by two witnesses shall, so far as execution and attestation go, be a valid exercise of a power to appoint by deed. The courts of equity also will interfere in some cases of defective execution in order to carry out the intentions of the settlor. The principle upon which the court acts is obscure, but the rule has been thus stated:—"Whenever a man having power over an estate, whether ownership or not, in discharge of moral or natural relations, shows an intention to execute such power, the court will operate upon the conscience of the heir (or of the persons entitled in default) to make him perfect this intention." Equity, however, only relieves against defects not of the essence of the power, such as the absence of seal or execution by will instead of deed, but where the defect is of the essence of the power, as where a consent is not obtained, equity will not assist, nor will it relieve where a power to appoint by will is purported to be exercised by deed. A power of appointment if exercised must be exercised bona fide, otherwise it will be void as fraudulent; thus it has been frequently decided that where a father, having a limited power of appointment among his children, appoints the whole fund to an infant child, who is in no need of the appointment and who is ill, in the expectation of the death of the child whereby the fund will come to him as next of kin, such appointment is void as a fraud upon the power. Where an execution is partly fraudulent and partly valid the court will, if possible, separate the two and only revoke that which is fraudulent; if, however, the two parts are not separable the whole is void. The same rule is applied in cases of excessive execution where the power is exercised in favour of persons some of whom are and some of whom are not objects of the power. The doctrine of *Election* (*q.v.*) applies to appointments under powers, but there must be a gift of free and disposable property to the persons entitled in default of appointment.

The appointment must in law be read into the instrument creating the power in lieu of the power itself. Thus an appointor under a limited power cannot appoint to any person to whom the donor could not have appointed by reason of the rule against perpetuities, but this is not so in the case of a general power, for there the appointor is virtually owner of the property appointed. In applying this rule to appointments a distinction arises between powers created by deed and will, for a deed speaks from the date of its execution but a will from the death of the testator, and so limitations bad when the will was made may have become good when it comes into operation. Since the Conveyancing Act 1881 all powers may be released by the donees thereof, unless the power is coupled with a trust in respect of which there is a duty cast on the donee to exercise it; and this is so even though the donee gets a benefit by such release as one entitled in default of appointment, for this is not a fraud upon the power.

(E. S. M. B.)

APPOMATTOX COURT HOUSE, a village of Appomattox county, Virginia, U.S.A., 25 m. E. of Lynchburg, in the S. part of the state. It is served by the Norfolk & Western railway. The village was the scene of the surrender of the Confederate Army of Northern Virginia under General Robert E. Lee to the Federal forces

under Lieutenant-General U.S. Grant on Sunday the 9th of April 1865. The terms were: “the officers to give their individual paroles not to take up arms against the government of the United States until properly exchanged, and each company or regimental commander to sign a like parole for the men of their commands,” ... neither “side arms of the officers nor their private horses or baggage” to be surrendered; and, as many privates in the Confederate Army owned horses and mules, all horses and mules claimed by men in the Confederate Army to be left in their possession.

APPONYI, ALBERT, Count (1846-), Hungarian statesman, the most distinguished member of an ancient noble family, dating back to the 13th century, and son of the chancellor Gyorgy Apponyi (1808-1899) and the accomplished and saintly Countess Julia Sztáray, was born at Pesth on the 29th of May 1846. Educated at the Jesuit seminary at Kalksburg and at the universities of Vienna and Pesth, a long foreign tour completed his curriculum, and at Paris he made the acquaintance of Montalembert, a kindred spirit, whose influence on the young Apponyi was permanent. He entered parliament in 1872 as a liberal Catholic, attaching himself at first to the Deák party; but the feudal and ultramontane traditions of his family circle profoundly modified, though they could never destroy, his popular ideals. On the break up of the Deák party he attached himself to the conservative group which followed Baron Pál Senynyey (1824-1888) and eventually became its leader. Until 1905 Count Albert was constantly in opposition, but in May of that year he consented to take office in the second Wekerle ministry. A lofty and magnetic orator, his speeches were published at Budapest in 1896; and he is the author of an interesting dissertation, *Esthetics and Politics, the Artist and the Statesman* (Hung.) (Budapest, 1895).

APPORTIONMENT (Fr. *apportionement;* Med. Lat. *apportionamentum;* derived from Lat. portio, share), distribution or allotment in proper shares; a term used in law in a variety of senses, (1) Sometimes it is employed roughly and with no technical meaning to indicate the distribution of a benefit (*e.g.* salvage or damages under the Fatal Accidents Act 1846, § 2), or liability (*e.g.* general average contributions, or tithe rent-charge), or the incidence of a duty (*e.g.* obligations as to the maintenance of highways). (2) In its strict legal interpretation apportionment falls into two classes, “apportionment in respect of estate” and “apportionment in respect of time.”

1. *Apportionment in respect of Estate* may result either from the act of the parties or from the operation of law. Where a lessee is evicted from, or surrenders or forfeits possession of part of the property leased to him, he becomes liable at common law to pay only a rent apportioned to the value of the interest which he still retains. So where the person entitled to the reversion of an estate assigns part of it, the right to an apportioned part of the rent incident to the whole reversion passes to his assignee. The lessee is not bound, however, by an apportionment of rent made upon the grant of part of the reversion unless it is made either with his consent or by the verdict of a jury. The assignee of the reversion of part of demised premises could not, at common law, re-enter for breach of a condition, inasmuch as a condition of re-entry in a lease could not at common law be apportioned. But this has now been altered by statute both in England (Law of Property Amendment Act 1859, § 3; Conveyancing Act 1881, § 12) and in many of the British colonies (*e.g.* Ontario, Rev. Stats., 1897, c. 170, § 9; Barbados, No. 12 of 1891, § 9). In the cases just mentioned there is apportionment in respect of estate by act of the parties.

> *Apportionment by operation of law* may be brought about where by act of law a lease becomes inoperative as regards its subject-matter, or by the “act of God” (as, for instance, where part of an estate is submerged by the encroachments of the sea). To the same category belongs the apportionment of rent which takes place under various statutes (*e.g.* the Lands Clauses Consolidation Act 1845, § 119, when land is required for public purposes; the Agricultural Holdings Act 1883, § 41, in the case of a tenant from year to year receiving notice to quit part of a holding; and the Irish Land Act 1903, § 61, apportionment of quit and crown rents).

2. Apportionment in respect of Time.—At common law, there was no apportionment of rent in respect of time. Such apportionment was, however, in ceftain cases allowed in England by the Distress for Rent Act 1737, and the Apportionment Act 1834, and is now allowed generally under the Apportionment Act 1870. Under that statute (§ 2) all rents, annuities, dividends and other periodical payments in the nature of income are to be considered as accruing from day to day and to be apportionable in respect of time accordingly. It is provided, however, that the apportioned part of such rents, &c., shall only be payable or recoverable in the case of a continuing payment, when the entire portion of which it forms part itself becomes payable, and, in the case of a payment determined by re-entry, death or otherwise, only when the next entire portion would have been payable if it had not so determined (§ 3). Persons entitled to apportioned parts of rent have the same remedies for recovering them when payable as they would have had in respect of the entire rent; but a lessee is not to be liable for any apportioned part specifically. The rent is recoverable by the heir or other person who would, but for the apportionment, be entitled to the entire rent, and he holds it subject to distribution (§ 4). The Apportionment Act 1870 extends to payments not made under any instrument in writing (§ 2), but not to annual sums made payable in policies of insurance (§ 6). Apportionment under the act can be excluded by express stipulation.

The apportionment created by this statute is “apportionment in respect of time.” The cases to which it applies are mainly cases of either (A) apportionment of rent due under leases where at a time between the dates fixed for payment the lessor or lessee dies, or some other alteration in the position of parties occurs; or

(B) apportionment of income between the representatives of a limited owner and the remainder-man when the limited interest determines at a time between the date when such income became due.

(A) With regard to the former of these classes, it may be noticed that although apportioned rent becomes payable only when the whole rent is due, the landlord, in the case of the bankruptcy of an ordinary tenant, may prove for a proportionate part of the rent up to the date of the receiving order (Bankruptcy Act 1883, Sched. ii. r. 19); and that a similar rule holds good in the winding up of a company (*in re South Kensington Co-operative Stores*, 1881, 17 Ch.D. 161); and further that the act of 1870 applies to the liability to pay, as well as to the right to receive, rent (*in re Wilson*, 1893, 62 L.J.Q.B. 628, 632). Accordingly where an assignment of a lease is made between two half-yearly rent-days, the assignee is not liable to pay the full amount of the half-year's rent falling due on the rent-day next after the date of the assignment, but only an apportioned part of that half-year's rent, computed from the last mentioned date (*Glass* v. *Patterson*, 1902, 2 Ir.R. 660).

(B.) With regard to the apportionment of income, the only points requiring notice here are that all dividends payable by public companies are apportionable, whether paid at fixed periods or not, unless the payment is, in effect, a payment of capital (§ 5).

The Apportionment Act 1870 extends to Scotland and Ireland. It has been followed in many of the British colonies (*e.g.* Ontario, Rev. Stats., 1897, c. 170, §§ 4-8; New Zealand, No. 4 of 1886; Tasmania, No. 8 of 1871; Barbados, No. 12 of 1891, §§ 9-12). Similar legislation has been adopted in many of the states of the American Union, where, as in England, rent was not, at common law, apportionable as to time (Kent, *Comm*. iii. 469-472).

An *equitable apportionment*, apart from statute law, arises where property is bequeathed on trust to pay the income to a tenant for life and the reversion to others, and the realization of the property in the form of a fund capable of producing income is postponed for the benefit of the estate. In such cases there is an ultimate apportionment between the persons entitled to the income and those entitled to the capital of the accumulations for the period of such postponement. The rule followed is this: the proceeds, when realized, are apportionable between capital and income by ascertaining the sum which, put out and accumulated at 3% *per annum* from the day of the testator's death (with yearly rents and deducting income tax) would have produced at the day of receipt the sum actually received. The sum so ascertained should be treated as capital and the residue as income. (*In re Earl of Chesterfield's Trusts*, 1883, 24 Ch.D. 643; *In re Goodenough*, 1895, 2 Ch. 537; *Rowlls* v. *Bebb*, 1900, 2 Ch. 107.)

In addition to the authorities cited in the text, see Stroud, *Jud. Dict.* (2nd ed., London, 1903), s.v. "Apportion"; Bouvier, *Law Dict.* (London and Boston, 1897), s.v. "Apportionment"; *Ruling Cases* (London, 1895), tit. "Apportionment"; Fawcett, *Landlord and Tenant* (London, 1905), pp. 238 et seq.; Foa, *Landlord and Tenant* (3rd ed., London, 1901), pp. 112 et seq.

(A. W. R.)

APPORTIONMENT BILL, an act passed by the Congress of the United States after each decennial census to determine the number of members which each state shall send to the House of Representatives. The ratio of representation fixed by the original constitution was 1 to 30,000 of the free population, and the number of the members of the first House was 65. As the House would, at this ratio, have become unmanageably large, the ratio, which is first settled by Congress before apportionment, has been raised after each census, as will be seen from the accompanying table.

Under	Census		Apportionment		Whole Number of Repre-sentatives.
	Year	Population	Year	Ratio	
Constitution	· ·	· ·	1789	30,000	65
First Census	1790	3,929,214	1793	33,000	105
Second Census	1800	5,308,483	1803	33,000	141
Third Census	1810	7,239,881	1813	35,000	181
Fourth Census	1820	9,633,822	1823	40,000	213
Fifth Census	1830	12,866,020	1833	47,700	240
Sixth Census	1840	17,069,453	1843	70,680	223
Seventh Census	1850	23,191,876	1853	93,423	234
Eighth Census	1860	31,443,321	1863	127,381	241
Ninth Census	1870	38,558,371	1873	131,425	292
Tenth Census	1880	50,155,783	1883	151,911	325
Eleventh Census	1890	62,622,250	1893	173,901	356
Twelfth Census	1900	75,568,686	1903	194,182	386

The same term is applied to the acts passed by the state legislatures for correcting and redistributing the representation of the counties. Such acts are usually passed at decennial intervals, more often after the federal census, but the dates may vary in different states. The state representatives are usually apportioned among the several counties according to population and not by geographical position. The electoral districts so formed are expected to be equal in proportion to the number of inhabitants; but this method has led to much abuse in the past, through the making of unequal districts for partisan purposes. (See GERRYMANDER.)

If a state has received an increase in the number of its representatives and its legislature does not pass an apportionment bill before the next congressional election, the votes of the whole state elect the additional

members on a general ticket and they are called “congressmen-at-large.”

APPRAISER (from Lat. *appretiare*, to value), one who sets a value upon property, real or personal. In England the business of an appraiser is usually combined with that of an auctioneer, while the word itself has given place, to a great extent, to that of “valuer.” (See the articles Auctions and Auctioneers, and Valuation and Valuers.)

In the United States appraiser is a term often used to describe a person specially appointed by a judicial or quasi-judicial authority to put a valuation on property, *e.g.* on the items of an inventory of the estate of a deceased person or on land taken for public purposes by the right of eminent domain. Appraisers of imported goods and boards of general appraisers have extensive functions in administering the customs laws of the United States. Merchant appraisers are sometimes appointed temporarily under the revenue laws to value where there is no resident appraiser without holding the office of appraiser (U.S. Rev. Stats. § 2609).

APPREHENSION (Lat. *ad*, to; *prehendere*, to seize), in psychology, a term applied to a mode of consciousness in which nothing is affirmed or denied of the object in question, but the mind is merely aware of (“seizes”) it. “Judgment” (says Reid, ed. Hamilton, i. p. 414) “is an act of the mind specifically different from simple apprehension or the bare conception of a thing”; and again, “Simple apprehension or conception can neither be true nor false.” This distinction provides for the large class of mental acts in which we are simply aware of or “take in” a number of familiar objects, about which we in general make no judgment unless our attention is suddenly called by a new feature. Or again two alternatives may be apprehended without any resultant judgment as to their respective merits. Similarly G.F. Stout points out that while we have a very vivid idea of a character or an incident in a work of fiction, we can hardly be said in any real sense to have any belief or to make any judgment as to its existence or truth. With this mental state may be compared the purely aesthetic contemplation of music, wherein apart from, say, a false note, the faculty of judgment is for the time inoperative. To these examples may be added the fact that one can fully understand an argument in all its bearings without in any way judging its validity.

Without going into the question fully, it may be pointed out that the distinction between judgment and apprehension is relative. In every kind of thought there is judgment of some sort in a greater or less degree of prominence. Judgment and thought are in fact psychologically distinguishable merely as different, though correlative, activities of consciousness. Professor Stout further investigates the phenomena of apprehension, and comes to the conclusion that “it is possible to distinguish and identify a whole without apprehending any of its constituent details.” On the other hand, if the attention focuses itself for a time on the apprehended object, there is an expectation that such details will as it were emerge into consciousness. Hence he describes such apprehension as “implicit,” and in so far as the implicit apprehension determines the order of such emergence he describes it as “schematic.” A good example of this process is the use of formulae in calculations; ordinarily the formula is used without question; if attention is fixed upon it, the steps by which it is shown to be universally applicable emerge and the “schema” is complete in detail.

With this result may be compared Kant’s theory of apprehension as a synthetic act (the “synthesis of apprehension”) by which the sensory elements of a perception are subjected to the formal conditions of time and space.

See G.F. Stout, *Analytic Psychology* (London, 1896); F. Brentano, *Psychologie* (bk. ii. ch. vii.), and *Vom Ursprung sittlicher Erkenntnis*; B. Titchener, *Outlines of Psychology* (New York, 1902), and text-books of psychology. Also Psychology.

APPRENTICESHIP (from Fr. *apprendre*, to learn), a contract whereby one person, called the master, binds himself to teach, and another, called the apprentice, undertakes to learn, some trade or profession, the apprentice serving his master for a certain time.

Roman law is silent on the subject on this contract, nor does it seem to have had any connexion with the division of the Roman citizens into tribes or colleges. So far as can be seen it arose in the middle ages, and formed an integral part of the system of trade gilds and corporations by which skilled labourers of all kinds sought protection against the feudal lords, and the maintenance of those exclusive privileges with which in the interests of the public they were favoured. In those times it was believed that neither arts nor sciences would flourish unless such only were allowed to practise them as had given proofs of reasonable proficiency and were formed into bodies corporate, with certain powers of self-government and the exclusive monopoly of their respective arts within certain localities; and the medieval *universitas* (corporation)—whether of smiths and tailors or of scholars—included both such as were entitled to practise and teach and such as were in course of learning. The former were the masters, the latter the apprentices. Hence the term *apprentice* was applied indifferently to such as were being taught a trade or a learned profession, and even to

undergraduates or scholars who were qualifying themselves for the degree of doctor or master in the liberal arts. When barristers were first appointed by Edward I. of England they were styled *apprenticii ad legem*—the serjeants-at-law being *servientes ad legem*; and these two terms corresponded respectively to the trade names of apprentices and journeymen. During the middle ages the term of apprenticeship was seven years, and this period was thought no more than sufficient to instruct the learner in his profession, craft or mystery under a properly qualified master, teacher or doctor—for these names were synonymous—and to reimburse the latter by service for the training received. After this the apprentice became himself a master and a member of the corporation, with full rights to practise the business and to teach others in his turn; so also it would seem that undergraduates had to pass through a curriculum of seven years before they could attain the degree of doctor or master in the liberal arts. On the continent of Europe these rules were observed with considerable rigour, both in the learned professions and in those which we now designate as trades. In England they made their way more slowly and did not receive much countenance, there being always a jealousy of anything savouring of interference with the freedom of trade. Nevertheless the formation of gilds and companies of tradesmen in England dates probably from the 12th century, and the institution of apprenticeships cannot be of much later date. In 1388 and 1405 it is noticed in acts of parliament. By various subsequent statutes provisions were made for the regulation of the institution, and from them it appears that seven years was its ordinary and normal term in the absence of special arrangement. By a statute of 1562 this was made the law of the land, and it was enacted that no person should exercise any “trade or mystery” without having served a seven years’ apprenticeship. In no place did the apprentices become so formidable by their numbers and organization as in London. During the Great Rebellion they took an active part as a political body, and were conspicuous after the Restoration by being frequently engaged in tumults. It was probably owing to this circumstance, quite as much as to economic considerations of freedom of trade, that the act of Elizabeth never found much favour with the courts of law. Soon after the Great Rebellion we find the apprentice laws strongly reprobated by the judges, who endeavoured, on the theory that the act of Elizabeth could apply to no trades which were not in existence at its date, to limit its operation as far as possible. Such limitation of the act gave rise to many absurd anomalies and inconsistencies, *e.g.* that a coachmaker could not make his own wheels but must buy them of a wheelwright, while the latter might make both wheels and coaches, because coach-making was not a trade in England when the act of Elizabeth was passed. For the like reason the great textile and metal manufactures which arose at Manchester and Birmingham were held exempt from the operation of the statute. Concurrently with the dislike to the apprentice laws which such anomalies generated, the doctrines of Adam Smith, that all monopolies or restrictions on the freedom of trade were injurious to the public interest, had gradually been making their way, and notwithstanding much opposition an act was passed in 1814 by which the statute of Elizabeth, in so far as it enacts that no person shall engage in any trade without a seven years’ apprenticeship, was wholly repealed. The effect of this act was to give every person the fullest right to exercise any occupation or calling of a mechanical or trading kind for which he deemed himself qualified.

Apprenticeship, therefore, which was formerly a compulsory, now became a voluntary contract. In the case of the learned professions the principles and theories which gave birth to corporations with monopolies, and required apprenticeship or its equivalents, have—contrary to what has taken place in trade— been not only maintained but intensified; that is to say, not only have such bodies retained and even extended in some cases their exclusive privileges, but in general no one is allowed to practise in such professions unless his capabilities have been tested and approved by public authority. Thus no man is allowed to practise law or medicine in any of their branches who has not undergone the appropriate training by attendance at a university or by apprenticeship—sometimes by both combined— and passed certain examinations. Entrance to the church is guarded by similar checks. In such instances the old principle— now generally abandoned in trade—of granting a monopoly to those possessing a certain standard of qualification is maintained in greater vigour than ever.

In some kinds of manufacture the old conditions have been modified by the subdivisions of labour or by the introduction of machinery, which have reduced the amount of skill which formerly was requisite, and thus they have passed out of the category of the higher skilled handicrafts, as only a very slight or short training is necessary to make an efficient worker; but a large number of the higher skilled trades remain which require a long period of training at the bench, and a careful inquiry into this subject has shown that in nearly all of such trades there is a scarcity of skilled workers, which is due to the falling off in the number of apprenticeships. Many persons qualified to form an opinion deplore that something in the nature of the old standard of qualification is not still applied to those trades, and consider that the only method of restoring a high standard of skill is by apprenticeship. The decay of apprenticeship in these trades is due, not to any inherent defect in the system, nor to its having been superseded by any other form of technical education, but to difficulties, especially in London and some other large towns, which place it beyond the reach of that class of persons who have the greatest need of it. Among these difficulties are:—first, insufficient organization, and secondly, want of funds to pay premiums where such are required. These difficulties are accentuated in 229
London and some other large towns, but in many other districts apprenticeship is actively proceeded with. Efforts are being made, notably by the National Institution of Apprenticeship, to meet these difficulties. The Charity Commissioners in their report for 1905 recognized the value of this institution, and stated that they would in future enable the trustees of charity endowments for apprenticeship to avail themselves of the practical co-operation of the institution. The modern trade unions, on the other hand, have done nothing to assist in restoring apprenticeship to its proper place; on the contrary, they have hampered it by restrictions which they have imposed, limiting the number of apprentices who may be taken. The result of fewer apprentices has been not only to lower the standard of skill in the higher trades, but to reduce the productive capacity of the artisans. The altered conditions now attending apprenticeship are, mainly, that the apprentice does not live with the master, and that the term is generally five years instead of a longer period; but the principle remains precisely the same, and the fact that it is applied more and more largely in Austria, Germany and other countries is an evidence of its necessity.

The contract of apprenticeship is generally created by indenture, but any writing properly expressed and attested will do. The full consideration must be set out, and the instrument, whether a premium is paid or not, must be duly stamped, except in the case of parish apprentices and apprentices to the sea service (see

Seamen, Laws Relating to). Where a charity or institution intervenes, it retains control over the indentures until the end of the term of apprenticeship, when the indenture should be cancelled and given up to the apprentice. Any one who is capable of making a contract can take an apprentice, and the law does not limit the number which may be taken by any master. Any person of legal capacity can bind himself as an apprentice, provided he is over seven years of age, though, as he is by the common law exempt from all liability *ex contractu*, it is usual for the apprentice's relations or friends to become bound for his service and good conduct during the period of his apprenticeship. The consent of the apprentice, however, must be expressed by his executing the indenture. No child under nine can be bound as a parish apprentice. The master must teach the apprentice the agreed trade or trades; should the master exercise two trades (which he has agreed to teach) and give up one, it would be good ground for dissolving the contract by the apprentice. An apprentice is not bound to work on Sundays, but he may be required to work on bank holidays. He cannot become a volunteer (soldier) without his master's consent. It is usual in the indenture to state whether the apprentice is to be paid wages or otherwise. If the contract is to pay wages, no deduction can be made owing to illness or accident, unless it has been so provided for in the indentures. Nor is the apprentice liable for breakages or similar faults. The master has been supposed to have a right to administer moderate corporal punishment, though he may not delegate it. But this right is really obsolete. According to old custom a master provided proper food for his apprentices, and medical attendance when required; but the modern practice is for apprentices to reside with their parents or friends who maintain them. A master cannot assign indentures without the approval of the apprentice or such parties as are named in the contract for this purpose, even if he should transfer his business. The contract of apprenticeship may be dissolved by (1) efflux of time; (2) by death (if the master dies, some part of the premium is usually returnable, but if the apprentice dies no part is returnable); (3) by consent; (4) in case of grave misconduct; (5) under the Bankruptcy Act 1883, providing for discharge of the indentures of apprenticeship and for payment on account of premium. Disputes between master and apprentice, in cases where no premium has been paid, or where the premium does not exceed £25, are dealt with by courts of summary jurisdiction. Apprentices bound according to the "custom of London," who are infants above the age of fourteen years and under twenty-one and unmarried, are responsible upon covenants contained in indentures executed by them just as if they were of full age. The term of apprenticeship is usually not less than four years. Apprentices by the custom of London in agreements made at the Guildhall are subject to the jurisdiction of the chamberlain of London.

Parish apprentices are those bound out by guardians of the poor in England. By the Poor Relief Act 1601, overseers of the poor were empowered, with the consent of two justices, to put out poor children as apprentices "where they shall be convenient." Owing to the disinclination to receive such apprentices it became necessary to make the reception compulsory (1696), but this compulsion to receive them was abolished in 1844. Many statutes have been passed from time to time regulating the apprenticing of parish children, but it is now under the control of the Local Government Board, which issues rules specifying fully the manner in which such children are to be bound, assigned and maintained.

Authorities.—See E. Austin, *Law Relating to Apprentices* (1890); Addison, *On Contracts* (1905). For the state of apprenticeship in European countries, and, more particularly in France, see *Apprentissage, enquête et documents* (Paris, 1904, Conseil Supérieur du Travail, Ministère du Commerce, de l'Industrie, des Postes et des Télégraphes, session de 1902). See also the literature issued by the National Institution of Apprenticeship, London.

(J. S. B.)

APPROPRIATION (from Lat. *appropriare*, to set aside), the act of setting apart and applying to a particular use to the exclusion of all other. In ecclesiastical law, appropriation is the perpetual annexation of an ecclesiastical benefice to the use of some spiritual corporation, either aggregate or sole. In the middle ages in England the custom grew up of the monasteries reserving to their own use the greater part of the tithes of their appropriated benefices, leaving only a small portion to their vicars in the parishes. On the dissolution of the monasteries these "great tithes" were often granted, with the monastic lands, to laymen, whose successors, known as "lay impropriators" or "lay rectors," still hold them, the system being known as *impropriation*. Appropriation may be severed and the church become disappropriate, by the presentation of a clerk, properly instituted and inducted, or by the dissolution of the corporation possessing the benefice.

In the law of debtor and creditor, appropriation of payments is the application of a particular payment for the purpose of paying a particular debt. When a creditor has two debts due to him from the same debtor on distinct accounts, the general law as to the appropriation of payments made by the debtor is that the debtor is entitled to apply the payments to such account as he thinks fit; *solvitur in modum solventis*. In default of appropriation by the debtor the creditor is entitled to determine the application of the sums paid, and may appropriate them even to the discharge of debts barred by the Statute of Limitations. In default of appropriation by either debtor or creditor, the law implies an appropriation of the earlier payments to the earlier debts.

In constitutional law, appropriation is the assignment of money for a special purpose. In the United Kingdom an Appropriation Bill is a bill passed at the end of each session of parliament, enumerating the money grants made during the session, and appropriating the various sums, as voted by committee of supply, to the various purposes for which it is to be applied. The United States constitution (art. I. § 9) says: "No money shall be drawn from the treasury, but in consequence of appropriations made by law." Bills for appropriating money originate in the House of Representatives, but may be amended in the Senate.

APPURTENANCES (from late Lat. *appertinentia*, from *appertinere*, to appertain), a legal term for what belongs to and goes with something else, the accessories or things usually conjoined with the substantive matter in question.

APRAKSIN, THEDOR MATVYEEVICH (1671-1728), Russian soldier, began life as one of the pages of Tsar Theodore III., after whose death he served the little tsar Peter in the same capacity. The playfellowship of the two lads resulted in a lifelong friendship. In his twenty-first year Apraksin was appointed governor of Archangel, then the most important commercially of all the Russian provinces, and built ships capable of weathering storms, to the great delight of the tsar. He won his colonelcy at the siege of Azov (1696). In 1700 he was appointed chief of the admiralty, in which post (from 1700 to 1706) his unusual technical ability was 230
of great service. While Peter was combating Charles XII., Apraksin was constructing fleets, building fortresses and havens (Taganrog). In 1707 he was transferred to Moscow. In 1708 he was appointed commander-in-chief in Ingria, to defend the new capital against the Swedes, whom he utterly routed, besides capturing Viborg in Carelia. He held the chief command in the Black Sea during the campaign of the Pruth (1711), and in 1713 materially assisted the conquest of Finland by his operations from the side of the sea. In 1710-1720 he personally conducted the descents upon Sweden, ravaging that country mercilessly, and thus extorting the peace of Nystad, whereby she surrendered the best part of her Baltic provinces to Russia. For these great services he was made a senator and admiral-general of the empire. His last expedition was to Reval in 1726, to cover the town from an anticipated attack by the English government, with whom the relations of Russia at the beginning of the reign of Catharine I. were strained almost to breaking-point. Though frequently threatened with terrible penalties by Peter the Great for his incurable vice of peculation, Apraksin, nevertheless, contrived to save his head, though not his pocket, chiefly through the mediation of the good-natured empress, Catharine, who remained his friend to the last, and whom he assisted to place on the throne on the death of Peter. Apraksin was the most genial and kind-hearted of all Peter's pupils. He is said to have never made an enemy. He died on the 10th of November 1728.

See R. Nisbet Bain, *The Pupils of Peter the Great* (London, 1897).

(R. N. B.)

APRICOT (from the Lat. *praecox*, or *praecoquus*, ripened early, *coquere*, to cook, or ripen; the English form, formerly "apricock" and "abrecox," comes through the Fr. *abricot*, from the Span. *albaricoque*, which was an adaptation of the Arabic *al-burquk*, itself a rendering of the late Gr. πρεκόκκια or πραικόκιον, adapted from the Latin; the derivation from *in aprico cactus* is a mere guess), the fruit of *Prunus armeniaca*, also called *Armeniaca vulgaris*. Under the former name it is regarded as a species of the genus to which the plums belong, the latter establishes it as a distinct genus of the natural order *Rosaceae*. The apricot is, like the plum, a stone fruit, cultivated generally throughout temperate regions, and used chiefly in the form of preserves and in tarts. The tree has long been cultivated in *Armenia* (hence the name *Armeniaca*); it is a native of north China and other parts of temperate Asia. It flowers very early in the season, and is a hardy tree, but the fruit will scarcely ripen in Britain unless the tree is trained against a wall. A great number of varieties of the apricot, as of most cultivated fruits, are distinguished by cultivators. The kernels of several varieties are edible, and in Egypt those of the Musch-Musch variety form a considerable article of commerce. The French liqueur *Eau de noyaux* is prepared from bitter apricot kernels. Large quantities of fruit are imported from France into the United Kingdom.

The apricot is propagated by budding on the mussel or common plum stock. The tree succeeds in good well-drained loamy soil, rather light than heavy. It is usually grown as a wall tree, the east and west aspects being preferred to the south, which induces mealiness in the fruit, though in Scotland the best aspects are necessary. The most usual and best mode of training is the fan method. The fruit is produced on shoots of the preceding year, and on small close spurs formed on the two-year-old wood. The trees should be planted about 20 ft. apart. The summer pruning should begin early in June, at which period all the irregular foreright and useless shoots are pinched off; and, shortly afterwards, those which remain are fastened to the wall. At the winter pruning all branches not duly furnished with spurs and fruit buds are removed. The young bearing shoots are moderately pruned at the points, care being, however, taken to leave a terminal shoot or leader to each branch. The most common error in the pruning of apricots is laying in the bearing shoots too thickly; the branches naturally diverge in fan training, and when they extend so as to be about 15 in. apart, a fresh branch should be laid in, to be again subdivided as required. The blossoms of the apricot open early in spring, but are more hardy than those of the peach; the same means of protection when necessary may be employed for both. If the fruit sets too numerously, it is thinned out in June and in the beginning of July, the later thinnings being used for tarts. In the south of England, where the soil is suitable, the hardier sorts of apricot, as the Breda and Brussels, bear well as standard trees in favourable seasons. In such cases the trees may be planted from 20 to 25 ft. apart.

The ripening of the fruit of the apricot is accelerated by culture under glass, the trees being either planted out like peaches or grown in pots on the orchard-house system. They must be very gently excited, since they naturally bloom when the spring temperature is comparatively low. At first a maximum of 40° only must be permitted; after two or three weeks it may be raised to 45°, and later on to 50° and 55°, and thus continued till the trees are in flower, air being freely admitted, and the minimum or night temperature ranging from 40° to 45°. After the fruit is set the temperature should be gradually raised, being kept higher in clear weather

than in dull. When the fruit has stoned, the temperature may be raised to 60° or 65° by day and 60° by night; and for ripening off it may be allowed to reach 70° or 80° by sun heat.

The Moorpark is one of the best and most useful sorts in cultivation, and should be planted for all general purposes; the Peach is a very similar variety, not quite identical; and the Hemskerk is also similar, but hardier. The Large Early, which ripens in the end of July and beginning of August, and the Kaisha, a sweet-kernelled variety, which ripens in the middle of August, are also to be recommended. For standard trees in favourable localities the Breda and Brussels may be added.

APRIES (Ἀπρίης), the name by which Herodotus (ii. 161) and Diodorus (i. 68) designate *Uehabrē*ʿ, Οὐαφρής (Pharaoh-Hophra), the fourth king (counting from Psammetichus I.) of the twenty-sixth Egyptian dynasty. He reigned from 589 to 570 B.C. See EGYPT and AMASIS.

APRIL, the second month of the ancient Roman, and the fourth of the modern calendar, containing thirty days. The derivation of the name is uncertain. The traditional etymology from Lat. *aperire*, "to open," in allusion to its being the season when trees and flowers begin to "open," is supported by comparison with the modern Greek use of ἄνοιξις (opening) for spring. This seems very possible, though, as all the Roman months were named in honour of divinities, and as April was sacred to Venus, the *Festum Veneris et Fortunae Virilis* being held on the first day, it has been suggested that Aprilis was originally her month Aphrilis, from her Greek name Aphrodite. Jacob Grimm suggests the name of a hypothetical god or hero, *Aper* or *Aprus*. On the fourth and the five following days, games (*Ludi Megalenses*) were celebrated in honour of Cybele; on the fifth there was the *Festum Fortunae Publicae*; on the tenth (?) games in the circus, and on the nineteenth equestrian combats, in honour of Ceres; on the twenty-first—which was regarded as the birthday of Rome—the *Vinalia urbana*, when the wine of the previous autumn was first tasted; on the twenty-fifth, the *Robigalia*, for the averting of mildew; and on the twenty-eighth and four following days, the riotous *Floralia*. The Anglo-Saxons called April *Oster-monath* or *Eostur-monath*, the period sacred to *Eostre* or *Ostara*, the pagan Saxon goddess of spring, from whose name is derived the modern Easter. St George's day is the twenty-third of the month; and St Mark's Eve, with its superstition that the ghosts of those who are doomed to die within the year will be seen to pass into the church, falls on the twenty-fourth. In China the symbolical ploughing of the earth by the emperor and princes of the blood takes place in their third month, which frequently corresponds to our April; and in Japan the feast of Dolls is celebrated in the same month. The "days of April" (*journées d'avril*) is a name appropriated in French history to a series of insurrections at Lyons, Paris and elsewhere, against the government of Louis Philippe in 1834, which led to violent repressive measures, and to a famous trial known as the *procès d'avril*.

See Chambers's *Book of Days*; Grimm's *Geschichte der deutschen Sprache*. Cap. "Monate"; also APRIL-FOOLS' DAY.

APRIL-FOOLS' DAY, or ALL-FOOLS' DAY, the name given to the 1st of April in allusion to the custom of playing practical jokes on friends and neighbours on that day, or sending them on fools' errands. The origin of this custom has been much disputed, and many ludicrous solutions have been suggested, *e.g.* that it is a farcical commemoration of Christ being sent from Annas to Caiaphas, from Caiaphas to Pilate, from Pilate to Herod, and from Herod back again to Pilate, the crucifixion having taken place about the 1st of April. What seems certain is that it is in some way or other a relic of those once universal festivities held at the vernal equinox, which, beginning on old New Year's day, the 25th of March, ended on the 1st of April. This view gains support from the fact that the exact counterpart of April-fooling is found to have been an immemorial custom in India. The festival of the spring equinox is there termed the feast of Huli, the last day of which is the 31st of March, upon which the chief amusement is the befooling of people by sending them on fruitless errands. It has been plausibly suggested that Europe derived its April-fooling from the French. They were the first nation to adopt the reformed calendar, Charles IX. in 1564 decreeing that the year should begin with the 1st of January. Thus the New Year's gifts and visits of felicitation which had been the feature of the 1st of April became associated with the first day of January, and those who disliked the change were fair butts for those wits who amused themselves by sending mock presents and paying calls of pretended ceremony on the 1st of April. Though the 1st of April appears to have been anciently observed in Great Britain as a general festival, it was apparently not until the beginning of the 18th century that the making of April-fools was a common custom. In Scotland the custom was known as "hunting the gowk," *i.e.* the cuckoo, and April-fools were "April-gowks," the cuckoo being there, as it is in most lands, a term of contempt. In France the person befooled is known as *poisson d'avril*. This has been explained from the association of ideas arising from the fact that in April the sun quits the zodiacal sign of the fish. A far more natural explanation would seem to be that the April fish would be a young fish and therefore easily caught.

A PRIORI (Lat. *a*, from, *prior, prius*, that which is before, precedes), (1) a phrase used popularly of a judgment based on general considerations in the absence of particular evidence; (2) a logical term first used, apparently, by Albert of Saxony (14th century), though the theory which it denotes is as old as Aristotle. In the order of human knowledge the particular facts of experience come first and are the basis of generalized laws or causes (the Scholastic *notiora nobis*); but in the order of nature the latter rank first as the self-existent, fundamental truths of existence (*notiora naturae*). Thus to Aristotle the *a priori* argument is from law or cause to effect, as opposed to what we call *a posteriori* (*posterior*, subsequent, derived), from effect to cause. Since Kant the two phrases have become purely adjectival (instead of adverbial) with a technical controversial sense, closely allied to the Aristotelian, in relation to knowledge and judgments generally. *A priori* is applied to judgments which are regarded as independent of experience, and belonging to the essence of thought; *a posteriori* to those which are derived from particular observations. The distinction is analogous to that between analysis and synthesis, deduction and induction (but there may be a synthesis of *a priori* judgments, cf. Kant's "Synthetic Judgment *a priori*"). Round this distinction a rather barren controversy has raged, and almost all modern philosophers have labelled themselves either "Intuitionalist" (*a priori*) or "Empiricist" (*a posteriori*) according to the view they take of knowledge. In fact, however, the rival schools are generally arguing at cross purposes; there is a knowledge based on particulars, and also a knowledge of laws or causes. But the two work in different spheres, and are complementary. The observation of isolated particulars gives not necessity, but merely strong probability; necessity is purely intellectual or "transcendental." If the empiricist denies the intellectual element in scientific knowledge, he must not claim absolute validity for his conclusions; but he may hold against the intuitionalist that absolute laws are impossible to the human intellect. On the other hand, pure *a priori* knowledge can be nothing more than form without content (*e.g.* formal logic, the laws of thought). The simple fact at the bottom of the controversy is that in all empirical knowledge there is an intellectual element, without which there is no correlation of empirical data, and every judgment, however simple, postulates a correlation of some sort if only that between the predicate and its contradictory.

APRON (a corruption arising from a wrong division of "a napron" into "an apron," from the Fr. *naperon, napperon*, a diminutive of *nappe*, Lat. *mappa*, a napkin), an article of costume used to protect the front of the clothes. It forms part of the ceremonial dress of Freemasons. The "apron" worn by church dignitaries is a shortened cassock (*q.v.*). The word has many technical uses, as for the protecting slope in front of the sill of dock-gates, or at the foot of weirs.

APSARAS, in Hindu mythology, a female spirit of the clouds and waters. In the Rig-Veda there is one Apsaras, wife of Gandharva; in the later scriptures there are many Apsaras who act as the handmaidens of Indra and dance before his throne. They are able to change their form, and specially rule over the fortunes of gaming. One of their duties is to guide to paradise the heroes who fall in battle, whose wives they then become. They are distinguished as *daivika* ("divine") or *laukika* ("worldly").

APSE (Gr. ἀψίς, a fastening, especially the felloe of a wheel; Lat. *absis*), in architecture, a semicircular recess covered with a hemispherical vault. The term is applied also to the termination to the choir, transept or aisle of any church which is either semicircular or polygonal in plan, whether vaulted or covered with a timber roof; a church is said to be "apsidal" when it terminates in an apse.

The earliest example of an apse is found in the temple of Mars Ultor at Rome (2 B.C.), and it formed afterwards the favourite feature terminating the rear of any temple, and one which gave importance to the statue of the deity to whom the temple was dedicated. Its use by the Romans was not confined to the temples, as it is found in the palaces on the Palatine Hill, the great Thermae (Baths) and other monuments. In the civil basilicas the apse was screened off by columns, and constituted the court of justice. In the Ulpian (Trajan's) Basilica the apses at each end were of such great dimensions as to come better under the definition of hemicycles (*q.v.*). In these apses the floor was raised, and had an altar placed in the centre of its chord, where sacrifices were made prior to the sittings. The only other two Roman basilicas in which the semicircular apse can still be traced are that commenced by Maxentius and completed by Constantine at Rome and the basilica at Trier (Trèves).

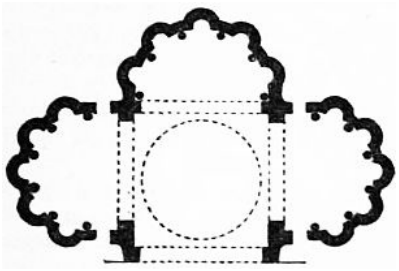
In the earliest Christian basilica, St Peter's at Rome, built 330 A.D., the apse, 57 ft. in diameter, raised above the confessio or crypt, was placed at the west end of the church. This orientation was originally followed in the churches of St Paul and St Lawrence (S. Lorenzo fuori le Mura), both outside the walls of Rome, and is found in most of the churches at Rome. On the other hand, in the Byzantine church, the apse was built at the east end of the church.

During the reign of Justin the Second (A.D. 565-574), owing to a change in the liturgy, two more apses were added, one on each side of the central apse. These in the Greek Church were provided not to hold altars but

for ceremonial purposes. One of the earliest examples is found in the church of St Nicholas at Myra of the 6th century, and the basilica erected in the great court of the temple at Baalbek shows the triple apse. The earliest example in Rome is found in the church of Sta Maria in Cosmedin (772-795), built probably by Greek craftsmen, who had been exiled by the Iconoclasts. Other triapsal choirs are found in the cathedral of Parenzo (542 A.D.), in St Mark's, Venice, in Sta Fosca and the Duomo at Torcello, and in numerous examples throughout Italy and Germany. In central Syria there is one example only, at Kalat Seman, where the side apses were a later addition.

There is one important distinction to be drawn between the Byzantine and the Latin apses; they are both semicircular internally, but externally the former are nearly always polygonal. It follows, therefore, that in those churches in Italy where the apse is polygonal externally, it is a sign of direct Byzantine influence. This is found in St Mark's, Venice; Sta Fosca, Torcello; Murano; nearly all the churches at Ravenna; and in the Crusaders' churches throughout Syria.

In the Coptic church in Egypt we find other characteristics; in the churches of the Red and White Monasteries, attributed to St Helena, an unusual depth is given to the apse, in the walls of which niches are sunk; in the church of St John at Antinoë there are no fewer than seven. Similar niches are found in the apses of St Mark's, Venice, built in A.D. 828, it is said in imitation of St Mark's in Alexandria, to receive the relics of St Mark brought over from there.



Apse of the White Monastery.

In a large number of the apses in the Coptic churches the seats round the apse with the bishop's throne in the centre are still preserved; of these the best examples are at Abu Sargah, Al 'Adra and Abu-s-Sifain. Unfortunately there are no remains of the fittings in the tribunes of the ancient Roman basilicas, but those in St Peter's at Rome, which were probably copied from them, are recorded in drawings, there being two or three rows of stone seats with the papal throne in the centre. It is possible also that some may still exist in the other early Christian basilicas at Rome, but there have been so many changes that it is not possible to trace them. In the cathedral of Parenzo in Istria (A.D. 532-535), the hemicycle of marble seats for the clergy with the episcopal chair in the centre still exists. A similar arrangement is found in the apse of the church of the 6th century attached to the church of St Helena in the island of Paros, where there are eight steep grades of semicircular stone seats with the bishop's chair in the centre. The aspect of the interior of this apse has in consequence very much the appearance of a Roman theatre. A third example, better known, exists at Torcello, with six concentric seats rising one above the other, and in the centre the episcopal chair with a flight of thirteen steps down in front of it.

In the basilica at Bethlehem, the east end of which was reconstructed probably in the 5th century, apses of similar dimensions to the eastern apse were built at the north and south end of the transept. The same disposition is found in the Coptic churches of the Red and White Monasteries just referred to, in the church of St Elias at Salonica (*c.* 1012), the cathedral of Echmiadzin in Armenia, at Vatopedi, Mt. Athos, and some other Byzantine churches. An early example in France exists in the church of Germigny-des-Prés on the Loire (806; rebuilt 1868), where the three apses are horseshoe on plan, and the same is found in the church at Oberzell in the island of Reichenau, Lake of Constance, except that the eastern apse there is square. Small examples also are found at Querqueville and at St Wandrille near Caudebec, both in Normandy, but the finest development takes place in the church of St Maria im Capitol at Cologne, where the aisles are carried round both the northern and southern apses. The same feature exists in the cathedral of Tournai in Belgium and the churches at Cambrai, Soissons and Valenciennes (the last destroyed at the Revolution) in France, and also in the cathedrals of Como and of Pisa in Italy. Without aisles, there are examples in the churches of the Apostles and of St Martin at Cologne; St Quirinus at Neuss; at Roermond; St Cross, Breslau; the cathedral of Bonn; and, at a later date, in the Marienkirche at Trier; S. Elizabeth at Marburg; the church of Sta Maria-del-Fiore at Florence; and the cathedral of Parma.

In consequence of a change made in the orientation of apses in the 6th or 7th century, others were subsequently added at the west end of existing churches, and this is considered to have been the case at Canterbury; but in the German churches sometimes apses were built from the first at both ends, such as are shown on the manuscript plan of St Gall, of the 9th century. Western apses exist at Gernrode; Drübeck; Huyseburg; the Obermünster of Regensburg; St Godehard in Hildesheim; the cathedrals of Worms and Trier; the Abbey church of Laach; the Minster at Bonn; and in St Pietro-in-Grado near Pisa.

The triapsal churches, to which we have referred, are those in which the side apses form the termination of the side aisles; but where there are transepts, the aisles are sometimes not continued beyond them, and the expansion of the transept to north and south gives more ample space for apses; of these there are many examples, as in the Abbey church of Laach in Germany; at Romsey; Christchurch, Hants; Gloucester, Ely, Norwich and Canterbury cathedrals, in England; and at St Georges de Boscherville in France; sometimes there being space for two apses on each side.

In the beginning of the 13th century in France, the apses became radiating chapels outside the choir aisle, henceforth known as the chevet. These radiating chapels would seem to have been suggested in Norwich and Canterbury cathedrals, but the feature is essentially a French one and in England is found only in Westminster Abbey, into which it was introduced by Henry III., to whom the chevets of Amiens, Beauvais and Reims were probably well known.

(R. P. S.)

APSE and **APSIDES,** in mechanics, either of the two points of an orbit which are nearest to and farthest from the centre of motion. They are called the lower or nearer, and the higher or more distant apsides respectively. The “line of apsides” is that which joins them, forming the major axis of the orbit.

APSINES of Gadara, a Greek rhetorician, who flourished during the 3rd century A.D. After studying at Smyrna, he taught at Athens, and gained such a reputation that he was raised to the consulship by the emperor Maximinus (235-238). He was the friend of Philostratus, the author of the *Lives of the Sophists*, who speaks of his wonderful memory and accuracy. Two rhetorical treatises by him are extant: Τέχνη ῥητορική, a handbook of rhetoric greatly interpolated, a considerable portion being taken from the *Rhetoric* of Longinus; and a smaller work, Περὶ ἐσχηματισμένων προβλημάτων, on Propositions maintained figuratively.

Editions by Bake, 1849; Spengel-Hammer in *Rhetores Graeci*, ii. (1894): see also Hammer, *De Apsine Rhetore* (1876); Volkmann, *Rhetorik der Griechen und Romer* (1885).

APT, a town of south-eastern France, in the department of Vaucluse, on the left bank of the Coulon, 41 m. E. of Avignon by rail. Pop. (1906) 4990. The town was formerly surrounded by massive ancient walls, but these have now been for the most part replaced by boulevards; many of its streets are narrow and irregular. The chief object of interest is the church of Sainte-Anne (once the cathedral), the building of which was begun about the year 1056 on the site of a much older edifice, but not completed until the latter half of the 17th century. Many Roman remains have been found in and near the town. A fine bridge, the Pont Julien, spanning the Coulon below the town, dates from the 2nd or 3rd century. A tribunal of first instance and a communal college are the chief public institutions. The chief manufactures are silk, confectionery and earthenware; and there is besides a considerable trade in fruit, grain and cattle. Apt was at one time the chief town of the Vulgientes, a Gallic tribe; it was destroyed by the Romans about 125 B.C. and restored by Julius Caesar, who conferred upon it the title *Apta Julia*; it was much injured by the Lombards and the Saracens, but its fortifications were rebuilt by the counts of Provence. The bishopric, founded in the 3rd century, was suppressed in 1790.

APTERA (Greek for “wingless”), a term in zoological classification applied by Linnaeus to various groups of wingless arthropods, including some of the insects, the centipedes, the millipedes, the Arachnida (scorpions, spiders, &c.) and the Crustacea. In modern zoology the term has become restricted to the lowest order of the class Hexapoda or true insects. This order includes the bristle-tails and the springtails.

Many wingless insects—such as lice, fleas and certain earwigs and cockroaches—are placed in various orders together with winged insects to which they show evident relationships. In such cases the absence of wings must be regarded as secondary—due to a parasitic or other special manner of life. But the bristle-tails and springtails, which form the modern order Aptera, are all without any trace of wings, and, on account of several remarkable archaic characters which they exhibit, there is reason for believing that they are primitively wingless—that they represent an early offshoot which sprang from the ancestral stock of the Hexapoda before organs of flight had been acquired by the class.

Characters.—In addition to the complete absence of wings and of metamorphosis, the Aptera are characterized by peculiar elongate mandibles (figs. 1, *Mn.*; 2, 4), with toothed apex and sub-apical grinding surface, like those of certain Crustacea; by the presence between the mandibles and maxillae of a pair of appendages (superlinguae or maxillulae), fig. 1, *Mxl.*, which are absent or vestigial in all other insects; and, in most genera, by the presence in the adult of abdominal appendages used for locomotion, these latter varying in number from one to nine pairs. Among peculiarities of the internal organs the segmental arrangement of the ovaries in most members of the order is noteworthy. Many Aptera are covered with flattened scales like those of moths.

Classification.—The Aptera are divided into two divergent sub-orders, the *Thysanura* (*q.v.*) or bristle-tails, and the *Collembola* or springtails.

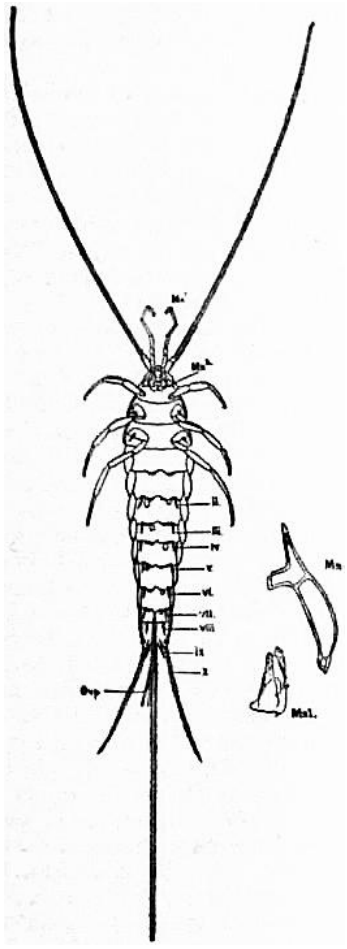
Thysanura.—The bristle-tails have an abdomen of eleven segments,

the tenth usually carrying a pair of long many-jointed tail-feelers (cerci, fig. 1, x.); sometimes a median, jointed tail-appendage is also present. To these feelers the popular name is due. There may also be abdominal appendages—in the form of simple unjointed stylets (fig. 1, ii.-ix.), accompanied by paired eversible sacs, probably respiratory in function—on eight (or fewer) other abdominal segments. The head of a bristle-tail carries a pair of compound eyes and a pair of elongate many-jointed feelers.

The air-tube system is developed in varying degree in different bristle-tails, the number of pairs of spiracles being three (*Campodea*), nine (*Machilis*), ten (*Lepisma*), or eleven (*Japyx*).

Four families of Thysanura are usually recognized. In the *Machilidae* and *Lepismidae* (these two families are known as the Ectotrophi) the maxillae are like those of typical biting insects, and there is a median tail-bristle in addition to the paired cerci; while in the *Campodeidae* and *Japygidae* (which form the group Entotrophi) the jaws are apparently sunk in the head, through a deep inpushing at the mouth, and there is no median tail-bristle. The cerci in *Japyx* are not, as usual, jointed feelers, but strong, curved appendages forming a forceps as in earwigs.

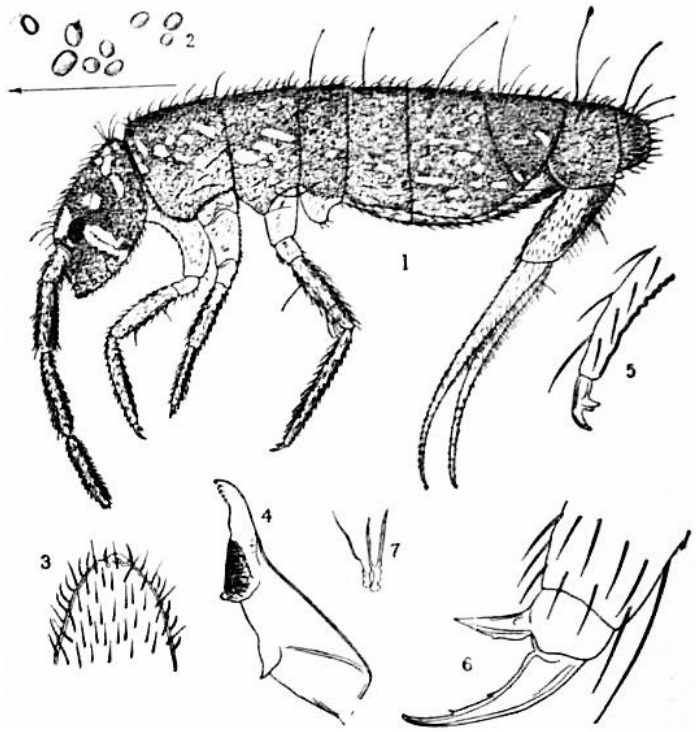
Collembola.—In springtails, or *Collembola*, the jaws are sunk into the head, as in the entotrophous Thysanura; the head carries a pair of feelers with not more than six (usually four) segments, and there are eight (or fewer) distinct simple eyes on each side of the head (fig. 2, 1, 2). These are in some genera like the single elements (*ommatidia*) of a compound insect eye, in others like simple ocelli. The abdomen consists of six segments only. The first of these usually carries a ventral tube, furnished with paired eversible sacs which assist the insects in walking on smooth surfaces, and perhaps serve also as organs for breathing. From the researches of V. Willem it appears that the viscid fluid which causes the adherence of the ventral tube is secreted by a pair of glands in the head whose ducts open into a superficial groove leading from the second maxillae backward to the tube on the first abdominal segment. The third abdominal segment usually carries a pair of short appendages whose basal segments are fused together; this is the "catch" (fig. 2, 7), whose function is to hold in place the "spring," which is formed by the fourth pair of abdominal appendages—also with fused basal segments. In most Collembola the spring appears to belong to the fifth abdominal somite, but Willem, by study of the muscles, has shown that it really belongs to the fourth. The fused basal segments of the appendages form the "manubrium" of the spring, which carries the two "dentes" (usually elongate and flexible), each with a "mucro" at its tip (fig. 2, 5). The fifth abdominal segment is the genital, and the sixth the anal somite.



From *Knowledge*.

FIG. 1.—A typical Thysanuran (*Machilus maritima*). Female, ventral view.

Mx[1], *Mx*[2], 1st and 2nd maxillae.
ii.-x., Appendages on 2nd to 10th abdominal segments. The eversible sacs on the abdominal segments are shown, some protruded and some retracted.
Ovp, Ovipositor.
Mn, Mandible, and *Mxl*, maxillula, dissected out of head.



From Carpenter, *Proc. R. Dub. Soc.*, vol. xi.

FIG. 2.—Structure of Collembola.

1. *Isotoma hibernica*. Side view.
2. ” Ocelli and post-antennal organ of right side.
3. ” Tip of terminal antennal segment with antennal organ.
4. ” Mandible.
5. ” Tip of left dens with mucro. Outer view.
6. ” Hind-foot with claws. × 240.
7. *Entomobrya anomala*. Catch.

The spring serves the Collembola which possess it as an efficient leaping-organ (see SPRINGTAIL). But in some genera it is greatly reduced and in many quite vestigial.

Most springtails are without air-tubes, and breathe through the general cuticle of the body. But in one family (*Sminthuridae*) a spiracle, opening on either side between the head and the prothorax, leads to a branching system of air-tubes. The *Sminthuridae* are further characterized by the globular abdomen, which shows but little external trace of segmentation, and by the well-developed spring.

In the *Entomobryidae* the body is elongate and clearly segmented, but the dorsal region (tergum) of the prothorax is much reduced and the head downwardly directed; the spring is well developed. In the *Achorutidae* the head is forwardly directed, the tergum of the prothorax conspicuous, and the spring small or vestigial.

In many genera of springtails a curious post-antennal organ, consisting of sensory structures (often complex in form) surrounded by a firm ring, is to be noticed on the cuticle of the head between the eyes and the feelers. It may be of use as an organ of smell. Other sensory organs occur on the third and fourth antennal segments in the *Achorutidae* and *Entomobryidae* (fig. 2, 3).

Distribution and Habits.—The Aptera are probably the most widely distributed of all insects. Among the bristle-tails we find the genus *Machilis*, represented in Europe (including the Faeroe Islands) and in Chile; while *Campodea* lives high on the mountains and in the deepest caves. The springtails have even a wider distribution. The genus *Isotoma*, for example, has some of its numerous species in regions so remote as Alaska, Franz Josef Land, the Sandwich Islands, the South Orkneys, Graham Land, Kerguelen and South Victoria Land. As it is unlikely that these delicate insects could be transported across sea-channels, their wide and discontinuous range suggests both their great antiquity and the former existence of continental tracts over which they may have travelled to their present stations.

Springtails and bristle-tails live in damp concealed places—under stones or tree-bark, in moss, and in the decaying vegetable or animal matter which serves as food for most of them. Some species, however, eat fresh plant-tissues. A species of bristle-tail (*Machilis maritima*) and quite a number of springtails haunt the sea-coast at or below high-water mark. In such localities many thousands of individuals may sometimes be found associated together. The insect fauna of limestone caves both in Europe and North America is largely composed of Aptera, especially Collembola.

Geological History.—A supposed Thysanuran from the Silurian of New Brunswick has been described by G.F. Matthew, and another genus from the French Carboniferous by C. Brongniart. Not till the Tertiary do we find remains of Aptera in any quantity, species both of living and extinct genera being represented in the amber.

Development.—The embryonic development of several genera of Aptera, which has been carefully studied, will be more suitably described in comparison with that of other insects than here (see HEXAPODA).

BIBLIOGRAPHY.—The modern study of the Aptera may be said to date from the classical memoirs of T. Tullberg, “Sveriges Podurider,” in *Kongl. Svensk Vetensk. Akad. Handl.* x., 1872, and Sir J. Lubbock (Lord Avebury), “Monograph of the Collembola and Thysanura,” *Ray Society*, 1873. In these, full references to the older literature will be found. Subsequently our knowledge of the Thysanura has been markedly advanced by J.T. Oudemans, *Bijdrage tot de Kennis den Thysanura en Collembola* (Amsterdam, 1888); B. Grassi, who published between 1885 and 1889 a series of memoirs entitled “I progenitori dei Miriapodi e degli Insetti,” in the *Atti Accad. di Scienz. Nat. Catania*, and the *Memor. R. Accad. dei Lincei*; and V. Willem, whose “Recherches sur les Collemboles et les Thysanoures,” in *Mem. Cour. Acad. Roy. Belgique*, lviii., 1900, are indispensable to the student. In addition to this work of Willem, valuable anatomical papers on Collembola have been published by H.J. Hansen (*Zool. Anz.* xvi., 1893), J.W. Folsom (*Bull. Mus. Comp. Anat. Harv.* xxxv., 1899), C. Börner (*Zool. Anz.* xxiii., 1900), and K. Absolon (*Zool. Anz.* xxiii. and xxiv., 1900, 1901), the two latter writers having paid especial attention to the peculiar post-antennal and antennal sense-organs of springtails. Absolon has also written on the Collembola of caves. These writers, with H. Schött, C. Schäffer and others, have published many systematic papers on Collembola, as has F. Silvestri on Thysanura. British species are mentioned in Lubbock’s monograph; for recent additions see G.H. Carpenter and W. Evans (*Proc. R. Phys. Soc. Edinb.* xiv., 1899, and xv., 1903).

(G. H. C.)

APTERAL (from the Gr. ἄπτερος, wingless, ἀ-, privative and πτερός, a wing), an architectural term applied to amphiprostyle temples which have no columns on the sides; in the Ionic temple on the Acropolis at Athens known as Nike Apteros, the adjective is used, not as applying to the goddess of victory but to the absence of any peristyle on the sides.

APTIAN (Fr. *Aptien*, from Apt in Vaucluse, France), in geology, the term introduced in 1843 by A. d'Orbigny (*Pal. France Crét.* ii.) for the upper stage of the Lower Cretaceous rocks. In England it comprises the Lower Greensand and part of the Speeton beds; in France it is divided into two sub-stages, the lower, "Bedoulian," of Bedoule in Provence, with *Hoplites deshayesei* and *Ancyloceras Matheroni*; and an upper, "Gargasian," from Gargas near Apt, with *Hoplites furcatus* (*Dufrenoyi*) and *Phylloceras Guettardi*. To this stage belong the *Toucasia* limestone and *Orbitolina* marls of Spain; the *Schrattenkalk* (part) of the Alpine and Carpathian regions; and the *Terebrirostra* limestone of the same area. Parts of the Flysch of the eastern Alps, the Biancone of Lombardy, and *argile scagliose* of Emilia, are of Aptian age; so also are the "Trinity Beds" of North America. Deposits of bauxite occur in the Aptian hippurite limestone at Les Baux near Aries, and in the Pyrenees. The Aptian rocks are generally clays, marls and green glauconitic sands with occasional limestones. (See Greensand and Cretaceous.)

APULEIUS, LUCIUS, Platonic philosopher and rhetorician, was born at Madaura in Numidia about A.D. 125. As the son of one of the principal officials, he received an excellent education, first at Carthage and subsequently at Athens. After leaving Athens he undertook a long course of travel, especially in the East, principally with the view of obtaining initiation into religious mysteries. Having practised for some time as an advocate at Rome, he returned to Africa. On a journey to Alexandria he fell sick at Oea (Tripoli), where he made the acquaintance of a rich widow, Aemilia Pudentilla, whom he subsequently married. The members of her family disapproved of the marriage, and indicted Apuleius on a charge of having gained her affections by magical arts. He easily established his innocence, and his spirited, highly entertaining, but inordinately long defence (*Apologia* or *De Magia*) before the proconsul Claudius Maximus is our principal authority for his biography. From allusions in his subsequent writings, and the mention of him by St. Augustine, we gather that the remainder of his prosperous life was devoted to literature and philosophy. At Carthage he was elected provincial priest of the imperial cult, in which capacity he occupied a prominent position in the provincial council, had the duty of collecting and managing the funds for the temples of the cult, and the superintendence of the games in the amphitheatre. He lectured on philosophy and rhetoric, like the Greek sophists, apparently with success, since statues were erected in his honour at Carthage and elsewhere. The year of his death is not known.

The work on which the fame of Apuleius principally rests has little claim to originality. The *Metamorphoses* or *Golden Ass* (the latter title seems not to be the author's own, but to have been bestowed in compliment, just as the *Libri Rerum Quotidianarum* of Gaius were called *Aurei*) was founded on a narrative in the *Metamorphoses* of Lucius of Patrae, a work extant in the time of Photius. From Photius's account (impugned, however, by Wieland and Courier), this book would seem to have consisted of a collection of marvellous stories, related in an inartistic fashion, and in perfect good faith. The literary capabilities of this particular narrative attracted the attention of Apuleius's contemporary, Lucian, who proceeded to work it up in his own manner, adhering, as Photius seems to indicate, very closely to the original, but giving it a comic and satiric turn. Apuleius followed this rifacimento, making it, however, the groundwork of an elaborate romance, interspersed with numerous episodes, of which the beautiful story of Cupid and Psyche is the most celebrated, and altering the *dénouement* to suit the religious revival of which he was an apostle.

The adventures of the youthful hero in the form of an ass are much the same in both romances, but in Apuleius he is restored to human shape by the aid of Isis, into whose mysteries he is initiated, and finally becomes her priestess. The book is a remarkable illustration of the contemporary reaction against a period of scepticism, of the general appetite for miracle and magic, and of the influx of oriental and Egyptian ideas into the old theology. It is also composed with a well-marked literary aim, defined by Kretzschmann as the emulation of the Greek sophists, and the transplantation of their *tours de force* into the Latin language. Nothing, indeed, is more characteristic of Apuleius than his versatility, unless it be his ostentation and self-confidence in the display of it. The dignified, the ludicrous, the voluptuous, the horrible, succeed each other with bewildering rapidity; fancy and feeling are everywhere apparent, but not less so affectation, meretricious ornament, and that effort to say everything finely which prevents anything being said well. The Latinity has a strong African colouring, and is crammed with obsolete words, agreeably to the taste of the time. When these defects are mitigated or overlooked, the *Golden Ass* will be pronounced a most successful work, invaluable as an illustration of ancient manners, and full of entertainment from beginning to end. The most famous and poetically beautiful portion is the episode of Cupid and Psyche, adapted from a popular legend of which traces are found in most fairy mythologies, which explains the seeming incongruity of its being placed in the mouth of an old hag. The allegorical purport he has infused into it is his own, and entirely in the spirit of the Platonic philosophy. Don Quixote's adventure with the wine-skins, and Gil Blas's captivity among the robbers, are palpably borrowed from Apuleius; and several of the humorous episodes, probably current as popular stories long before his time, reappear in Boccaccio.

Of Apuleius's other writings, the *Apology* has been already mentioned. The *Florida* (probably meaning simply "anthology," without any reference to style) consists of a collection of excerpts from his declamations, ingenious but highly affected, and in general perfect examples of the sophistical art of saying nothing with emphasis. They deal with the most varied subjects, and are intended to exemplify the author's versatility. The pleasing little tract *On the God of Socrates* expounds the Platonic doctrine of beneficent daemons, an intermediate class between gods and men. Two books on Plato (*De Platone et Ejus Dogmate*) treat of his life, and his physical and ethical philosophy; a third, treating of logic, is generally considered spurious. The *De Mundo* is an adaptation of the Περὶ κόσμόυ wrongly attributed to Aristotle. Apuleius informs us that he had also composed numerous poems in almost all possible styles, and several works on natural history, some in Greek. In the preparation of these he seems to have attended more closely to actual anatomical research than was customary with ancient naturalists. Some other works—dealing with theology, the properties of herbs, medical remedies and physiognomy, are wrongly attributed to him.

The character of Apuleius, as delineated by himself, is attractive; he appears vehement and passionate, but devoid of rancour; enterprising, munificent, genial and an enthusiast for the beautiful and good. His vanity and love of display are conspicuous, but are extenuated by a genuine thirst for knowledge and a surprising versatility of attainments. He prided himself on his proficiency in both Greek and Latin. His place in letters is accidentally more important than his genius strictly entitles him to hold. He is the only extant example in Latin literature of an accomplished sophist in the good sense of the term. The loss of other ancient romances has secured him a peculiar influence on modern fiction; while his chronological position in a transitional period renders him at once the evening star of the Platonic, and the morning star of the Neo-Platonic philosophy.

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APULIA (sometimes APPULIA in manuscripts but never in inscriptions), the district inhabited in ancient times by the Apuli. Strictly a Samnite tribe (see SAMNITES) settled round Mount Garganus on the east coast of Italy (Strabo vi. 3. 11), the Apuli mingled with the Iapygian tribes of that part of the coast (Dauni, Peucetii, Poediculi) who, like the Messapii, had come from Illyria, so that the name Apulia reached down to the border of the ancient Calabria. Almost the only monument of Samnite speech from the district is the famous *Tabula Bantina* from Bantia, a small city just inside the Peucetian part of Apulia, on the Lucanian border. This inscription is one of the latest and in some ways the most important monument of Oscan, though showing what appear to be some southern peculiarities (see OSCA LINGUA). Its date is almost certainly between 118 and 90 B.C., and it shows that Latin had not even then spread over the district (cf. LUCANIA). Far older than this are some coins from Ausculum and Teate (later known as Teanum Apulum), of which the earliest belong to the 4th century B.C. Roman or Latin colonies were few, Luceria (planted 314 B.C.) in the north and Brundisium (soon after 268) being the chief. (See R.S. Conway, *Italic Dialects*, xxviii.-xxx. pp. 15 f.; and Mommsen's introduction to the opening sections of *C.I.L.* ix.)

(R. S. C.)

The wars of the 4th and 3rd centuries B.C. brought a great part of the pastures of the Apulian plain into the hands of the Roman state, and a tax was paid on every head of cattle and every sheep, at first to the tax farmer and later to the imperial procurator. It was under the Romans that the system of migration for the flocks reached its full development, and the practice is still continued; the sheep-tracks (*tratturi*), 350 ft. wide, leading from the mountains of the Abruzzi to the plain of Apulia date in the main at least from the Roman period, and are mentioned in inscriptions. The plain, however, which once served as winter grazing ground for a million sheep, now gives pasture to about one-half of that number.[1] The shepherds, who were slaves, often gave considerable trouble; we hear that some 7000 of them, who had made the whole country unsafe, were condemned to death in 185 B.C. (Livy xxxix. 29). Sheep-farming on a large scale was no doubt detrimental to the interests of the towns. We hear of repeated risings, for the last time in the Social War. Even in the 4th century B.C. the then chief town of Apulia, Teate or Teanum Apulum (see above), suffered in this way. Luceria subsequently took its place, largely owing to its military importance; but under the Empire it was succeeded by Canusium.

The road system of Apulia, which touched all the important towns, consisted of three main lines, the Via Appia (see APPIA, VIA), the Via Traiana, and the coast road, running more or less parallel in an east-south-east direction. The first (the southernmost), coming east from Beneventum, entered Apulia at the Pons Aufidi, and ran through Venusia to Tarentum, and thence, turning north-east, to Brundusium. The second, coming north-east from Beneventum, turned east at Aecae, and ran through Herdoniae, Canusium, Butuntum, Barium and Gnathia (Gnatia) to Brundusium. There was also a short cut from Butuntum to Gnathia through Caelia, keeping inland. The third parallel line ran to the north of the Via Traiana, in continuation of the road along the north-east coast of Picenum and Samnium; it entered Apulia near Larinum (whence a branch ran south to Bovianum Undecimanorum), and thence, keeping in the plain to the south of the Mons Garganus, rejoined the coast at Sipontum, where it received a branch road from the Via Traiana at Aecae, passing through Luceria and Arpi. It then passed through Barduli (where it was joined by a road from Canusium by way of Cannae) to Barium, where it joined the Via Traiana. From Barium a road probably ran direct to Caelia, and thence south-south-east to join the Via Appia some 25 m. north-west of Tarentum.

Barium was an important harbour, though less so than Brundusium and Tarentum, which, however, belonged to Calabria in the Roman sense. Apulia, with Calabria, formed the second region of Augustus, though we once find Calabria treated as a part of the third region, Lucania (*C.I.L.* ix. 2213). The Hannibalic and later wars had, Strabo tells us, destroyed the former prosperity of the country; in imperial times we hear little or nothing of it. Both were governed by a *corrector* from the time of Constantine onwards, but in 668 the

Lombards conquered Calabria and Apulia, and it was then that the former name was transferred to Bruttium, the meaning of the latter being extended to include Calabria also. In the 10th century the greater part of this territory was recovered by the Byzantine emperors, whose governor was called Καταπανός, a name which, under the corrupt form Capitanata, belonged to the province of Foggia till 1861. It was conquered by the Normans under William Bras-de-fer, who took the title of *comes Apuliae* in 1042; it was raised to a dukedom with Calabria by Robert Guiscard in 1059, and united to the Sicilian monarchy in 1127. Many of the important towns possess fine Romanesque cathedrals, constructed under the Normans and the Hohenstaufen rulers. It shared the subsequent fate of Sicily, becoming a part of the kingdom of the Two Sicilies in 1734, and being united with Italy in 1861.

Modern Apulia comprises the three provinces of Foggia, Bari and Lecce (the latter corresponding roughly with the ancient Calabria, which, however, extended somewhat farther north inland), and is often known as Le Puglie; it stretches from Monte Gargano to the south-east extremity of Italy, with an area of 7376 sq. m.; it is bounded on the north and east by the Adriatic, on the south-east by the Gulf of Taranto, on the south by Basilicata and on the west by Campania and the Abruzzi. The three provinces correspond to the three natural divisions into which it falls. That of Foggia, though it has mountains on the west and south-west boundary, and the Monte Gargano at its north-east extremity, is in the main a great plain called the Tavoliere (chessboard) di Puglia, with considerable lagoons on its north and east coast. That of Bari, east-south-east of Foggia and divided from it by the Ofanto (Aufidus), the only considerable river of Apulia, 104 m. long, is a hilly district with a coast strip along which are the majority of the towns—the lack of villages is especially noticeable; in the *circondario* of Barletta, the north-east portion of the province, there are only eleven communes, with a total population of 335,934. That of Lecce, to the east-south-east again, is a low flat limestone terrace.

Modern Apulia.

The industries of Apulia are mainly pastoral or agricultural. Besides sheep, a considerable number of horses, cattle and swine are bred; while despite the lack of water, which is the great need of modern Apulia (in 1906 arrangements were made for a great aqueduct, to supply the three provinces from the headwaters of the Sele), cultivation is actively carried on, especially in the province of Bari, where grain, wine, olives, almonds, lemons, oranges, tobacco, &c., are produced in abundance, and the export of olive oil is attaining considerable importance. The salt works of Margherita di Savoia produce large quantities of salt, and nitre is extracted near Molfetta.

Railway communications are fairly good, the main line from Bologna to Brindisi passing through the whole length of Apulia, by way of Foggia and Bari, and having branches from Foggia (the main railway centre of Apulia) to Benevento and Caserta, to Manfredonia, to Lucera and to Rocchetta S. Antonio (and thence to either Avellino, Potenza or Gioia del Colle), from Ofantino to Margherita di Savoia, from Barletta to Spinazzola (between Rocchetta S. Antonio and Gioia del Colle), from Bari to Putignano, and via Gioia del Colle to Taranto, and from Brindisi to Taranto, and to Lecce and Otranto; besides which, there is a steam tramway from Barletta to Bari via Andria.

The most important harbours of Apulia are Brindisi, Bari, Taranto, Barletta, Molfetta and Gallipoli. The export of olive oil to foreign countries from the province of Lecce in 1905 amounted to 1048 tons, as against 3395 in 1901; but that to home ports increased from 7077 to 9025 tons in the same period. The production of wine was 358,953 tons in 1905 as against 203,995 tons in 1901 (an exceptionally bad year) and 284,156 tons in 1902. Of this 211,872 tons were forwarded by rail and sea, in the proportion of five to two respectively, the rest being used for home consumption and as a reserve. The cultivation of oriental tobacco is extending in the province (see *Consular Report*, No. 3672, July 1906).

The population of the province of Foggia was 425,450 (1901) as against 322,755 in 1871, the chief towns being Foggia (53,151), Cerignola (34,195), S. Severo (30,040), Monte S. Angelo (21,870), S. Marco in Lamis (17,309), Lucera (17,515); that of Bari, 827,698 (1901) as against 604,540 in 1871, the chief towns being Bari (77,478), Andria (49,569), Barletta (42,022), Corato (41,573), Molfetta (40,135), Trani (31,800), Bisceglie (30,885), Bitonto (30,617), Canosa (24,169), Ruvo (23,776), Terlizzi (23,232), Altamura(22,729), Monopoli (22,545), Gioia del Colle (21,721); that of Lecce, 706,520 (1901) as against 493,594 in 1871, the chief towns being Taranto (60,733), Lecce (32,687), Brindisi (25,317), Martina Franca (25,007), Ostuni (22,997), Francavilla Fontana (20,422), Ceglie Messapica (16,867), Nardo (14,387), Galatina (14,071), Gallipoli (13,552), Manduria (13,113).

(T. As.)

1 The migration was made compulsory by Alphonso I. in 1442, and remained so until 1865. Since that time the *tratturi* have been to some extent absorbed by private proprietors.

APURÉ, a river of western Venezuela, formed by the confluence of the Sarare and Uribante at 6° 45′ N. lat. and 71° W. long., and flowing eastward across the Venezuelan *llanos* to a junction with the Orinoco at about 7° 40′ N. lat. and 66° 45′ W. long. Its drainage area includes the slopes of both the Colombian and Venezuelan Andes. It has a sluggish course across the *llanos* for about 300 m., and is navigable throughout its length. Its principal tributaries are the Caparro, Portuguesa and Guarico on the north, and the Caucagua on the south. Its lateral channels on the south mingle with those of the Arauca for many miles, forming an extensive district subject to annual inundations.

APURIMAC, a river of central Peru, rising in the Laguna de Villafra in the western Cordilleras, 7 m. from Caylloma, a village in the department of Arequipa, and less than 100 m. from the Pacific coast. It flows first north-easterly, then north-westerly past Cuzco to the mouth of the Perené tributary, thence east and north to its junction with the Ucayali at 10° 41′ S. lat., and 73° 34′ W. long. It is known as the Apurimac only down to the mouth of the Mantaro tributary, 11° 45′ S. lat. and 1325 ft. above sea-level. Thence to the mouth of the Perene (984 ft.) it is known as the Ené, and from that point to its junction with the Ucayali (859 ft.) as the Tambo.

APURIMAC, an interior department of southern Peru, bounded N. by the department of Ayacucho, E. by Cuzco, S. and W. by Cuzco and Ayacucho. Area, 8187 sq. m.; pop. (1896) 177,387. The department was created in 1873 and comprises five provinces. Its physical features and productions are very similar to those of Ayacucho (*q.v.*), with the exception that sugar-cane is cultivated with noteworthy success in the low valley of the province of Abancay. The capital, Abancay, 110 m. south-west of Cuzco, which is only a village in size but is rich in historical associations and Andahuaylas, in the north-west part of the department, are its principal towns.

APYREXIA (Gr. ἀπυρεξία, from ἀ-, privative, πυρέσσειν, to be in a fever, πῦρ, fire, fever), in pathology, the normal interval or period of intermission in a fever.

ʻAQĪBA BEN JOSEPH (*c.* 50-132), Jewish Palestinian rabbi, of the circle known as *tana* (*q.v.*). It is almost impossible to separate the true from the false in the numerous traditions respecting his life. He became the chief teacher in the rabbinical school of Jaffa, where, it is said, he had 24,000 scholars. Whatever their number, it seems certain that among them was the celebrated Rabbi Meir, and that through him and others ʻAqība exerted a great influence on the development of the doctrines embodied in the Mishnah. He sided with Bar Cochebas in the last Jewish revolt against Rome, recognized him as the Messiah, and acted as his sword-bearer. Being taken prisoner by the Romans under Julius Severus, he was flayed alive with circumstances of great cruelty, and met his fate, according to tradition, with marvellous steadfastness and composure. He is said by some to have been a hundred and twenty years old at the time of his death. He is one of the ten Jewish martyrs whose names occur in a penitential prayer still used in the synagogue service. ʻAqība was among the first to systematize the Jewish tradition, and he paved the way for the compilation of the Mishnah. From his school emanated the Greek translation of the scriptures by Aquila.

AQUAE (Lat. for “waters”), a name given by the Romans to sites where mineral springs issued from the earth. Over a hundred can be identified, some declaring by their modern names their ancient use: Aix-les-Bains in Savoy (*Aquae Sabaudicae*), Aix-en-Provence (*Aquae Sextiae*), Aix-la-Chapelle or Aachen (*Aquae Granni*), &c. Only two occur in Britain: *Aquae Sulis*—less correctly *Aquae Solis*—at Bath in Somerset, which was famous, and Buxton (called *Aquae* simply), which seems to have been far less important. Aquae Sulis was occupied by the Romans almost as soon as they entered the island in A.D. 43, and flourished till the end of the Roman period. It was frequented by soldiers quartered in Britain, by the Britons, and by visitors from north Gaul, and its name was known in Italy, though patients probably seldom travelled so far. Like most mineral springs known to the ancients, it was under the protection of a local deity, the Celtic Sul, whom the Romans equated with their Minerva. Stately remains of its baths and temple have been found at various times, especially in 1790 and 1878-1895, and may still be seen there.

AQUAE CUTILIAE, a mineral spring in Italy, near the modern Cittaducale, 9 m. E. of Rieti. The lake near it was supposed by classical writers to be the central point of Italy, and was renowned for its floating islands, which, as in other cases, were formed from the partial petrification of plants by the mineral substances contained in the water. Considerable remains of baths may still be seen there—they were apparently resorted to by both Vespasian and Titus in their last illnesses, for both died there.

AQUAMARINE (Lat. *aqua marina*, “water of the sea”), a transparent variety of beryl (*q.v.*), having a delicate blue or bluish-green colour, suggestive of the tint of sea-water. It occurs at most localities which yield ordinary beryl, some of the finest coming from Russia. The gem-gravels of Ceylon contain aquamarine. Clear yellow beryl, such as occurs in Brazil, is sometimes called aquamarine chrysolite. When corundum presents the bluish tint of typical aquamarine, it is often termed Oriental aquamarine.

AQUARELLE (from Ital. *acquarella*, water-colour), a form of painting with thin water-colour or ink.

AQUARII, a name given to the Christians who substituted water for wine in the Eucharist. They were not a sect, for we find the practice widely in vogue at an early time, even among the orthodox. In Greek they were called *Hydroparastatae*, or those who offer water. Theodosius, in his persecuting edict of 382, classes them as a special sect with the Manicheans, who also eschewed wine. See Eucharist.

AQUARIUM (plural *aquaria*), the name given to a receptacle for a marine flora and fauna. Until comparatively recently, aquaria were little more than domestic toys, or show-places of a popular character, but they have now not only assumed a profound scientific importance for the convenient study of anatomical and physiological problems in marine botany and zoology, but have also attained an economic value, as offering the best opportunities for that study of the habits and environment of marketable food-fish without which no steps for the improvement of sea-fisheries can be safely taken. The numerous “zoological stations” which have sprung up, chiefly in Europe and the United States, but also in the British colonies and Japan, often endeavour to unite these two aims, and have in many cases become centres of experimental work in problems relating to fisheries, as well as in less directly practical subjects. Of these stations, the oldest and the most important is that at Naples, which, though designed for purely scientific objects, also encourages popular study by means of a public aquarium. The following account (1902) of this station by Dr W. Giesbrecht, a member of the staff, will serve to show the methods and aims, and the complex and expensive equipment, of a modern aquarium:—

“The zoological station at Naples is an institution for the advancement of biological science—that is, of comparative anatomy, zoology, botany, physiology. It serves this end by providing the biologist with the various objects of his study and the necessary appliances; it is not a teaching institution. The station was founded by Dr Anton Dohrn, and opened in the spring of 1874; it is the oldest and largest of all biological stations, of which there are now about thirty in existence. Its two buildings are situated near the seashore in the western town park (Villa Nazionale) of Naples. The older and larger one, 33 metres long, 24 m. deep, 16 m. high, contains on the ground floor the aquarium, which is open to the public. On the first floor there is, facing south, the principal library, ornamented with fresco paintings, and, facing north, a large hall containing twelve working tables, several smaller rooms and the secretarial offices. On the second floor is the physiological laboratory, and on the third floor the small library, a hall with several working tables, and the dark rooms used in developing photographs. The ground floor of the smaller building, which was finished in 1887, contains the rooms in which the animals are delivered, sorted and preserved, and the fishing tackle kept, together with the workshop of the engineer; on the first and second floors are workrooms, amongst others the botanical laboratory; on the third floor are store-rooms. In the basement of both buildings, which is continued underneath the court, there are sea-water cisterns and filters, engines and store-rooms. The materials for study which the station offers to the biologist are specimens of marine animals and plants which abound in the western part of the Mediterranean, and especially in the Gulf of Naples. To obtain these, two screw-steamers and several rowing boats are required, which are moored in the harbour of Mergellina, situated close by. The larger steamer, ‘Johannes Müller’ (15 m. long, 2½ m. wide, 1 m. draught), which can steam eight to ten English miles per hour, is provided with a steam dredge working to a depth of eighty fathoms. From the small steamer, ‘Frank Balfour,’ and the rowing boats, the fishing is done by means of tow-nets. Besides these there are fishermen and others who daily supply living material for study. The plankton (small floating animals) is distributed in the morning, other animals as required. The animals brought in by the fishermen are at once distributed amongst the biologists, whereas the material brought up by the dredges is placed in flat revolving wooden vessels, so as to give the smaller animals time to come out of their hiding-places. The students who work in the station have the first claim on specimens of plants and animals; but specimens are also supplied to museums, laboratories and schools, and to individuals engaged in original research elsewhere. Up to the present time about 4000 such parcels have been despatched, and not infrequently live specimens of animals are sent to distant places. This side of the work has been of very great value to science. The principal appliances for study with which the station provides the biologist are workrooms furnished with the apparatus and chemicals necessary for anatomical research and physiological experiments and tanks. Every student receives a tank for his own special use. The large tanks of the principal aquarium are also at his disposal for purposes of observation and experiment if necessary.

“The water in the tanks is kept fresh by continual circulation, and is thus charged with the oxygen

necessary to the life of the organisms. It is not pumped into the tanks directly from the sea, but from three large cisterns (containing 300 cubic metres), to which it again returns from the tanks. The water wasted or evaporated during this process is replaced by new water pumped into the cisterns directly from the sea. The water flows from the large cisterns into a smaller cistern, from which it is distributed by means of an electric pump through vulcanite or lead pipes to the various tanks. The water with which the tanks on the upper floors are filled is first pumped into large wooden tanks placed beneath the roof, thence it flows, under almost constant pressure, into the tanks. The water circulated in this manner contains by far the largest number of such animals as are capable of living in captivity in good condition. Some of them even increase at an undesirable rate, and it sometimes happens that young Mytilus or Ciona stop up the pipes; in laying these, therefore, due regard must be had to the arrangements for cleaning. For the cultivation of very delicate animals it is necessary to keep the water absolutely free from harmful bacteria; for this purpose large sand-filters have lately been placed in the system, through which the water passes after leaving the cisterns. Each of the smaller cisterns, which are fixed in the workrooms, consist of two water-tanks, placed one above the other; their frames are of wrought iron and the walls generally of glass. Vessels containing minute animals can be placed between these two tanks, receiving their water through a siphon from the upper tank; the water afterwards flows away into the lower tank.

"The twenty-six tanks of the public aquarium (the largest of which contains 112 cubic metres of water) have stone walls, the front portion alone being made of glass. As the tanks hold a very large number of animals in proportion to the quantity of water, they require to be well aerated. The pipes through which the water is conducted are therefore placed above the surface of the water, and the fresh supply is driven through them under strong pressure. A large quantity of air in the form of fine bubbles is thus taken to the bottom of the tank and distributed through the entire mass of water. Should the organisms which it is desired to keep alive be very minute, there is a danger of their being washed away by the circulating water. To obviate this, either the water which flows away is passed through a strainer, or the water is not changed at all, air being driven through it by means of an apparatus put into motion by the drinking-water supply.

"The library contains about 9000 volumes, which students use with the help of a slip catalogue, arranged according to authors. The station has published at intervals since 1879 two periodicals treating of the organisms of the Mediterranean. One is *Fauna und Flora des Golfes van Neapel*, the other *Mittheilungen aus der zoologischen Station zu Neapel*. The former consists of monographs in which special groups of animals and plants are most exhaustively treated and the Mediterranean species portrayed according to life in natural colours; up to the present time twenty-one zoological and five botanical monographs have appeared, making altogether 1200 4to sheets with about 400 plates. Of the Mittheilungen, which contain smaller articles on organisms of the Mediterranean, fourteen volumes in 8vo have been published. The station also publishes a *Zoologischer Jahresbericht*, which at first treated of the entire field of zoology, but since 1886 has been confined principally to comparative anatomy and ontogeny; it appears eight to nine months after the end of the year reported. The *Guide to the Aquarium*, with its descriptions and numerous pictures, is meant to give the lay visitor an idea of the marine animal world.

"There are about forty officials, amongst them six zoologists, one physiologist, one secretary, two draughtsmen, one engineer. The station is a private institution, open to biologists of all nations under the following conditions: there are agreements with the governments of Austria, Baden, Bavaria, Belgium, Hamburg, Holland, Hesse, Italy, Prussia, Russia, Saxony, Switzerland, Hungary, Württemberg, the province of Naples, and the universities of Cambridge, Oxford, Strassburg, Columbia College (New York), and the British Association for the Advancement of Science, the Smithsonian Institution, and a society of women in the United States of North America (formerly also with Bulgaria, Rumania, Spain, the Academy of Sciences in Berlin, Williams College, University of Pennsylvania), by virtue of which the governments and corporate bodies named have the right, on payment of £100 per annum, to send a worker to the station; this places at his disposal a 'table' or workplace, furnished with all the necessary appliances and materials as set down in the agreement. At present there are agreements for thirty-three tables, and since the foundation of the station nearly 1200 biologists have worked there. The current expenses are paid out of the table-rents, the entrance fees to the public aquarium, and an annual subvention paid by the German empire."

In England a station on similar lines, but on a smaller scale, is maintained at Plymouth by the Marine Biological Association of the United Kingdom, with the help of subsidies from the government and the Fishmongers' Company.

Little difficulty is experienced in maintaining, breeding and rearing fresh-water animals in captivity, but for many various reasons it is only by unremitting attention and foresight that most marine animals can be kept even alive in aquaria, and very few indeed can be maintained in a condition healthy enough to breed. Much experience, however, has been gained of late years at considerable expense, both in England and abroad. In starting a marine aquarium of whatever size, it should be obvious that the first consideration must be a supply of the purest possible water, as free as may be, not only from land-drainage and sewage, but also from such suspended matters as chalk, fine sand or mud. This is most ideally and economically secured by placing the station a few feet above high-water mark, in as sheltered a position as possible, on a rocky coast, pumping from the sea to a large reservoir above the station, and allowing the water to circulate gently thence through the tanks by gravity (Banyuls). At an inland aquarium (Berlin, Hamburg), given pure water in the first instance, excellent if less complete results may nevertheless, be obtained. The next consideration is the method by which oxygen is to be supplied to the organisms in the aquarium. Of the two methods hitherto in use, that of pumping a jet of air into tanks otherwise stagnant or nearly so (Brighton), while supplying sufficient oxygen, has so many other disadvantages, that it has not been employed regularly in any of the more modern aquaria. It is, however, still useful in aerating quite small bodies of water in which hardy and minute organisms can be isolated and kept under control. In the other method, now in general use, a fine jet of water under pressure falls on to the surface of the tank; this carries down with it a more than sufficient air-supply, analysis showing in some cases a higher percentage of oxygen in aquarium water than in the open sea.

The water supply is best effected by gravity from reservoirs placed above the tanks, but may be also

achieved by direct pumping from low reservoirs or from the sea to the tanks. Provided that an unlimited supply of pure water can be obtained cheaply, the overflow from the tanks is best run to waste; but in aquaria less fortunately placed, it returns to a storage low-level reservoir, from which it is again pumped, thus circulating round and round (Naples, Plymouth). The storage reservoirs should be in all cases very large in comparison with the bulk of water in circulation; if practicable, they should be excavated in rock, and lined with the best cement. Thera is no reason why they should not be shallow, exposed to light and air, and cultivated as rock-pools by the introduction of seaweeds and small animals, but they must then be screened from rain, cold and dust. The pumps used in circulation will be less likely to kill minute animals if of the plunger or ram type, rather than rotary, and should be of gun-metal or one of the new bronze-alloys which take a patina in salt water. For the circulating pipes many materials have been tried. Vulcanite is not only expensive and brittle, but has other disadvantages; common iron pipes, coated internally with cement or asphalt or glazed internally, with all unions and joints cemented, have been used with more or less success. Probably best of all is common lead piping, the joints being served with red-lead; water should be circulated through such pipes till they become coated with insoluble carbonate, for some time before animals are put into the tanks. For small installations glass may be used, the joints being made with marine glue or other suitable cement.

In building the tanks themselves, regard must be had to their special purposes. If intended for show-tanks for popular admiration, or for the study of large animals, they must be large with a plate-glass front; for ordinary scientific work small tanks with all sides opaque are preferable from every point of view. According to their character, size and position, fixed tanks may be of brickwork, masonry or rock, coated in each case with cement; asphalting the sides offers no particular advantages, and often gives rise to great trouble and expense. All materials, and especially the cements, must be of the finest quality procurable. For smaller and movable tanks, slate slabs bolted or screwed together have some disadvantages, notably those of expense, weight and brittleness, but are often used. Better, cheaper and lighter, if less permanent, are tanks of wood bolted together, pitched internally. Glass bell-jars, useful in particular cases, should generally have their sides darkened, except when required for observation. Provision should always be made for cleaning every part of the tanks, pipes and reservoirs; all rock-work in tanks should therefore be removable. As regards the lighting of fixed tanks, it should always be directly from above. In all tanks with glass sides, whether large or small, as much light as possible should be kept from entering through the glass; otherwise, with a side-light, many animals become restless, and wear themselves out against the glass, affected by even so little light as comes through an opposite tank.

In cases where distance from the sea or other causes make it impracticable to allow the overflow from the tanks to run to waste, special precautions must be taken to keep the water pure. Chemically speaking, the chief character of the water in an aquarium circulation, when compared with that of the open sea, lies in the excessive quantity of nitrogen present in various forms, and the reduced alkalinity; these two being probably connected. The excess of nitrogen is referable to dead animals, to waste food and to the excreta of the living organisms. The first two of these sources of contamination may be reduced by care and cleanliness, and by the maintenance of a flow of water sufficient to prevent the excessive accumulation of sediment in the tanks. The following experiment shows the rapid rise of nitrogen if unchecked. A tank with a considerable fauna was isolated from the general circulation and aerated by four air-jets, except during hours 124-166 of the experiment; column I. shows per 100,000 the nitrogen estimated as ammonia, column II. the total inorganic nitrogen:—

	I.	II.
Sea-water at source of original supply	0.001	0.003
Aquarium water in tank at commencement of experiment	0.012	0.400
After 22½ hours	0.020	. .
” 75 ”	0.025	1.200
” 93 ”	0.019	. .
” 121½ ”	0.012	. .
” 141 ”	0.015	2.200
” 165 ”	0.025	. .
” 169 ”	0.025	. .
” 189 ”	0.012	. .

During this time the alkalinity was reduced to the equivalent of 30 mg. $CaCO_3$ per litre, ocean water having an alkalinity equivalent to 50-55 mg. per litre. It has been suggested that the organic nitrogen becomes oxidized into nitrous, then into nitric acid, which lowers the carbonate values. A great deal of reduction of this nitrogenous contamination can be effected by filtration, a method first introduced successfully at Hamburg, where a most thriving aquarium has been maintained by the local Zoological Society for many years on the circulation principle, new water being added only to compensate for waste and evaporation. The filters consist of open double boxes, the inner having a bottom of perforated slate on which rests rough gravel; on the latter is fine gravel, then coarse, and finally fine sand. Filtration may be either upwards or downwards through the inner box to the outer. Such filters, intercalated between tanks and reservoir, have been shown by analysis to stop a very large proportion of nitrogenous matter. It is doubtful whether aquarium water will not always show an excess of nitrogenous compounds, but they must be kept down in every way possible. In small tanks, well lighted, seaweeds can be got to flourish in a way that has not been found practicable in large tanks with a circulation; these, with Lamellibranchs and small Crustacea as scavengers, will be found useful in this connexion. Slight or occasional circulation should be employed here also, to remove the film of dust and other matters, which otherwise covers the surface of the water and prevents due oxygenation.

In such small tanks for domestic use the fauna must be practically limited to bottom-living animals, but for purposes of research it is often desired to keep alive larval and other surface-swimming animals (plankton). In this case a further difficulty is presented, that of helping to suspend the animals in the water, and thus to avoid the exhaustion and death which soon follow their unaided efforts to keep off the bottom; this duty is

effected in nature by specific gravity, tide and surface current. In order to deal with this difficulty a simple but efficient apparatus has been devised by Mr E.T. Browne; a “plunger,” generally a glass plate or filter funnel, moves slowly up and down in a bell-jar or other small tank, with a period of rest between each stroke; the motive power is obtained through a simple bucket-and-siphon arrangement worked by the overflow from other tanks. This apparatus (first used at the Plymouth Laboratory of the Marine Biological Association in 1897, and since introduced into similar institutions), by causing slight eddies in the water, keeps the floating fauna in suspension, and has proved very successful in rearing larvae and in similar work.

(G. H. Fo.)

AQUARIUS (the “Water-bearer” or “Cup-bearer”), in astronomy, the eleventh sign of the zodiac (*q.v.*), situated between Capricornus and Pisces. Its symbol is ♒, representing part of a stream of water, probably in allusion to the fact that when the sun is in this part of the heavens (January, February) the weather is rainy. It is also a constellation mentioned by Eudoxus (4th century B.C.) and Aratus (3rd century B.C.); Ptolemy catalogued forty-five stars, Tycho Brahe forty-one, Hevelius forty-seven. ζ *Aquarii* is a well-defined binary, having both components of the fourth magnitude; it is probably of long period.

AQUATINT (Lat. *aqua*, water, and *tincta*, dyed), a kind of etching (*q.v.*) which imitates washes with a brush. There are many ways of preparing a plate for aquatint, the following being recommended by P.G. Hamerton. Have three different solutions of rosin in rectified alcohol, making them of various degrees of strength, but always thin enough to be quite fluid, the weakest solution being almost colourless. First pour the strongest solution on the plate. When it dries it will produce a granulation; and you may now bite as in ordinary etching for your darker tones, stopping out what the acid is not to operate upon, or you may use a brush charged with acid, perchloride of iron being a very good mordant for the purpose. After cleaning the plate, you proceed with the weaker solutions in the same way, the weakest giving the finest granulation for skies, distances, &c. The process requires a good deal of stopping-out, and some burnishing, scraping, &c., at last. Aquatint may be effectively used in combination with line etching, and still more harmoniously with soft ground etching in which the line imitates that of the lead pencil.

AQUAVIVA, CLAUDIO (1542-1615), fifth general of the Jesuits, the youngest son of the duke d’Altri, was born at Naples. He joined the Jesuits at Rome in 1567, and his high administrative gifts marked him out for the highest posts. He was soon nominated provincial of Naples and then of Rome; and during this office he offered to join the Jesuit mission to England that set out under Robert Parsons (*q.v.*) in the spring of 1580. The following year, being then only thirty-seven years old, he was elected, by a large majority, general of the society in succession to Mercurian, to the great surprise of Gregory XIII.; but the extraordinary political ability he displayed, and the vast increase that came to the Society during his long generalate, abundantly justified the votes of the electors. He, together with Lainez, may be regarded as the real founder of the Society as it is known to history. A born ruler, he secured all authority in his own hands, and insisted that those who prided themselves on their obedience should act up to the profession. In his first letter “On the happy increase of the Society” (25th of July 1581), he treats of the necessary qualifications for superiors, and points out that government should be directed not by the maxims of human wisdom but by those of supernatural prudence. He successfully quelled a revolt among the Spanish Jesuits, which was supported by Philip II., and he made use in this matter of Parsons. A more difficult task was the management of Sixtus V., who was hostile to the Society. By consummate tact and boldness Aquaviva succeeded in playing the king against the pope, and Sixtus against Philip. For prudential reasons, he silenced Mariana, whose doctrine on tyrannicide had produced deep indignation in France; and he also appears to have discountenanced the action of the French Jesuits in favour of the League, and was thus able to secure solid advantages when Henry IV. overcame the confederacy. To him is due the Jesuit system of education in the book *Ratio atque institutio studiorum* (Rome, 1586). But the Dominicans denounced it to the Inquisition, and it was condemned both in Spain and in Rome, on account of some opinions concerning the Thomist doctrines of the divine physical premotion in secondary causes and predestination. The incriminated chapters were withdrawn in the edition of 1591. In the fierce disputes that arose between the Jesuit theologians and the Dominicans on the subject of grace, Aquaviva managed, under Clement VIII. and Paul V., to save his party from a condemnation that at one time seemed probable. He died at Rome on the 31st of January 1615, leaving the Society numbering 13,000 members in 550 houses and 15 provinces. The subsequent influence exercised by the Jesuits, in their golden age, was largely due to the far-seeing policy of Aquaviva, who is undoubtedly the greatest general that has governed the Society.

(E. Tn.)

AQUEDUCT (Lat. *aqua*, water, and *ducere*, to lead; Gr. ὑδραγωγεῖον, ὑδραγώγιον, ὑπόνομος), a term properly including artificial works of every kind by means of which water is conveyed from one place to another, but generally used in a more limited sense. It is, in fact, rarely employed except in cases where the work is of considerable magnitude and importance, and where the water flows naturally by gravitation. The most important purpose for which aqueducts are constructed is that of conveying pure water, from sources more or less distant, to large masses of population. Aqueducts are either below ground, on the surface, or raised on walls either solid or pierced with arches; to the last the term is often confined in popular language. The choice of method naturally depends on the contour of the country.

I. *Ancient Aqueducts.*—In Egypt, Babylonia and Assyria—flat countries traversed by big rivers and subject to floods—water was supplied by means of open canals with large basins. In Persia devices of all kinds were adopted according to the nature of the country. In relation to the achievements of Greece and Rome, the Phoenicians are the most important among pre-classical engineers. In Cyprus water was supplied to temples by rock-cut subterranean conduits carried across intervening valleys in siphons. Such conduits have been found near Citium, Amathus, &c. (Cesnola, *Cyprus*, pp. 187, 341). In Syria the most striking of Phoenician waterworks is the well of Ras-el-Ain near Tyre, which consisted of four strong octagonal towers through which rises to a height of 18 to 20 ft. the water from four deep artesian wells. The water thus accumulated was carried off in conduits to reservoirs near the shore, and thence in vessels or skins to the island. The aqueduct across to the island is, of course, of Roman work.

Phoenician.

It is not possible in all cases to find a satisfactory date for the numerous conduits which have supplied Jerusalem; some probably go back to the times of the kings of Judah. The principal reservoir consists of the three Pools of Solomon which supplied the old aqueduct; the highest is about 20 ft. above the middle one and 40 above the lowest. These pools collected the water from Ain Saleh and other springs, and sent it to the city by two conduits. The higher of these— probably the older—was partly a rock-cut canal, partly carried on masonry; the siphon-pipe system was adopted across the lower ground near Rachel's Tomb, where the pipe (15 in. wide) is formed of large pierced stones embedded in rubble masonry. The lower conduit is still complete; it winds so much as to be altogether some 20 m. long. Near the Birket-es-Sultan it passes over the valley of Hinnom on nine low arches and reaches the city on the hill above the Tyropeon valley. It enters the Haram enclosure at the Gate of the Chain (Bāb es-Silsila), outside which is a basin 84 ft. by 42 by 24 deep. It is interesting to note in the case of the underground tunnel which brought water from the Virgin's Fountain to the pool of Siloam, that the two boring parties had no certain means of keeping the line; there is evidence that they had to make shafts to discover their position, and that ultimately the parties almost passed one another. Though the direct distance is 1100 ft., the length of the conduit is over 1700 ft. Perrot and Chipiez incline to attribute the Pools of Solomon to the Asmonaeans, followed by Roman governors, whereas the earlier tunnels of the Kedron and Tyropeon valley may be Punic-Jewish (see also *Palest. Explor. Fund Mem.*, "Jerusalem," pp. 346-365). Besides these conduits excavation has discovered traces of many other cisterns, tunnels and conduits of various kinds. Many of them point to periods of great prosperity and engineering enterprise which gave to the city a water-supply far superior to that which exists at present.

Jerusalem.

See the publications of the Palestine Exploration Fund; A.S. Murray's *Handbook to Syria and Palestine* (1903), pp. 63-67; Perrot and Chipiez, *History of Art in Sardinia, Judaea, &c.* (Eng. trans., 1890), pp. 321 ff.; other authorities quoted under JERUSALEM.

The earliest attempts in Europe to solve the problems of water-supply were made by the Greeks, who perhaps derived their ideas from the Phoenicians. It has generally been held, partly on the strength of a passage in Strabo (v. 3. 8, p. 235), and partly owing to the comparative unimportance of the remains discovered, that the Greek works were altogether inferior to the Roman. Research in the Greek towns of Asia Minor, together with a juster appreciation of the remains as a whole, must be held to modify this view. Among the earliest examples of Greek work are the tunnels or *emissaria* which drained Lake Copais in Boeotia; these, though not strictly aqueducts, were undoubtedly the precursors of such works, consisting as they did of subterranean tunnels (ὑπόνομοι) with vertical shafts (φρεατίαι), sixteen of which are still recognizable, the deepest being about 150 ft. They may be compared with that described by Polybius as conveying water from Taurus to Hecatompylos, and with numerous other remains in Asia Minor, Syria, Phoenicia and Palmyra. Popular legend ascribed them to Cadmus, just as Argos referred the irrigation of its lands to Danaüs. They are undoubtedly of great antiquity.

Greek

The insufficiency of water, supplied by natural springs and cisterns hewn in the rock, which in an early age had satisfied the small communities of Greece, had become a pressing public question by the time of the Tyrants, of whom Polycrates of Samos and Peisistratus of Athens were distinguished for their wisdom and enterprise in this respect. The former obtained the services of Eupalinus, an engineer celebrated for the skill with which he had carried out the works for the water-supply of Megara (see *Athen. Mittheil.* xxv., 1900, 23) under the direction of the Tyrant Theagenes (*c.* 625 B.C.). At Samos the difficulty lay in a hill which rose between the town and the water source. Through this hill Eupalinus cut a tunnel 8 ft. broad, 8 ft. high and 4200 ft. long, building within the tunnel a channel 3 ft. broad and 11 ells deep. The water, flowing by an accurately reckoned declivity, and all along open to the fresh air, was received at the lower end by a conduit of masonry, and so led into the town, where it supplied fountains, pipes, baths, cloacae, &c., and ultimately passed into the harbour (Herod, iii. 60). In Athens, under the rule of the Peisistratids (*c.* 560-510 B.C.), a similarly extensive, if less difficult, series of works was completed to bring water from the neighbouring hills to supplement the inadequate supply from the springs. From Hymettus were two conduits passing under the bed of the Ilissus, most of the course being cut in the rock. Pentelicus, richer in water, supplied another conduit, which can still be traced from the modern village of Chalandri by the air shafts built several feet above the ground, and at a distance apart of 130-160 ft.; the diameter of these shafts is 4-5 ft., and the number of them still preserved is about sixty. Tributary channels conveyed into the main stream the waters of the district through which it passed. Outside Athens, those two conduits met in a large reservoir, from which the water was distributed by a ramification of underground channels throughout the city. These latter channels vary in form, being partly round, partly square, and generally walled with stone; the chief one is sufficiently large for two men to pass in it. The precise location of the reservoir depends on the value of Dr

Wilhelm Dörpfeld's theory as to the site of the Enneacrunus of Thucydides and Pausanias (see Athens: *Topography and Antiquity*). Dörpfeld places it south-west of the Acropolis, where there is a cistern connected with an aqueduct which passed under the theatre of Dionysus and on towards the Ilissus (see map under Athens). Others have placed it south of the Olympieum in the Ilissus bed. Beside these works water was brought from Pentelicus in an underground conduit begun by the emperor Hadrian and completed by Antoninus Pius. This aqueduct is still in use, having been repaired in 1869.

In Sicily, the works by which Empedocles, it is said, brought the water into the town of Selinus, are no longer visible; but it is probable that, like those of Syracuse, they consisted chiefly of tunnels and pipes laid under the ground. Syracuse was supplied by two aqueducts, one of which the Athenians destroyed (Thuc. vi. 100). One was fed by an affluent (the mod. Buttigliara) of the Anapus (mod. Anapo); it carried the water up to the top of Epipolae, where the channel was open, and thence down to the city and finally into the harbour. The other also ascends to the top of Epipolae, skirts the city on the north, and then proceeds along the coast. Its course is marked by rectangular shafts (*spiragli*) at the bottom of which water is still visible.

An example of what appears to have been the earliest form of aqueduct in Greece was discovered in the island of Cos beside the fountain Burinna (mod. Fountain of Hippocrates) on Mount Oromedon. It consists of a bell-shaped chamber, built underground in the hill-side, to receive the water of the spring and keep it cool; a shaft from the top of the chamber supplied fresh air. From this reservoir the water was led by a subterranean channel, 114 ft. long and 6½ ft. high.

(J. M. M.)

Roman.

In comparing Greek and Roman aqueducts, many writers have enlarged on the greatness of the latter as an example of Roman contempt for natural obstacles, or even of Roman ignorance of the laws of nature. Now, in the first place, the Romans were not unacquainted with the law that water finds its own level (see Pliny, *Hist. Nat.* xxxi. 57, "subit altitudinem exortus sui"), and took full advantage of it in the construction of lofty fountains and the supplying of the upper floors of houses. That they built aqueducts across valleys in preference to carrying pipes underground was due simply to economy. Pipes had to be made of lead which was weak, or of bronze which was expensive; and the Romans were not sufficiently expert in the casting of large pipes which would stand a very great pressure to employ them for the whole course of a great aqueduct. Secondly, the water was so extremely hard that it was important that the channels should be readily accessible for repair as well as for the detection of leakage.[1] Moreover, as we shall see, the Roman aqueducts did not, in fact, preserve a straight line regardless of the configuration of the country. A striking example is the aqueduct of Nemausus (Nîmes), the springs of which are some 10 m. from the town, though the actual distance traversed is about 25. Other devices, such as changing the level and then modifying the slope, and siphon arrangements of various kinds, were adopted (as in the aqueduct at Aspendus).

Sextus Julius Frontinus, appointed *curator aquarum* in A.D. 97, mentions in his treatise *de aquaeductibus urbis Romae* (on the aqueducts of the city of Rome) nine aqueducts as being in use in his time (the lengths of the aqueducts as given here follow his measurements). These are: (1) Aqua Appia, which took its rise between the 6th and 7th milestones of the Via Collatina, and measured from its source to the Porta Trigemina 11 Roman miles, of which all but about 300 ft. were below ground. It appears to have been the first important enterprise of the kind at Rome, and was the work of the censor Appius Claudius Caecus, from whom it derived its name. The date of its construction was 312 B.C. (2) Anio Vetus, constructed in 272-269 B.C. by the censor Manius Curius Dentatus. From its source near Tivoli, on the left side of the Anio, it flowed some 43 m.,[2] of which only 1100 ft. was above ground. At the distance of 2 m. from Rome (Frontinus, i. 21), it parted into two courses, one of which led to the *horti Asiniani*, and was thence distributed; while the other (*rectus ductus*) led by the temple of Spes to the Porta Esquilina. (3) Aqua Marcia, reconstructed in 1869-1870 under the name of Acqua Pia or Marcia-Pia after Pius IX. (though from Tivoli to Rome the modern aqueduct takes an entirely different course), rising on the left side of the Via Valeria near the 36th milestone. It traversed 61¾ m., of which 54¼ were underground, and for the remaining distance was carried partly on substructions and partly on arches. It was the work of the praetor Quintus Marcius Rex (144-140 B.C.), not of Ancus Marcius, the fourth king of Rome, as Pliny (*N.H.* xxxi. 3) fancied, and took its name from its constructor. Its waters were celebrated for their coolness and excellent quality. Its volume was largely increased by Augustus, who added to it the Aqua Augusta; and it was repaired and restored by Titus, Septimus Severus, Caracalla and Diocletian. (4) Aqua Tepula, from its source (now known as Sorgente Preziosa) in the district of Tusculum, to Rome, was some 11 m. in length. The first portion of its course must have been almost entirely subterranean and is not now traceable. For the last 6½ m. it ran on the same series of arches that carried the Aqua Marcia, but at a higher level. It was the work of the censors Cn. Servilius Caepio and L. Cassius Longinus, and was completed in the year 125 B.C. Its water is warm (about 63° Fahr.) and not of the best quality. (5) The Aqua Julia, from a source 2 m. from that of the Tepula, joined its course at the 10th milestone of the Via Latina. The combined stream, after a distance of 4 m., was received in a reservoir, and then once more divided into two channels. The entire length of the Julia was 15½ m. It was constructed in the year 33 B.C. by M. Vipsanius Agrippa, who also built the (6) Aqua Virgo which, from its origin at a copious spring in a marsh on the Via Collatina, measured 14 m. in length; it was conveyed in a channel, partly under and partly above ground. It was begun in the year 33 B.C. and was celebrated for the excellence of its waters. It was restored to use by Pius V. in 1570. (7) Aqua Alsietina or Augusta, the source of which is the Lacus Alsietinus (mod. Lago di Martignano), to the north of Rome, was over 22 m. in length, of which 358 paces were on arches. It was the work of Augustus, probably with the object of furnishing water for his *naumachia* (a basin for sham sea-fights), and not for drinking purposes. Its course is unknown, as no remains of it exist, but an inscription relating to it is given in *Notizie d. Scant* (1887), p. 182. (8, 9) The Aqua Claudia and Anio Novus were two aqueducts begun by Caligula in A.D. 38 and completed by Claudius in A.D. 52. The springs of the former belonged to the same group as those of the Marcia, and were situated near the 38th milestone of the Via Sublacensis, not far from its divergence from the Via Valeria, while the original intake of the latter from the river Anio was 4 m. farther along the same road. As the water was thick it was collected in a purifying tank, and 4 m. below, a branch stream, the Rivus Herculaneus, was added to it. According to Frontinus, over 10 m. of the course of the Claudia and nearly 9½ of that of the Anio Novus were above ground. Seven miles out of

Rome they united and ran from that point into Rome, following a natural isthmus formed by a lava stream from the Alban volcano, upon a line of arches, which still forms one of the most conspicuous features of the Campagna. The original inscription of Claudius (A.D. 52) on the Porta Maggiore, by which the Aqua Claudia and Anio Novus crossed the Via Praenestina and the Via Labicana, gives the length of the Aqua Claudia as 45 m., and that of the Anio Novus as 62 m. Frontinus, on the other hand, gives 46.406 m. (*i.e.* about 43 English miles) and 58.700 m. (*i.e.* about 54 English miles). Albertini (*Mélanges de l'École Française*, 1906, 305) explains the difference as due to the fact that Frontinus was calculating the length of the Claudia from the farthest spring, the Fons Albudinus, and that of the Anio Novus from the new intake constructed by Trajan in one of the three lakes constructed by Nero for the adornment of his villa above Subiaco. Two other inscriptions on the Porta Maggiore record restorations by Vespasian in A.D. 70, and by Titus in A.D. 80. That the aqueducts should be spoken of as *vetustate dilapsi* so soon after their construction is not a little surprising, and may be attributed either to hasty construction in order to complete them by a fixed date, or to jobbery by the imperial freedmen who under Claudius were especially powerful, or to the fact that a line of arches intended originally in all probability for the Aqua Claudia alone was made to carry the Anio Novus as well.

The size of the channels (*specus*) of the principal aqueducts varies considerably at different points of their course. The Anio Novus has the largest of them all, measuring 3 to 4 ft. wide and 9 ft. high to the top of the roof, which is pointed. They are lined with hard cement (*opus signinum*) containing fragments of broken brick. Those aqueducts of which the most conspicuous remains exist in the neighbourhood of Rome are the four from the upper valley of the Anio, the two which took their supply and their name from the river itself, and the Marcia and the Claudia, which originated from the same group of springs, in the floor of the Anio valley 6 m. below Subiaco. Those of the Anio Vetus, which travelled at a considerably lower level than the other three, are the least conspicuous, while the Claudia and Anio Novus as a rule kept close together, the latter at the highest level of all. The ruins of bridges and substructions in the Anio valley down to Tivoli, though comparatively little known, are of great importance. In all the aqueducts the original construction of the bridges was in *opus quadratum* (masonry), while the substructions are in brick-faced concrete; but the bridges are as a rule strengthened (and often several times) with reinforcing walls of concrete faced with *opus reticulatum* or brickwork. Below Tivoli, where the Anio leaves its narrow valley, the aqueducts sweep round towards the Alban hills, and pass through some very difficult country between Tivoli and Gallicano, alternately crossing ravines, some of which are as much as 300 ft. deep, and tunnelling through hills.[3]

The engineering skill displayed is remarkable, and one wonders what instruments were employed—probably the so-called *chorobates*, an improvement upon the ordinary water-level (Vitruvius viii. 6), though this would be slow and complicated. The optical properties of glass lenses were, however, unknown to the ancients, and the *dioptra*, or angle measure, was considered by Vitruvius less trustworthy than the *chorobates* for the planning of aqueducts (cf. E. Hultsch, *s.v.* in Pauly-Wissowa, *Real-encyclopädie*). The aqueducts as a rule were carried on separate bridges, though all four united at the Ponte Lupo, a huge structure, which after the addition of all the four, and with the inclusion of all the later strengthening walls that were found necessary in course of time, measures 105 ft. in height, 508 in length, and 46 in thickness at the bottom, without including the buttresses. From Gallicano onwards the course of these four aqueducts follows the lower slopes of the Alban Hills. Previous writers on the subject have been unable to determine their course, which is largely subterranean; but it can be followed step by step with the indications given by the presence of the calcareous deposit which was thrown out at the *putei* or shafts (which were, as a rule, placed at intervals of 240 ft., as were the *cippi*) when the *specus* was cleaned; and remains of bridges, though less important, owing to the less difficult character of the country, are not entirely absent (cf. the works by T. Ashby cited in bibliography).[4] Near the 7th milestone of the Via Latina at Le Capanelle, the Aqua Claudia and Anio Novus emerge from their underground course, and run into Rome upon the long series of arches already mentioned, passing over the Porta Maggiore. The Claudia sent off an important branch from the Porta Maggiore over the Caclian to the Palatine, but the main aqueduct soon reached its termination. A mile farther on the Aqua Marcia also, owing to the gradual slope of the ground towards Rome, begins to be supported on arches, which were also used to carry the Aqua Tepula and the Aqua Julia (of the two latter, before their junction with the Marcia, no remains exist above ground, but inscribed *cippi* of the last named and its underground channel have been found at Le Capanelle, and *cippi* also close to its springs, which are a little way above Grottaferrata at Gli Squarciarelli). The Anio Vetus followed the same line, but kept underground (as was natural at the early period at which it was constructed) until the immediate neighbourhood of Rome, near the locality known as "ad Spem veterem" (from a temple of Spes, of which no remains are known) close to the Porta Maggiore. At this point, besides the aqueducts named, the Aqua Appia, as we are told by Frontinus, entered the city, and received an important branch, the Appia Augusta. No remains of either have been discovered outside the city.

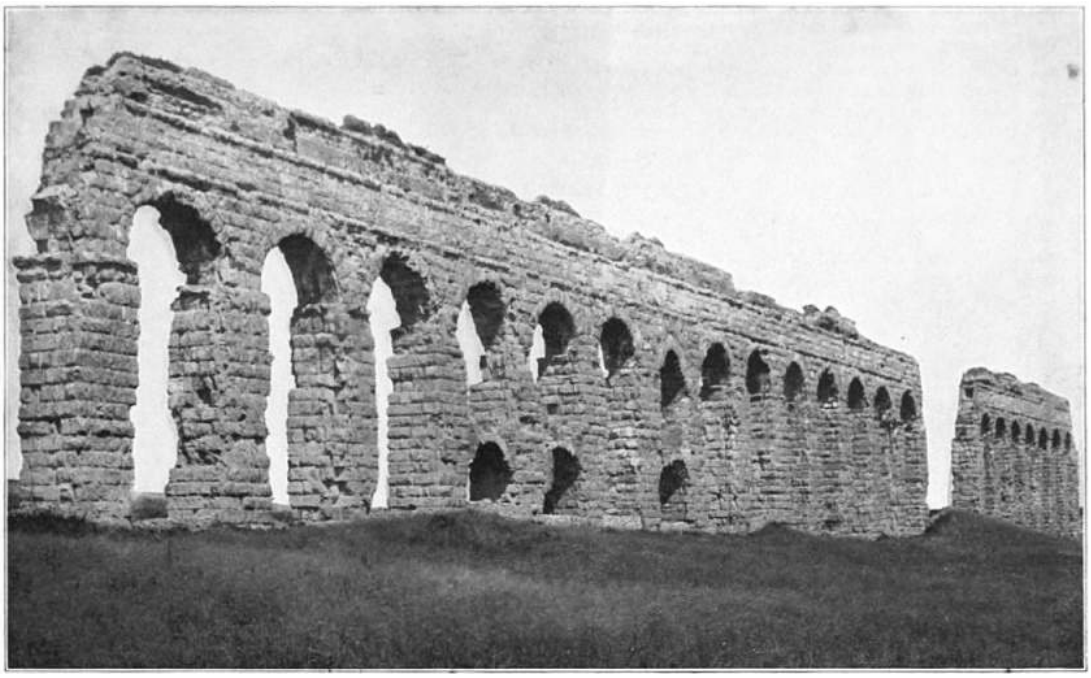
The Aqua Alexandrina must also have entered the city here, though its channel, which lay at some depth below ground, has not been discovered. Considerable remains of its brick aqueducts exist in the district between the Via Praenestina and the Via Labicana.

Of the two aqueducts on the right bank of the Tiber, the Alsietina, as we have said, has no remains at all, while those of the Traiana are not of great importance. The line of the aqueducts was marked by *cippi*, inscribed (in the case of the Anio Vetus, Marcia, Tepula, Julia and Virgo—those of the Claudia and Anio Novus are uninscribed, and those of the Traiana are differently worded) with the name of the aqueduct, the distance from the next *cippus* (generally 240 ft.) and the number, counting from Rome (not from the springs). These boundary stones were erected in pairs, to mark off the strip of land 30 ft. in width reserved for the aqueduct, and for the road or path which generally followed it. The shafts (*putei*) often stood, but not necessarily, at the same points as the *cippi*.

To these nine must be added the two following, constructed after Frontinus's time: (10) Aqua Traiana, from springs to the north-west of the Lacus Sabatinus (Lago di Bracciano), constructed by Trajan in A.D. 109, about 36½ English miles in length. It was restored by Paul V. in 1611, who made use of and largely transformed the remains of the ancient aqueduct; he allowed some of the inferior water of the lake to flow into the channel, and it is thus no longer used for drinking. (11) Aqua Alexandrina, rising about 14 English miles from Rome,

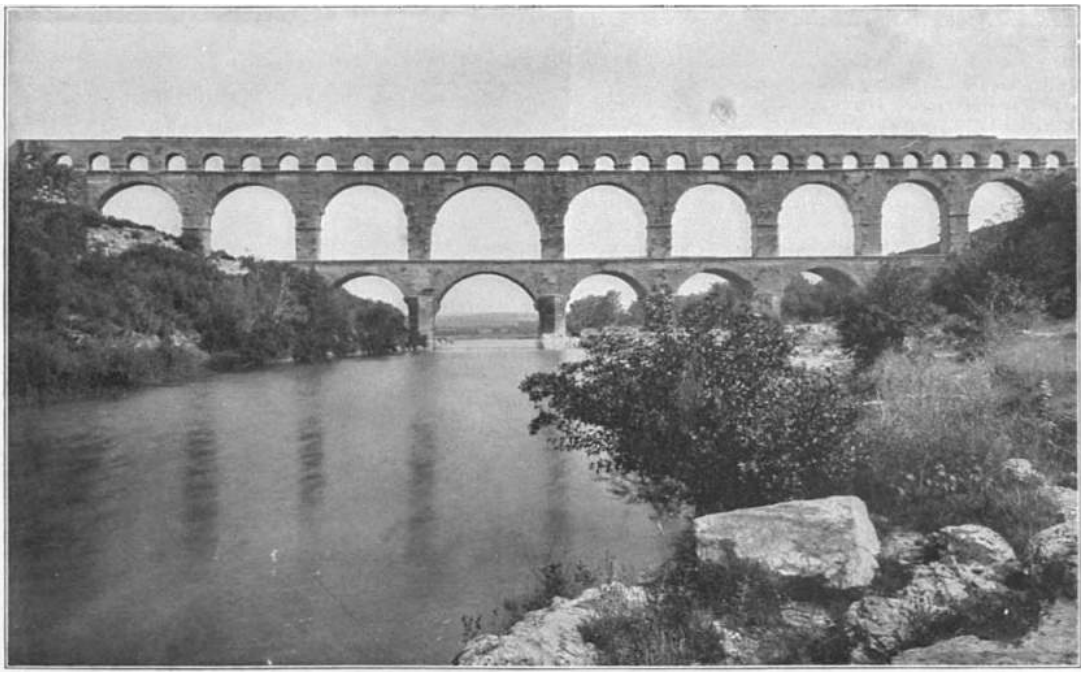
between the Via Praenestina and the Via Labicana, the work of Alexander Severus (A.D. 226). The springs now supply the modern Acqua Felice, constructed by Sixtus V. in 1585, but the course of the latter is mainly subterranean and not identical with that of the former.

PLATE I.



Photo, Altnari.

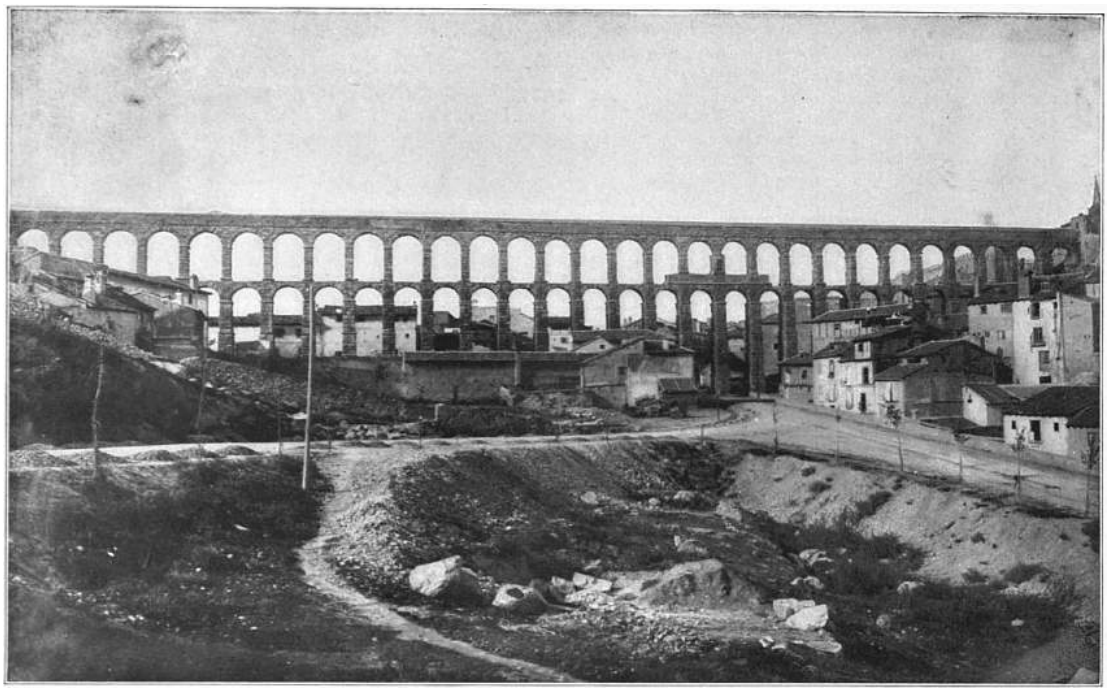
AQUA CLAUDIA, ROME.



Photo, Neurdein.

PONT DU CARD, NÎMES (NEMAUSUS).

PLATE II.

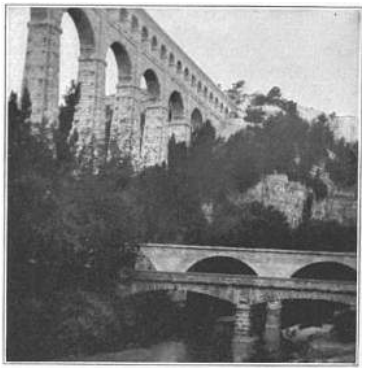


Photo, Laureat y Cia.

ROMAN AQUEDUCT AT SEGOVIA.

Photo, Brogi.

PISCINA MIRABILIS AT BAIAE.



AQUEDUCT OF ROQUEFAVOUR, MARSEILLES.
Early nineteenth century.

Photo, Dr T. Ashby.

AQUA MARCIA, ROME.

It is agreed that these eleven are all that were constructed. Procopius speaks of fourteen (and the Regionary catalogues mention others), but this number includes branch conduits. All the aqueducts ended in the city in huge *castella* or reservoirs for the purpose of distribution. Vitruvius recommends the division of these into three parts—one for the supply of fountains, &c., one for the public baths and one for private consumers. In the Piazza Vittorio Emmanuele at Rome there are still to be seen the remains of a large ornamental fountain built probably for the Aqua Julia by Domitian or Alexander Severus (Jordan-Hülsen, *Topographie*, i. 3350). Besides these main *castella* there were also many minor *castella* in various parts of the city for sub-distribution. To allow the water to purify itself before being distributed in the city, filtering and settling tanks (*piscinae limariae*) were built outside the walls. These *piscinae* were covered in with a vaulted roof, and were sometimes on a very large scale, as in the example still preserved at Fermo, which consists of two stories, each having three oblong basins communicating with each other; or the Piscina Mirabilis at Baiae, which is covered in by a vaulted roof, supported on forty-eight pillars and perforated to permit the escape of foul air. Two stairs lead by forty steps to the bottom of the reservoir. In the middle of the basin is a sinking to collect the deposit of the water. The walls and pillars are coated with a stucco so hard as to resist a tool.

The oversight of aqueducts was placed, in the times of the republic, under the aediles, who were not, however, the constructors of them; of the four aqueducts built during this period, three are the work of censors, one (the Marcia) of a praetor. Under the empire this task devolved on special officials styled

Curatores Aquarum, instituted by Augustus, who, as he himself says, “rivos aquarum omnium refecit” (inscription on the arch by which the Aqua Marcia crossed the Via Tiburtina).

(T. As.)

Among the aqueducts outside Italy, constructed in Roman times and existing still, the most remarkable are: (1) the aqueduct at Nîmes (Nemausus), erected probably by Vipsanius Agrippa in the time of Augustus, which rose to 160 ft. The Pont du Card, as this aqueduct is now called, consists of three tiers of arches across the valley of the river Gardon. In the lowest tier are six arches, of which one has a span of 75 ft., the others each 60 ft. In the second tier are eleven arches, each with a span of 75 ft. In the third tier are thirty-five smaller arches which carried the *specus*. As a bridge, the Pont du Gard has no rival for lightness and boldness of design among the existing remains of works of this class carried out in Roman times. (2) The aqueduct bridges at Segovia (Merckel, *Ingenieurtechnik*, pp. 566-568), Tarragona (*ibid.* 565-566), and Merida in Spain, the former being 2400 ft. long, with 109 arches of fine masonry, in two tiers, and reaching the height of 102 ft. The bridge at Tarragona is 876 ft. long and 83 ft. high. (3) At Mainz are the ruins of an aqueduct 7000 yds. long, about half of which is carried on from 500 to 600 pillars (*Archaeological Journal*, xlvii., 1890, pp. 211-214). This aqueduct was built by the XIVth legion and was for the use of the camp, not for the townspeople. For the similar aqueduct at Luynes see *Arch. Journ.* xlv. (1888), pp. 235-237. Similar witnesses of Roman occupation are to be seen in Dacia, Africa (see especially under Carthage), Greece and Asia Minor. (4) The aqueduct at Jouy-aux-Arches, near Metz, which originally extended across the Moselle, here very broad, conveyed to the city an abundance of excellent water from Gorze. From a large reservoir at the source of the aqueduct the water passed along subterranean channels built of hewn stone, and sufficiently spacious for a man to walk in them upright. Similar channels received the water after it had crossed the Moselle by this bridge, at the distance of about 6 m. from Metz, and conveyed it to the city. The bridge consisted of only one row of arches nearly 60 ft. high. The middle arches have given way under the force of the water, but the others are still perfectly solid. This aqueduct is probably to be attributed to the latter half of the 4th century A.D. It is for the use of the town; hence its size. (5) One of the principal bridges of the aqueduct of Antioch in Syria is 700 ft. long, and at the deepest point 200 ft. high. The lower part consists almost entirely of solid wall, and the upper part of a series of arches with very massive pillars. The masonry and design are rude. The water supply was drawn from several springs at a place called Beit el-Ma (anc. Daphne) about 4 or 5 m. from Antioch. From these separate springs the water was conducted by channels of hewn stone into a main channel, similarly constructed, which traversed the rest of the distance, being carried across streams and valleys by means of arches or bridges. (6) At the village of Moris, about an hour’s distance north-west from the town of Mytilene, is the bridge of an aqueduct, carried by massive pillars built of large hewn blocks of grey marble, and connected by means of three rows of arches, of which the uppermost is of brick. The bridge extended about 500 ft. in length, and at the deepest point was from 70 to 80 ft. high. Judged by the masonry and the graceful design, it has been thought to be a work of the age of Augustus. Remains of this aqueduct are to be seen at Larisson Lamarousia, an hour’s distance from Moris, and at St Demetri, two hours and a half from Ayasos, on the road to Vasilika.

Asia Minor.

The whole subject of the ancient and medieval aqueducts of Asia Minor has been considered in great detail by G. Weber (“Wasserleitungen in kleinasiatischen Städten,” in the *Jahrbuch des kaiserl. deutsch. archäolog. Instit.* xix., 1904; see also earlier articles in *Jahrbuch*, 1892, 1899). The aqueducts examined are those at Pergamum, Laodicea and Smyrna (in the earlier articles), and those at Metropolis (Ionia), Tralles (Aidin), Antioch-on-Maeander, Aphrodisias, Trapezopolis, Hierapolis, Apamea Cibotus and Antioch in Pisidia. In most of these cases it is difficult or even impossible to decide whether the work is Hellenistic or Roman; to the Romans Weber inclines to attribute, *e.g.* those at Metropolis, Tralles (perhaps), Aphrodisias; to the Greeks, *e.g.* those at Antioch-on-Maeander and Antioch in Pisidia. Since, therefore, a detailed description of these remains does not provide material for any satisfactory generalizations as to the distinctive features of Hellenistic and Roman work, it will be sufficient here to mention a few of the more interesting discoveries.

In the case of Metropolis, the aqueduct in the valley of the Astraeus consisted of an arcade about 13 to 16 ft. high. Nearer to the town in the hills there are distinct traces of a canal with brick walls. It is clear that the water could not have served more than the lower parts of the town, the acropolis of which is nearly 200 ft. above the level of the conduit. In the case of Tralles the water was supplied by a high pressure conduit and distributed from the acropolis, where there are the remains of a basin (13 ft. by 10) arched over with brick. The ancient aqueduct is to be distinguished from a later, probably Byzantine, canal conduit, the course of which avoids the deeper depressions, crossed by the old aqueduct. Of the Antioch-on-Maeander aqueduct only a few clay-pipes remain, and the same is true of the aqueduct which was built by Carminius in the 2nd century A.D. to supply the community when reinforced by the amalgamation of Plarasa and Tauropolis; two of its basins are still distinguishable, but the two water-towers which are still standing belong to a later Byzantine structure. Trapezopolis was supplied from Mt. Salbacus (Baba Dagh): some twenty stone-pipes have been found built into a low wall which varies from 3¼ to about 5 ft. wide. Of the pillars which carried the conduit-pipe to Antioch in Pisidia, nineteen are still standing. Each arch consists of eleven keystones; no cement was used. The conduit, which was high-pressure, ends in a distributing tower and reservoir.

(J. M. M.)

II. *Medieval.*—The aqueduct near Spoleto, which now serves also as a bridge, is deserving of notice as an early instance of the use of the pointed arch, belonging as it does to the 7th or 8th century. It has ten arches, remarkable for the elegance of their design and the airy lightness of their proportions, each over 66 ft. in span, and about 300 ft. in height.

Constantinople.

The aqueduct of Pyrgos, near Constantinople, is a remarkable example of works of this class carried out in the later times of the Roman empire, and consisted of two branches. From this circumstance it was called Egri Kemer (“the Crooked Aqueduct”), to distinguish it from the Long Aqueduct, situated near the source of the waters. One of the branches extends 670 ft. in length, and is 106 ft. in height at the deepest part. It is composed of three tiers of arches, those in each row increasing in width from the bottom to the top—an arrangement very properly introduced with the view of saving materials without diminishing the strength of the work. The two upper rows consisted of arches of

semicircles, the lower of Gothic arches; and this circumstance leads to the belief that the date of the structure is about the 10th century. The breadth of the building at the base was 21 ft., and it diminished with a regular batter on each side to the top, where it was only 11 ft. The base also was protected by strong buttresses or counterforts, erected against each of the pillars. The other branch of the aqueduct was 300 ft. long, and consisted of twelve semicircular arches. This aqueduct serves to convey to Constantinople the waters of the valley of Belgrad, one of the principal sources from which the city is supplied. These are situated on the heights of Mount Haemus, the extremity of the Balkan Mountains, which overhangs the Black Sea. The water rises about 15 m. from the city, and between 3 and 4 m. west of the village of Belgrad, in three sources, which run in three deep and very confined valleys. These unite a little below the village, and then are collected into a large reservoir. After flowing a mile or two from this reservoir, the waters are augmented by two other streams, and conveyed by a channel of stone to the Crooked Aqueduct. From this they are conveyed to another which is the Long Aqueduct; and then, with various accessions, into a third, termed the Aqueduct of Justinian. From this they enter a vaulted conduit, which skirts the hills on the left side of the valley, and crosses a broad valley 2 m. below the Aqueduct of Justinian, by means of an aqueduct, with two tiers of arches of a very beautiful construction. The conduit then proceeds onward in a circuitous route, till it reaches the reservoir of Egri Kapu, situated just without and on the walls of the city. From this the water is conducted to the various quarters of the city, and also to the reservoir of St Sophia, which supplies the seraglio of the grand signior. The Long Aqueduct (Usun Kemer) is more imposing by its extent than the Crooked one, but is far inferior in the regularity of design and disposition of the materials. It is evidently a work of the Turks. It consists of two tiers of arches, the lower being forty-eight in number, and the upper fifty. The whole length was about 2200 ft., and the height 80 ft. The aqueduct of Justinian (Muallak Kemer or “Hanging Aqueduct”) is without doubt one of the finest monuments which remain to us of the middle ages. It consists of two tiers of large pointed arches, pierced transversely. Those of the lower story have 55 ft. of span, the upper ones 40 ft. The piers are supported by strong buttresses, and at different heights they have little arches passing through them laterally, which relieve the deadness of the solid pillar. The length of this aqueduct is 720 ft. and the height 108 ft. This aqueduct has been attributed both to Constantine I. and to Justinian, the latter being perhaps the more probable.

Besides the waters of Belgrad, Constantinople was supplied from several other principal sources, one of which took its rise on the heights of the same mountains, 3 or 4 m. east of Belgrad. This was conveyed in a similar manner by an arched channel elevated, when it was necessary, on aqueduct bridges, till it reached the northern parts of the city. It was in the course of this aqueduct that the contrivance of the *souterasi* or hydraulic obelisks, described by Andréossy (on his voyage to the Black Sea, the account of the Thracian Bosporus), was constructed, which excited some attention, as being an improvement on the method of conducting water by aqueduct bridges. “The souterasi,” says Andréossy, “are masses of masonry, having generally the form of a truncated pyramid or an Egyptian obelisk. To form a conduit with souterasi, we choose sources of water, the level of which is several feet higher than the reservoir by which it is to be distributed over the city. We bring the water from its sources in subterranean canals, slightly declining until we come to the borders of a valley or broken ground. We there raise on each side a souterasi, to which we adapt vertically leaden pipes of determinate diameters, placed parallel to the two opposite sides of the building. These pipes are disjoined at the upper part of the obelisk, which forms a sort of basin, with which the pipes are connected. The one permits the water to rise to the level from whence it had descended; by the other, the water descends from this level to the foot of the souterasi, where it enters another canal underground, which conducts it to a second and to a third souterasi, where it rises and again descends, as at the last station. Here a reservoir receives it and distributes it in different directions by orifices of which the discharge is known.” Again he says, “it requires but little attention to perceive that this system of conducting tubes is nothing but a series of siphons open at their upper part, and communicating with each other. The expense of a conduit by souterasi is estimated at only one-fifth of that of an aqueduct with arcades.” There seems to be really no advantage in these pyramids, further than as they serve the purpose of discharging the air which collects in the pipes. They are in themselves an evident obstruction, and the water would flow more freely without any interruption of the kind. In regard to the leaden pipes, again, they would have required, with so little head pressure as is stated, to be used of very extraordinary dimensions to pass the same quantity of water as was discharged along the arched conduits (see also works quoted under Constantinople). The other principal source from which Constantinople is supplied, is from the high grounds 6 or 8 m. west of the town, from which it is conducted by conduits and arches, in the same manner as the others. The supply drawn from all these sources, as detailed by Andréossy, amounted to 400,000 cubic ft. per day.

(A. S. M.; J. M. M.)

III. *Modern Construction.*—Where towns are favourably situated the aqueduct may be very short and its cost bear a relatively small proportion to the total outlay upon a scheme of water supply, but where distant sources have to be relied upon the cost of the aqueduct becomes one of the most important features in the scheme, and the quantity of water obtainable must be considerable to justify the outlay. Hence it is that only very large towns can undertake the responsibility for this expenditure. In Great Britain it has in all large schemes become a condition that, when a town is permitted to go outside its own watershed, it shall, subject to a priority of a certain number of gallons per day per head of its own inhabitants, allow local authorities, any part of whose district is within a certain number of miles of the aqueduct, to take a supply on reasonable terms. The first case in which this principle was adopted on a large scale was the Thirlmere scheme sanctioned by parliament in 1879, for augmenting the supply of Manchester. The previous supply was derived from a source only about 15 m. distant, and the cost of the aqueduct, chiefly cast-iron pipes, was insignificant compared with the cost of the impounding reservoirs. But Thirlmere is 96 m. distant from the service reservoir near Manchester, and the cost of the aqueduct was more than 90% of the total cost. As a supply of about 50,000,000 gallons a day is available the outlay was justifiable, and the water is in fact very cheaply obtained. Liverpool derives a supply of about 40,000,000 gallons a day from the river Vyrnwy in North Wales, 68 m. distant, and Birmingham has constructed works for impounding water in Radnorshire, and conveying it a distance of 74 m., the supply being about 75,000,000 gallons a day. In the year 1899 an act of parliament was passed authorizing the towns of Derby, Leicester, Sheffield and Nottingham, jointly to obtain a supply of water from the head waters of the river Derwent in Derbyshire. Leicester is 60 m. distant from this source, and its share of the supply is

Aqueducts and water supply.

about 10,000,000 gallons a day. For more than half the distance, however, the aqueduct is common to Derby and Nottingham, which together are entitled to about 16,000,000 gallons a day, and the expense to Leicester is correspondingly reduced. These are the most important cases of long aqueducts in England, and all are subsequent to 1879. It is obvious, therefore, how greatly the design and construction of the aqueduct have grown in importance, and what care must be Exercised in order that the supply upon which such large populations depend may not be interrupted, and that the country through which such large volumes of water are conveyed may not be flooded in consequence of the failure of any of the works.

Construction.

Practically only two types of aqueduct are used in England. The one is built of concrete, brickwork, &c., the other of cast-iron (or, in special circumstances, steel) pipes. In the former type the water surface coincides with the hydraulic gradient, and the conditions are those of an artificial river; the aqueduct must therefore be carefully graded throughout, so that the fall available between source and termination may be economically distributed. This condition requires that the ground in which the work is built shall be at the proper elevation; if at any point this is not the case, the aqueduct must be carried on a substructure built up to the required level. Such large structures are, however, extremely expensive, and require elaborate devices for maintaining water-tightness against the expansion and contraction of the masonry due to changes of temperature. They are now only used where their length is very short, as in cases where mountain streams have to be crossed, and even these short lengths are avoided by some engineers, who arrange that the aqueduct shall pass, wherever practicable, under the streams. Where wide valleys interrupt the course of the built aqueduct, or where the absence of high ground prevents the adoption of that type at any part of the route, the cast-iron pipes hereafter referred to are used.

Masonry aqueducts.

The built aqueduct may be either in tunnel, or cut-and-cover, the latter term denoting the process of cutting the trench, building the floor, side-walls, and roof, and covering with earth, the surface of the ground being restored as before. For works conveying water for domestic supply, the aqueduct is in these days, in England, always covered. Where, as is usually the case, the water is derived from a tract of mountainous country, the tunnel work is sometimes very heavy. In the case of the Thirlmere aqueduct, out of the first 13 m. the length of the tunnelled portions is 8 m., the longest tunnel being 3 m. in length. Conditions of time, and the character of the rock, usually require the use of machinery for driving, at any rate in the case of the longer tunnels. For the comparatively small tunnels required for aqueducts, two percussion drilling machines are usually mounted on a carriage, the motive power being derived from compressed air sent up the tunnel in pipes. The holes when driven are charged with explosives and fired. In the Thirlmere tunnels, driven through very hard Lower Silurian strata, the progress was about 13 yds. a week at each face, work being carried on continuously day and night for six days a week. Where the character of the country through which the aqueduct passes is much the same as that from which the supply is derived, the tunnels need not be lined with concrete, &c., more than is absolutely necessary for retaining the water and supporting weak places in the rock; the floor, however, is nearly always so treated. The lining, whether in tunnel or cut-and-cover, may be either of concrete, or brickwork, or of concrete faced with brickwork. To ensure the impermeability of work constructed with these materials is in practice somewhat difficult, and no matter how much care is taken by those supervising the workmen, and even by the workmen themselves, it is impossible to guarantee entire freedom from trouble in this respect. With a wall only about 15 in. thick, any neglect is certain to make the work permeable; frequently the labourers do not distribute the broken stone and fine material of the concrete uniformly, and no matter how excellent the design, the quality of materials, &c., a leak is sure to occur at such places (unless, indeed, the pressure of the outside water is superior and an inflow occurs). A further cause of trouble lies in the water which flows from the strata on to the concrete, and washes away some of the cement upon which the work depends for its watertightness, before it has time to set. For this reason it is advisable to put in the floor before, and not after, the sidewalls and arch have been built, otherwise the only outlet for the water in the strata is through the ground on which the floor has to be laid. Each length of about 20 ft. should be completely constructed before the next is begun, the water then having an easy exit at the leading end. Manholes, by which the aqueduct can be entered, are usually placed in the roof at convenient intervals; thus, in the case of the Thirlmere aqueduct, they occur at every quarter of a mile.

Timber aqueducts.

In some parts of America aqueducts are frequently constructed of wood, being then termed flumes. These are probably more extensively used in California than in any other part of the world, for conveying large quantities of water which is required for hydraulic mining, for irrigation, for the supply of towns and for transporting timber. The flumes are frequently carried along precipitous mountain slopes, and across valleys, supported on trestles. In Fresno county, California, there is a flume 52 m. in length for transporting timber from the Sierra Nevada Mountains to the plain below; it has a rectangular V-shaped section, 3 ft. 7 in. wide at the top, and 21 in. deep vertically. The boards which form the sides are 1¼ in. thick, and some of the trestlework is 130 ft. high. The steepest grade occurs where there is a fall of 730 ft. in a length of 3000 ft. About 9,000,000 ft. of timber were used in the construction. At San Diego there is a flume 35 m. long for irrigation and domestic supply, the capacity being 50 ft. per second; it has 315 trestle bridges (the longest of which is that across Los Coches Creek, 1794 ft. in length and 65 ft. in height) and 8 tunnels, and the cost was $900,000. The great bench flume of the Highline canal, Colorado, is 2640 ft. in length, 28 ft. wide, and 7 ft. deep; the gradient is 5.28 ft. per mile, and the discharge 1184 ft. per second.

Aqueduct in iron piping.

As previously stated, the type of aqueduct built of concrete, &c., can only be adopted where the ground is sufficiently elevated to carry it, and where the quantity of water to be conveyed makes it more economical than piping. Where the falling contour is interrupted by valleys too wide for a masonry structure above the surface of the ground, the detached portions of the built aqueduct must be connected by rows of pipes laid beneath, and following the main undulations of, the surface. In such cases the built aqueduct terminates in a chamber of sufficient size to enclose the mouths of the several pipes, which, thus charged, carry the water under the valley up to a corresponding chamber on the farther hillside from which the built aqueduct again carries on the supply. These connecting pipes are sometimes called siphons, although they have nothing whatever to do with the principle of a siphon, the water simply flowing into the pipe at one end and out at the other under the

influence of gravity, and the pressure of the atmosphere being no element in the case. The pipes are almost always made of cast-iron, except in such cases as the lower part of some siphons, where the pressure is very great, or where they are for use abroad, when considerations of weight are of importance, and when they are made of rolled steel with riveted or welded seams. It is frequently necessary to lay them in deep cuttings, in which case cast-iron is much better adapted for sustaining a heavy weight of earth than the thinner steel, though the latter is more adapted to resist internal pressure. Mr D. Clarke (*Trans. Am. Soc. C.E.* vol. xxxviii. p. 93) gives some particulars of a riveted steel pipe 24 m. long, 33 to 42 in. diameter, varying in thickness from 0.22 in. to 0.375 in. After a length of 9 m. had been laid, and the trench refilled, it was found that the crown of the pipe had been flattened by an amount varying from ½ in. to 4 in. Steel pipes suffer more from corrosion than those made of cast-iron, and as the metal attacked is much thinner the strength is more seriously reduced. These considerations have prevented any general change from cast-iron to steel.

Mr. Clemens Herschel has made some interesting remarks (*Proc. Inst. C.E.* vol. cxv. p. 162) as to the circumstances in which steel pipes have been found preferable to cast-iron. He says that it had been demonstrated by practice that cast-iron cannot compete with wrought-iron or steel pipes in the states west of the Rocky Mountains, on the Pacific slope. This is due to the absence of coal and iron ore in these states, and to the weight of the imported cast-iron pipes compared with steel pipes of equal capacity and strength. The works of the East Jersey Water Company for the supply of Newark, N.J., include a riveted steel conduit 48 in. in diameter and 21 m. long. This conduit is designed to resist only the pressure due to the hydraulic gradient, in contradistinction to that which would be due to the hydrostatic head, this arrangement saving 40% in the weight and cost of the pipes. For the supply of Rochester, N.Y., there is a riveted steel conduit 36 in. in diameter and 20 m. long; and for Allegheny City, Pennsylvania, there is a steel conduit 5 ft. in diameter and nearly 10 m. long. The works for bringing the water from La Vigne and Verneuil to Paris include a steel main 5 ft. in diameter between St. Cloud and Paris.

Cast-iron pipes rarely exceed 48 in. in diameter, and even this diameter is only practicable where the pressure of the water is low. In the Thirlmere aqueduct the greatest pressure is nearly 180 lb on the square inch, the pipes where this occurs being 40 in. in diameter and 1¾ in. thick. These large pipes, which are usually made in lengths of 12 ft., are generally cast with a socket at one end for receiving the spigot end of the next pipe, the annular space being run with lead, which is prevented from flowing into the interior of the pipe by a spring ring subsequently removed; the surface of the lead is then caulked all round the outside of the pipe. A wrought-iron ring is sometimes shrunk on the outer rim of the socket, previously turned to receive it, in order to strengthen it against the wedging action of the caulking tool. Sometimes the pipes are cast as plain tubes and joined with double collars, which are run with lead as in the last case. The reason for adopting the latter type is that the stresses set up in the thicker metal of the socket by unequal cooling are thereby avoided, a very usual place for pipes to crack under pressure being at the back of the socket. The method of turning and boring a portion, slightly tapered, of spigot and socket so as to ensure a watertight junction by close annular metallic contact, is not suitable for large pipes, though very convenient for smaller diameters in even ground. Spherical joints are sometimes used where a line of main has to be laid under a large river or estuary, and where, therefore, the pipes must be jointed before being lowered into the previously dredged trench. This was the case at the Willamette river, Portland, Oregon, where a length of 2000 ft. was required. The pipes are of cast-iron 28 in. in diameter, 1½ in. thick, and 17 ft. long. The spigots were turned to a spherical surface of 20 in. radius outside, the inside of the sockets being of a radius ⅜ in. greater. After the insertion of the spigot into the socket, a ring, 3 in. deep, turned inside to correspond with the socket, was bolted to the latter, the annular space then being run with lead. These pipes were laid on an inclined cradle, one end of which rested on the bed of the river and the other on a barge where the jointing was done; as the pipes were jointed the barge was carefully advanced, thus trailing the pipes into the trench (*Trans. Am. Soc. C.E.* vol. xxxiii. p. 257). As may be conjectured from the pressure which they have to stand, very great care has to be taken in the manufacture and handling of cast-iron pipes of large diameter, a care which must be unfailing from the time of casting until they are jointed in their final position in the ground. They are cast vertically, socket downwards, so that the densest metal may be at the weakest part, and it is advisable to allow an extra head of metal of about 12 in., which is subsequently cut off in a lathe. An inspector representing the purchaser watches every detail of the manufacture, and if, after being measured in every part and weighed, they are found satisfactory they are proved with internal fluid pressure, oil being preferable to water for this purpose. While under pressure, they are rapped from end to end with a hand hammer of about 5 lb in weight, in order to discover defects. The wrought-iron rings are then, if required, shrunk on to the sockets, and the pipes, after being made hot in a stove, are dipped vertically in a composition of pitch and oil, in order to preserve them from corrosion. All these operations are performed under cover. A record should be kept of the history of the pipe from the time it is cast to the time it is laid and jointed in the ground, giving the date, number, diameter, length, thickness, and proof pressure, with the name of the pipe-jointer whose work closes the record. Such a history sometimes enables the cause (which is often very obscure) of a burst in a pipe to be ascertained, the position of every pipe being recorded.

Cast-iron pipes, even when dipped in the composition referred to, suffer considerably from corrosion caused by the water, especially soft water, flowing through them. One pipe may be found in as good a condition as when made, while the next may be covered with nodules of rust. The effect of the rust is twofold; it reduces the area of the pipe, and also, in consequence of the resistance offered by the rough surface, retards the velocity of the water. These two results, expecially the latter, may seriously diminish the capability of discharge, and they should always be allowed for in deciding the diameter. Automatic scrapers are sometimes used with good results, but it is better to be independent of them as long as possible. In one case the discharge of pipes, 40 in. in diameter, was found after a period of about twelve years to have diminished at the rate of about 1% per year; in another case, where the water was soft and where the pipes were 40 in. in diameter, the discharge was diminished by 7% in ten years. An account of the state of two cast-iron mains supplying Boston with water is given in the *Trans. Am. Soc. C.E.* vol. xxxv. p. 241. These pipes, which were laid in 1877, are 48 in. in diameter and 1800 ft. long. When they were examined in 1894-1895, it was estimated that the tubercles of rust covered nearly one-third of the interior surfaces, the bottom of the pipe being more encrusted than the sides and top. They had central points of attachment to the iron, at which no doubt the coating was defective, and from them the tubercles spread over the surface of the surrounding coating. In this case they were removed by hand, and the coating of the pipes was not injured in the process. Cast-iron pipes must not be laid in contact with cinders from a blast furnace with which roads are sometimes made, because these corrode the metal. Mr Russell Aitken (*Proc. Inst. C.E.* vol. cxv. p. 93) found in India that

cast-iron pipes buried in the soil rapidly corroded, owing to the presence of nitric acid secreted by bacteria which attacked the iron. The large cast-iron pipes conveying the water from the Tansa reservoir to Bombay are laid above the surface of the ground. Cast-iron pipes of these large diameters have not been in existence sufficiently long to enable their life to be predicted. A main, 40 in. in diameter, conveying soft water, after being in existence fifty years at Manchester, was apparently as good as ever. In 1867 Mr J.B. Francis found that no apparent deterioration had taken place in a cast-iron main, 8 in. diameter, which was laid in the year 1828, a period of thirty-nine years (*Trans. Soc. Am. C.E.* vol. i. p. 26). These two instances are probably not exceptional.

Methods of laying.

Pipes in England are usually laid with not less than 2 ft. 6 in. of cover, in order that the water may not be frozen in a severe winter. Where they are laid in deep cutting they should be partly surrounded with concrete, so that they may not be fractured by the weight of earth above them. Angles are turned by means of special bend pipes, the curves being made of as large a radius as convenient. In the case of the Thirlmere aqueduct, double socketed castings about 12 in. long (exclusive of the sockets) were used, the sockets being inclined to each other at the required angle. They were made to various angles, and for any particular curve several would be used connected by straight pipes 3 ft. long. As special castings are nearly double the price of the regular pipes, the cost was much diminished by making them as short as possible, while a curve, made up of the slight angles used, offered practically no more impediment to the flow of water in consequence of its polygonal form, than would be the case had special bend pipes been used. In all cases of curves on a line of pipes under internal fluid pressure, there exists a resultant force tending to displace the pipes. When the curve is in a horizontal plane and the pipes are buried in the ground, the side of the pipe trench offers sufficient resistance to this force. Where, however, the pipes are above ground, or when the curve is in a vertical plane, it is necessary to anchor them in position. In the case of the Tansa aqueduct to Bombay, there is a curve of 500 ft. radius near Bassein Creek. At this point the hydrostatic head is about 250 ft., and the engineer, Mr Clerke, mentions that a tendency to an outward movement of the line of pipes was observed. At the siphon under Kurla Creek the curves on the approaches as originally laid down were sharp, the hydrostatic head being there about 210 ft.; here the outward movement was so marked that it was considered advisable to realign the approaches with easier curves (*Proc. Inst. C.E.* vol. cxv. p. 34). In the case of the Thirlmere aqueduct the greatest hydrostatic pressure, 410 ft., occurs at the bridge over the river Lune, where the pipes are 40 in. in diameter, and in descending from the bridge make reverse angles of 31½°. The displacing force at each of these angles amounts to 54 tons, and as the design includes five lines of pipes, it is obvious that the anchoring arrangements must be very efficient. The steel straps used for anchoring these and all other bends were curved to fit as closely as possible the castings to be anchored. Naturally the metal was not in perfect contact, but when the pipes were charged the disappearance of all the slight inequalities showed that the straps were fulfilling their intended purpose. At every summit on a line of pipes one or more valves must be placed in order to allow the escape of air, and they must also be provided on long level stretches, and at changes of gradient where the depth of the point of change below the hydraulic gradient is less than that at both sides, causing what may be called a virtual summit. It is better to have too many than too few, as accumulations of air may cause an enormous diminution in the quantity of water delivered. In all depressions discharge valves should be placed for emptying the pipes when desired, and for letting off the sediment which accumulates at such points. Automatic valves are frequently placed at suitable distances for cutting off the supply in case of a burst. At the inlet mouth of the pipe they may depend for their action on the sudden lowering of the water (due to a burst in the pipe) in the chamber from which they draw their supply, causing a float to sink and set the closing arrangement in motion. Those on the line of main are started by the increased velocity in the water, caused by the burst on the pipe at a lower level. The water, when thus accelerated, is able to move a disk hung in the pipe at the end of a lever and weighted so as to resist the normal velocity; this lever releases a catch, and a door is then gradually revolved by weights until it entirely closes the pipe. Reflux valves on the ascending leg of a siphon prevent water from flowing back in case of a burst below them; they have doors hung on hinges, opening only in the normal direction of flow. Due allowance must be made, in the amount of head allotted to a pipe, for any head which may be absorbed by such mechanical arrangements as those described where they offer opposition to the flow of the water. These large mains require most careful and gradual filling with water, and constant attention must be given to the air-valves to see that the gutta-percha balls do not wedge themselves in the openings. A large mass of water, having a considerable velocity, may cause a great many bursts by water-ramming, due to the admission of the water at too great a speed. In places where iron is absent and timber plentiful, as in some parts of America, pipes, even of large diameter and in the most important cases, are sometimes made of wooden staves hooped with iron. A description of two of these will be found below.

Thirlmere.

The *Thirlmere Aqueduct* is capable of conveying 50,000,000 gallons a day from Thirlmere, in the English lake district, to Manchester. The total length of 96 m. is made up of 14 m. of tunnels, 37 m. of cut-and-cover, and 45 m. of cast-iron pipes, five rows of the latter being required. The tunnels where lined, and the cut-and-cover, are formed of concrete, and are 7 ft. in height and width, the usual thickness of the concrete being 15 in. The inclination is 20 in. per mile. The floor is flat from side to side, and the side-walls are 5 ft. high to the springing of the arch, which has a rise of 2 ft. The water from the lake is received in a circular well 65 ft. deep and 40 ft. in diameter, at the bottom of which there is a ring of wire-gauze strainers. Wherever the concrete aqueduct is intersected by valleys, cast-iron pipes are laid; in the first instance only two of the five rows 40 in. in diameter were laid, the city not requiring its supply to be augmented by more than 20,000,000 gallons a day, but in 1907 it was decided to lay a third line. All the elaborate arrangements described above for stopping the water in case of a burst have been employed, and have perfectly fulfilled their duties in the few cases in which they have been called into action. The water is received in a service reservoir at Prestwich, near Manchester, from which it is supplied to the city. The supply from this source was begun in 1894. The total cost of the complete scheme may be taken at about £5,000,000, of which rather under £3,000,000 had been spent up to the date of the opening, at which time only one line of pipes had been laid.

The *Vyrnwy Aqueduct* was sanctioned by parliament in 1880 for the supply of Liverpool from North Wales, the quantity of water obtainable being at least 40,000,000 gallons a day. A tower built in the artificial lake from which the supply is derived, contains the inlet and arrangements for straining the water. The aqueduct

Vyrnwy. is 68 m. in length, and for nearly the whole distance will consist of three lines of cast-iron pipes, two of which, varying in diameter from 42 in. to 39 in., are now in use. As the total fall between Vyrnwy and the termination at Prescot reservoirs is about 550 ft., arrangements had to be made to ensure that no part of the aqueduct be subjected to a greater pressure than is required for the actual discharge. Balancing reservoirs have therefore been constructed at five points on the line, advantage being taken of high ground where available, so that the total pressure is broken up into sections. At one of these points, where the ground level is 110 ft. below the hydraulic gradient, a circular tower is built, making a most imposing architectural feature in the landscape. At the crossing of the river Weaver, 100 ft. wide and 15 ft. deep, the three pipes, here made of steel, were connected together laterally, floated into position, and sunk into a dredged trench prepared to receive them. Under the river Mersey the pipes are carried in a tunnel, from which, during construction, the water was excluded by compressed air.

Denver Aqueduct.—The supply to Denver City, initiated by the Citizens Water Company in 1889, is derived from the Platte river, rising in the Rocky Mountains. The first aqueduct constructed is rather over 20 m. in length, of which a length of 16½ m. is made of wooden stave pipe, 30 in. in diameter. The maximum pressure is that due to 185 ft. of water; the average cost of the wooden pipe was $1.36½ per foot, and the capability of discharge 8,400,000 gallons a day. Within a year of the completion of the first conduit, it became evident that another of still greater capacity was required. This was completed in April 1893; it is 34 in. in diameter and will deliver 16,000,000 gallons a day. By increasing the head upon the first pipe, the combined discharge is 30,000,000 gallons a day. An incident in obtaining a temporary supply, without waiting for the completion of the second pipe, was the construction of two wooden pipes, 13 in. in diameter, crossing a stream with a span of 104 ft., and having no support other than that derived from their arched form. One end of the arch is 24½ ft. above the other end, and, when filled with water, the deflection with eight men on it was only ⅞ of an inch. A somewhat similar arch, 60 ft. span, occurs on the 34-in. pipe where it crosses a canal. Schuyler points out (*Trans. Am. Soc. C.E.* vol. xxxi. p. 148) that the fact that the entire water supply of a city of 150,000 inhabitants is conveyed in wooden mains, is so radical a departure from all precedents, that it is deserving of more than a passing notice. He says that it is manifestly and unreservedly successful, and has achieved an enormous saving in cost. The sum saved by the use of wooden, in preference to cast-iron pipes, is estimated at $1,100,000. It is perhaps necessary to state that the pipe is buried in the ground in the same way as metal pipes. The edges of the staves are dressed to the radius with a minute tongue 1/16 in. high on one edge of each stave, but with no corresponding groove in the next stave; its object is to ensure a close joint when the bands are tightened up. Leaks seldom or never occur along the longitudinal seams, but the end shrinkage caused troublesome joint leaks. The shrinkage in California redwood, which had seasoned 60 to 90 days before milling, was frequently as much as 3 in. in the 20 staves that formed the 34-in. pipe, and the space so formed had to be filled by a special closing stave. Metallic tongues, ¾ in. deep, are inserted at the ends of abutting staves, in a straight saw cut. The bands, which are of mild steel, have a head at one end and a nut and washer at the other; the ends are brought together on a wrought-iron shoe, against which the nut and washer set. The staves forming the lower half of the pipe are placed on an outside, and the top staves on an inside, mould. While the bands are being adjusted the pipe is rounded out to bring the staves out full, and the staves are carefully driven home on to the abutting staves. The spacing of the bands depends on circumstances, but is about 150 bands per 100 ft. With low heads the limit of spacing was fixed at 17 in. The outer surface of the pipe, when charged, shows moisture oozing slightly over the entire surface. This condition Schuyler considers an ideal one for perfect preservation, and the staves were kept as thin as possible to ensure its occurrence. Samples taken from pipes in use from three to nine years are quite sound, and it is concluded that the wood will last as long as cast-iron if the pipe is kept constantly charged. The bands are the only perishable portion, and their life is taken at from fifteen to twenty years. Other portions of the second conduit for a length of nearly 3 m. were formed of concrete piping, 38 in. diameter, formed on a mould in the trench, the thickness being 2½ to 3 in. So successful an instance of the use of wooden piping on a large scale is sure to lead to a large development of this type of aqueduct in districts where timber is plentiful and iron absent.

Denver.

Pioneer Aqueduct, Utah.—The construction of the Pioneer Aqueduct, Utah, was begun in 1896 by the Pioneer Electric Power Company, near the city of Ogden, 35 m. north of Salt Lake City. The storage reservoir, from which it draws its water, will coyer an area of 2000 acres, and contain about 15,000 million gallons of water. The aqueduct is a pipe 6 ft. in diameter, and of a total length of 6 m.; for a distance of rather more than 5 m. it is formed of wooden staves, the remainder, where the head exceeds 117 ft., being of steel. It is laid in a trench and covered to a depth of 3 ft. The greatest pressure on the steel pipe is 200 lb per sq. in., and the thickness varies from ⅜ to 11/16 in. The pipe was constructed according to the usual practice of marine boiler-work for high pressures, and each section, about 9 ft. long, was dipped in asphalt for an hour. These sections were supported on timber blocking, placed from 5 to 9 ft. apart, and consisting of three to six pieces of 6 × 6 in. timbers laid one on the top of the other; they were then riveted together in the ordinary way. The wooden stave-pipe is of the type successfully used in the Western States for many years, but its diameter is believed to be unequalled for any but short lengths. There were thirty-two staves in the circle, 2 in. in thickness, and about 20 ft. long, hooped with round steel rods ⅝ in. in diameter, each hoop being in two pieces. The pipe is supported at intervals of 8 ft. by sills 6 × 8 in. and 8 ft. long. The flow through it is 250 cubic ft. per second.

Pioneer, Utah.

The *Santa Ana Canal* was constructed for irrigation purposes in California, and is designed to carry 240 cub. ft. of water per second (*Trans. Am. Soc. C.E.* vol. xxxiii. p. 99). The cross section of the flumes shows an elliptical bottom and straight sides consisting of wooden staves held together by iron and steel ribs. The width and depth are each 5 ft. 6 in., the intended depth of water being 5 ft. The staves are held by T-iron supports resting on wooden sills spaced 8 ft. apart, and are compressed together by a framework. They were caulked with oakum, on the top of which, to a third of the total depth, hot asphalt was run. The use of nails was altogether avoided except in parts of the framework, it being noticed that decay usually starts at nail-holes. It was found possible to make the flume absolutely watertight, and in case of repair being necessary at any part the framework is easily taken to pieces so that new staves can be inserted. The water in the flume has a velocity of 9.6 ft. per second. The Warm Springs, Deep, and Morton cañons on the line are crossed by wooden stave pipes 52 in. in diameter, bound with round steel rods, and laid above the surface of the ground. The work is planned for two rows of pipes, each capable of carrying 123 cub. ft. per second; of these one so far has been laid. The lengths of the pipes at each of the three cañons are 551, 964 and 756 ft. respectively, and the maximum head at any place is 160 ft. The pipes

Santa Ana.

are not painted, and it has been suggested that they would suffer in their exposed position in case of a bush fire, a contingency to which, of course, flumes are also liable.

Aqueducts of New York.—There are three aqueducts in New York—the Old Croton Aqueduct (1837-1843), the Bronx River Conduit (1880-1885), and the New Croton Aqueduct (1884-1893), discharging respectively 95, 28, and 302 million U.S. gallons a day; their combined delivery is therefore 425 million gallons a day. The Old Croton Aqueduct is about 41 m. in length, and was constructed as a masonry conduit, except at the Harlem and Manhattan valleys, where two lines of 36-in. pipe were used. The inclination of the former is at the rate of about 13 in. per mile. The area of the cross-section is 53.34 sq. ft., the height is 8½ ft., and the greatest width 7 ft. 5 in.; the roof is semicircular, the floor segmental, and the sides have a batter on the face of ½ in. per foot. The sides and invert are of concrete, faced with 4 in. of brickwork, the roof being entirely of brickwork. There is a bridge over the Harlem river 1450 ft. in length, consisting of fifteen semicircular arches; its soffit is 100 ft. above high water, and its cost was $963,427. The construction of the New Croton Aqueduct was begun in 1885, and the works were sufficiently advanced by the 15th of July 1890 to allow the supply to be begun. The lengths of the various parts of the aqueduct are as follows:—

New York.

	Miles.
Tunnel	29.75
Cut-and-cover	1.12
Cast-iron pipes, 48 in. diameter, 8 rows.	2.38
Croton Inlet to Central Park.	33.25

The length of tunnel under pressure (circular form) is 7.17 m., and that not under pressure (horse-shoe form) 23.70 m. The maximum pressure in the former is 55 lb per sq. in. The width and height of the horse-shoe form are each 13 ft. 7 in., and the diameter of the circular form (with the exception of two short lengths) is 12 ft. 3 in. The reason for constructing the aqueduct in tunnel for so long a distance was the enhanced value of the low-lying ground near the old aqueduct. The tunnel deviates from a straight line only for the purpose of intersecting a few transverse valleys at which it could be emptied. For 25 m. the gradient is 0.7 foot per mile; the tunnel is then depressed below the hydraulic gradient, the maximum depth being at the Harlem river, where it is 300 ft. below high water. The depth of the tunnel varies from 50 to 500 ft. from the surface of the ground. Forty-two shafts were sunk to facilitate driving, and in four cases where the surface of the ground is below the hydraulic gradient these are closed by watertight covers. The whole of the tunnel is lined with brickwork from 1 to 2 ft. in thickness, the voids behind the lining being filled with rubble-in-mortar. The entry to the old and new aqueducts is controlled by a gatehouse of elaborate and massive design, and the pipes which take up the supply at the end of the tunnel are also commanded by a gate-house. The aqueduct, where it passes under the Harlem river, is worthy of special notice. As it approaches the river it has a considerable fall, and eventually ends in a vertical shaft 12 ft. 3 in. in diameter (where the water has a fall of 174 ft.), from the bottom of which, at a depth of 300 ft. below high-water level, the tunnel under the river starts. The latter is circular in form, the diameter being 10 ft. 6 in., and the length is 1300 ft.; it terminates at the bottom of another vertical shaft also 12 ft. 3 in. in diameter. The depth of this shaft, measured from the floor of the lower tunnel to that of the upper tunnel leading away from it, is 321 ft.; it is continued up to the surface of the ground, though closed by double watertight covers a little above the level of the upper tunnel. Adjoining this shaft is another shaft of equal diameter, by means of which the water can be pumped out, and there is also a communication with the river above high-water level, so that the higher parts can be emptied by gravitation. The cost of the Old Croton Aqueduct was $11,500,000; that of the new aqueduct is not far short of $20,000,000.

The *Nadrai Aqueduct Bridge*, in India, opened at the end of 1889, is the largest structure of its kind in existence. It was built to carry the water of the Lower Ganges canal over the Kali Naddi, in connexion with the irrigation canals of the north-west provinces. In the year 1888-1889 this canal had 564 m. of main line, with 2050 m. of minor distributaries, and irrigated 519,022 acres of crops. The new bridge replaces one of much smaller size (five spans of 35 ft.), which was completely destroyed by a high flood in July 1885. It gives the river a waterway of 21,000 sq. ft., and the canal a waterway of 1040 sq. ft., the latter representing a discharge of 4100 cub. ft. per second. Its length is 1310 ft., and it is carried on fifteen arches having a span of 60 ft. The width between the faces of the arches is 149 ft. The foundations below the river-bed have a depth of 52 ft., and the total height of the structure is 88 ft. It cost 44½ lakhs of rupees, and occupied four years in building. The foundations consist of 268 circular brick cylinders, and the fifteen spans are arranged in three groups, divided by abutment piers; the latter are founded on a double row of 12-ft. cylinders, and the intermediate piers on a single row of 20-ft. cylinders, all the cylinders being hearted with hydraulic lime concrete filled in with skips. This aqueduct-bridge has a very fine appearance, owing to its massive proportions and design.

Nadrai.

(E. P. H.*)

AUTHORITIES.—For ancient aqueducts in general: Curt Merckel, *Die Ingenieurtechnik im Alterthum* (Berlin, 1899); ch. vi. contains a very full account from the earliest Assyrian aqueducts onwards, with illustrations, measurements and an excellent bibliography. For Greek aqueducts see E. Curtius, "Über städtische Wasserbauten der Hellenen," in *Archaeologische Zeitung* (1847); G. Weber (as above); papers in *Athen. Mittheil.* (Samos), 1877, (Enneacrunus) 1892, 1893, 1894, 1905, and articles on ATHENS, PERGAMUM, &c. For Roman aqueducts: R. Lanciani, "I Commentari di Frontino intorno le acque e gli acquedotti," in *Memorie dei Lincei*, serie iii. vol. iv. (Rome, 1880), 215 sqq., and separately; C. Herschel, *The Two Books on the Water Supply of the City of Rome of Sextus Julius Frontinus* (Boston, 1899); T. Ashby in *Classical Review* (1902), 336, and articles in *The Builder*; cf. also the maps to T. Ashby's "Classical Topography of the Roman Campagna," in *Papers of the British School at Rome*, i., in., iv. (in progress).

For modern aqueducts, see Rickman's *Life of Telford* (1838); Schramke's *New York Croton Aqueduct; Second Annual Report of the Department of Public Works of the City of New York in 1872; Report of the Aqueduct Commissioners* (1887-1895), and *The Water Supply of the City of New York* (1896), by Wegmann; *Mémoires sur les eaux de Paris*, presentés par le Préfet de la Seine au Conseil Municipal (1854 and 1858); *Recherches statistiques sur les sources du bassin de la Seine*, par M. Belgrand, Ingénieur en chef des ponts et

chaussées (1854); "Descriptions of Mechanical Arrangements of the Manchester Waterworks," by John Frederic Bateman, F.R.S., Engineer-in-chief, from the *Minutes of Proceedings of the Institution of Mechanical Engineers* (1866); *The Glasgow Waterworks*, by James M. Gale, Member Inst. C.E. (1863 and 1864); *The Report of the Royal Commission on Water Supply, and the Minutes of Evidence* (1867 and 1868). For accounts of other aqueducts, see the Transactions of the Societies of Engineers in the different countries, and the Engineering Journals.

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1 There have been found at Caerwent, in Monmouthshire, clear traces of wooden pipes (internal diameter about 2 in.) which must have carried drinking-water, and almost certainly a pressure supply from the surrounding hills. Some patches of lead also have been found obviously nailed on to the pipes at points where they had burst (see *Archaeologia*, 1908).

2 This distance will not agree with the length given on some of the *cippi* (Lanciani, *Bull. Com.*, 1899, 38).

3 The course of the Aqua Claudia was considerably shortened by the cutting of a tunnel 3 m. long under the Monte Affliano in the time of Domitian (T. Ashby, in *Papers of the British School at Rome*, iii, 133).

4 About 3 m. south-east of this point the presence of large quantities of deposit and a sudden fall in the level of the channels seems to indicate the existence of settling tanks, of which no actual traces can be seen.

AQUILA Ἀκύλας, (1) a Jew from Rome, who with his wife Prisca or Priscilla had settled in Corinth, where Paul stayed with them (Acts xviii. 2,3). They became Christians and fellow-workers with Paul, to whom they seem to have shown their devotion in some special way (Rom. xvi. 3, 4). (2) A native of Pontus, celebrated for a very literal and accurate translation of the Old Testament into Greek. Epiphanius (*De Pond. et Mens.* c. 15) preserves a tradition that he was a kinsman of the emperor Hadrian, who employed him in rebuilding Jerusalem (Aelia Capitolina, *q.v.*), and that he was converted to Christianity, but, on being reproved for practising pagan astrology, apostatized to Judaism. He is said also to have been a disciple of Rabbi 'Aqiba (d. A.D. 132), and seems to be referred to in Jewish writings as עקילס. Aquila's version is said to have been used in place of the Septuagint in the synagogues. The Christians generally disliked it, alleging without due grounds that it rendered the Messianic passages incorrectly, but Jerome and Origen speak in its praise. Origen incorporated it in his *Hexapla*.

It was thought that this was the only copy extant, but in 1897 fragments of two codices were brought to the Cambridge University Library. These have been published—the fragments containing 1 Kings xx. 7-17; 2 Kings xxiii. 12-27 by F.C. Burkitt in 1897, those containing parts of Psalms xc.-ciii. by C. Taylor in 1899. See F.C. Burkitt's article in the *Jewish Encyclopaedia*.

AQUILA, CASPAR [Kaspar Adler] (1488-1560), German reformer, was born at Augsburg on the 7th of August 1488, educated there and at Ulm (1502), in Italy (he met Erasmus in Rome), at Bern (1508), Leipzig (1510) and Wittenberg (1513). According to his son, he entered the ministry in August 1514, at Bern. He was for some time a military chaplain. In 1516 he became pastor of Jenga, near Augsburg. Openly proclaiming his adhesion to Luther's doctrine, he was imprisoned for half a year (1520 or 1522) at Dillingen, by order of the bishop of Augsburg; a death sentence was commuted to banishment through the influence of Isabella, wife of Christian II. of Denmark and sister of Charles V. Returning to Wittenberg he met Luther, acted as tutor to the sons of Franz von Sickingen at Ebernburg, taught Hebrew at Wittenberg, and aided Luther in his version of the Old Testament. The dates and particulars of his career are uncertain till 1527, when he became pastor at Saalfeld, and in 1528, superintendent. His vehement opposition to the Augsburg Interim (1548) led him to take temporary shelter at Rudolstadt with Catherine, countess of Schwarzburg. In 1550 he was appointed dean of the Collegiatstift in Schmalkalden. Here he had a controversy with Andreas Osiander. Restored to Saalfeld, not without opposition, in 1552, he remained there, still engaged in controversy, till his death on the 12th of November 1560. He was twice married, and left four sons. He published numerous sermons, a few Old Testament expositions and some controversial tracts.

See G. Kawerau, in A. Hauck's *Realencyklopadie* (1896); *Allgemeine deutsche Biog.* (1875); Lives by J. Avenarius (1718); J.G. Hillinger (1731); Chr. Schlegel (1737); Fr. Gensler (1816).

AQUILA, SERAFINO DELL' (1466-1500), Italian poet and improvisatore, was born in 1466 at the town of Aquila, from which he took his name, and died in the year 1500. He spent several years at the courts of Cardinal Sforza and Ferdinand, duke of Calabria; but his principal patrons were the Borgias at Rome, from whom he received many favours. Aquila seems to have aimed at an imitation of Dante and Petrarch; and his poems, which were extravagantly praised during the author's lifetime, are occasionally of considerable merit. His reputation was in great measure due to his remarkable skill as an improvisatore and musician. His works were printed at Venice in 1502, and there have been several subsequent editions.

AQUILA, a city of the Abruzzi, Italy, the capital of the province of Aquila, and the seat of an archbishop, 2360 ft. above sea-level, 50 m. directly N.E. of Rome, and 145 m. by rail. Pop. (1901) town, 18,494; commune, 21,261. It lies on a hill in the wide valley of the Aterno, surrounded by mountains on all sides, the Gran Sasso d'Italia being conspicuous on the north-east. It is a favourite summer resort of the Italians, but is cold and windy in winter. In the highest part of the town is the massive citadel, erected by the Spanish viceroy Don Pedro de Toledo in 1534. The church of S. Bernardino di Siena (1472) has a fine Renaissance façade by Nicolò Filotesio (commonly called Cola dell' Amatrice), and contains the monumental tomb of the saint, decorated with beautiful sculptures, and executed by Silvestro Ariscola in 1480. The church of S. Maria di Collemaggio, just outside the town, has a very fine Romanesque façade of simple design (1270-1280) in red and white marble, with three finely decorated portals and a rose-window above each. The two side doors are also fine. The interior contains the mausoleum of Pope Celestine V. (d. 1296) erected in 1517. Many smaller churches in the town have similar façades (S. Giusta, S. Silvestro, &c.). The town also contains some fine palaces: the municipality has a museum, with a collection of Roman inscriptions and some illuminated service books. The Palazzi Dragonetti and Persichetti contain private collections of pictures. Outside the town is the *Fontana delle novantanove cannelle*, a fountain with ninety-nine jets distributed along three walls, constructed in 1272. Aquila has some trade in lace and saffron, and possesses other smaller industries. It was a university town in the middle ages, but most of its chairs have now been suppressed.

Aquila was founded by Conrad, son of the emperor Frederick II., about 1250, as a bulwark against the power of the papacy. It was destroyed by Manfred in 1259, but soon rebuilt by Charles I. of Anjou. Its walls were completed in 1316; and it maintained itself as an almost independent republic until it was subdued in 1521 by the Spaniards, who had become masters of the kingdom of Naples in 1503. It was twice sacked by the French in 1799.

See V. Bindi, *Monumenti storici ed artistici degli Abruzzi* (Naples, 1889), pp. 771 seq.

AQUILA, in astronomy, the "Eagle," sometimes named the "Vulture," a constellation of the northern hemisphere, mentioned by Eudoxus (4th cent. B.C.) and Aratus (3rd cent. B.C.). Ptolemy catalogued nineteen stars jointly in this constellation and in the constellation *Antinous*, which was named in the reign of the emperor Hadrian (A.D. 117-138), but sometimes, and wrongly, attributed to Tycho Brahe, who catalogued twelve stars in Aquila and seven in Antinous; Hevelius determined twenty-three stars in the first, and nineteen in the second. The most brilliant star of this constellation, α-*Aquilae* or Altair, has a parallax of 0.23″, and consequently is about eight times as bright as the sun; *η-Aquilae* is a short-period variable, while *Nova Aquilae* is a "temporary" or "new" star, discovered by Mrs Fleming of Harvard in 1899.

AQUILA ROMANUS, a Latin grammarian who flourished in the second half of the 3rd century A.D. He was the author of an extant treatise *De Figuris Sententiarum et Elocutionis*, written as an instalment of a complete rhetorical handbook for the use of a young and eager correspondent. While recommending Demosthenes and Cicero as models, he takes his own examples almost exclusively from Cicero. His treatise is really adapted from that by Alexander, son of Numenius, as is expressly stated by Julius Rufinianus, who brought out a supplementary treatise, augmented by material from other sources. Aquila's style is harsh and careless, and the Latin is inferior.

Halm, *Rhetores Latini minores* (1863); Wensch, *De Aquila Romano* (1861).

AQUILEIA, an ancient town of Italy, at the head of the Adriatic at the edge of the lagoons, about 6 m. from the sea, on the river Natiso (mod. Natisone), the course of which has changed somewhat since Roman times. It was founded by the Romans in 181 B.C. as a frontier fortress on the north-east, not far from the site where, two years before, Gaulish invaders had attempted to settle. The colony was led by two men of consular and one of praetorian rank, and 3000 *pedites* formed the bulk of the settlers. It was probably connected by road with Bononia in 175 B.C.; and subsequently with Genua in 148 B.C. by the Via Postumia, which ran through Cremona, Bedriacum and Altinum, joining the first-mentioned road at Concordia, while the construction of the Via Popilia from Ariminum to Ad Portum near Altinum in 132 B.C. improved the communications still further. In 169 B.C., 1500 more families were settled there as a reinforcement to the garrison. The discovery of the goldfields near the modern Klagenfurt in 150 B.C. (Strabo iv. 208) brought it into notice, and it soon became a place of importance, not only owing to its strategic position, but as a centre of trade, especially in agricultural products. It also had, in later times at least, considerable brickfields. It was originally a Latin colony, but became a *municipium* probably in 90 B.C. The customs boundary of Italy was close by in Cicero's day. It was plundered by the Iapydes under Augustus, but, in the period of peace which followed, was able to develop its resources. Augustus visited it during the Pannonian wars in 12-10 B.C. and it was the birthplace of Tiberius's son by Julia, in the latter year. It was the starting-point of several important roads leading to the north-eastern portion of the empire—the road (Via Iulia Augusta) by Iulium Carnicum to Veldidena (mod.

Wilten, near Innsbruck), from which branched off the road into Noricum, leading by Virunum (Klagenfurt) to Lauricum (Lorch) on the Danube, the road into Pannonia, leading to Emona (Laibach)[1] and Sirmium (Mitrowitz), the road to Tarsatica (near Fiume) and Siscia (Sissek), and that to Tergeste (Trieste) and the Istrian coast.

In the war against the Marcomanni in A.D. 167, the town was hard pressed; the fortifications had fallen into disrepair during the long peace. In A.D. 238, when the town took the side of the senate against the emperor Maximinus, they were hastily restored, and proved of sufficient strength to resist for several months, until Maximinus himself was assassinated. The 4th century marks, however, the greatest importance of Aquileia; it 250
became a naval station and, probably, the seat of the *corrector Venetiarum et Histriae*; a mint was established here, the coins of which are very numerous, and the bishop obtained the rank of patriarch. An imperial palace was constructed here, in which the emperors after the time of Diocletian frequently resided; and the city often played a part in the struggles between the rulers of the 4th century. At the end of the century, Ausonius enumerated it as the ninth among the great cities of the world, placing Rome, Mediolanum and Capua before it, and called it “moenibus et portu celeberrima.” In A.D. 452, however, it was destroyed by Attila, though it continued to exist until the Lombard invasion of A.D. 568. After this the patriarchate was transferred to Grado. In 606 the diocese was divided into two parts, and the patriarchate of Aquileia, protected by the Lombards, was revived, that of Grado being protected by the exarch of Ravenna and later by the doges of Venice. In 1027 and 1044 Patriarch Poppo of Aquileia entered and sacked Grado, and, though the pope reconfirmed the patriarch of the latter in his dignities, the town never recovered, though it continued to be the seat of the patriarchate until its formal transference to Venice in 1450. The seat of the patriarchate of Aquileia had been transferred to Udine in 1238, but returned in 1420 when Venice annexed the territory of Udine. It was finally suppressed in 1751, and the sees of Udine and Gorizia (Görz) established in its stead. Its buildings served as stone quarries for centuries, and no edifices of the Roman period remain above ground. Excavations have revealed one street and the north-west angle of the town walls, while the local museum contains over 2000 inscriptions, besides statues and other antiquities. The cathedral, a flat-roofed basilica, was erected by Patriarch Poppo in 1031 on the site of an earlier church, and rebuilt about 1379 in the Gothic style by Patriarch Marquad. The narthex and baptistery belong to an earlier period. Of the palace of the patriarchs only two isolated columns remain standing. The modern village (pop. 2300) is rendered unhealthy by rice-fields.

See T.W. Jackson, *Dalmatia, Istria and the Quarnero* (Oxford, 1887), iii. 377 seq.; H. Maionica, *Aquileia zur Romerzeit* (Görz, 1881), *Fundkarte van Aquileia* (Görz, 1893), “Inschriften in Grado” (Roman inscriptions removed thither from Aquileia) in *Jahreshefte des Österr. Arch. Instituts*, i. (1898), Beiblatt, 83, 125.

(T. As.)

1 This road is described in detail by O. Cuntz in *Jahreshefte des Österr. Arch. Inst.* v. (1902), Beiblatt, pp. 139 seq.

AQUILLIUS, MANIUS, Roman general, consul in 101 B.C. He successfully put down a revolt of the slaves under Athenion in Sicily. After his return, being accused of extortion, he was acquitted on account of his military services, although there was little doubt of his guilt. In 88 he acted as legate against Mithradates the Great, by whom he was defeated and taken prisoner. Mithradates treated him with great cruelty, and is said to have put him to death by pouring molten gold down his throat.

Diodorus Siculus xxxvi. 3; Appian, *Mithrid.* ii. 17. 21; Vell. Paterculus ii. 18; Cicero, *Verres*, iii. 54, *De Officiis*, ii. 14, *Tusc.* v. 5.

AQUINAS, THOMAS [Thomas of Aquin or Aquino], (*c.* 1227-1274), scholastic philosopher, known as *Doctor Angelicus, Doctor Universalis*, was of noble descent, and nearly allied to several of the royal houses of Europe. He was born in 1225 or 1227, at Roccasecca, the castle of his father Landulf, count of Aquino, in the territories of Naples. Having received his elementary education at the monastery of Monte Cassino, he studied for six years at the university of Naples, leaving it in his sixteenth year. While there he probably came under the influence of the Dominicans, who were doing their utmost to enlist within their ranks the ablest young scholars of the age, for in spite of the opposition of his family, which was overcome only by the intervention of Pope Innocent IV., he assumed the habit of St Dominic in his seventeenth year.

His superiors, seeing his great aptitude for theological study, sent him to the Dominican school in Cologne, where Albertus Magnus was lecturing on philosophy and theology. In 1245 Albertus was called to Paris, and there Aquinas followed him, and remained with him for three years, at the end of which he graduated as bachelor of theology. In 1248 he returned to Cologne with Albertus, and was appointed second lecturer and *magister studentium*. This year may be taken as the beginning of his literary activity and public life. Before he left Paris he had thrown himself with ardour into the controversy raging between the university and the Friar-Preachers respecting the liberty of teaching, resisting both by speeches and pamphlets the authorities of the university; and when the dispute was referred to the pope, the youthful Aquinas was chosen to defend his order, which he did with such success as to overcome the arguments of Guillaume de St Amour, the champion of the university, and one of the most celebrated men of the day. In 1257, along with his friend Bonaventura, he was created doctor of theology, and began to give courses of lectures upon this subject in Paris, and also in Rome and other towns in Italy. From this time onwards his life was one of incessant toil; he was continually

engaged in the active service of his order, was frequently travelling upon long and tedious journeys, and was constantly consulted on affairs of state by the reigning pontiff.

In 1263 we find him at the chapter of the Dominican order held in London. In 1268 he was lecturing now in Rome and now in Bologna, all the while engaged in the public business of the church. In 1271 he was again in Paris, lecturing to the students, managing the affairs of the church and consulted by the king, Louis VIII., his kinsman, on affairs of state. In 1272 the commands of the chief of his order and the request of King Charles brought him back to the professor's chair at Naples. All this time he was preaching every day, writing homilies, disputations, lectures, and finding time to work hard at his great work the *Summa Theologiae*. Such rewards as the church could bestow had been offered to him. He refused the archbishopric of Naples and the abbacy of Monte Cassino. In January 1274 he was summoned by Pope Gregory X. to attend the council convened at Lyons, to investigate and if possible settle the differences between the Greek and Latin churches. Though suffering from illness, he at once set out on the journey; finding his strength failing on the way, he was carried to the Cistercian monastery of Fossa Nuova, in the diocese of Terracina, where, after a lingering illness of seven weeks, he died on the 7th of March 1274, Dante (*Purg*. xx. 69) asserts that he was poisoned by order of Charles of Anjou. Villani (ix. 218) quotes the belief, and the *Anonimo Fiorentino* describes the crime and its motive. But Muratori, reproducing the account given by one of Thomas's friends, gives no hint of foul play. Aquinas was canonized in 1323 by Pope John XXII., and in 1567 Pius V. ranked the festival of St Thomas with those of the four great Latin fathers, Ambrose, Augustine, Jerome and Gregory. No theologian save Augustine has had an equal influence on the theological thought and language of the Western Church, a fact which was strongly emphasized by Leo XIII. (*q.v.*) in his *Encyclical* of August 4, 1879, which directed the clergy to take the teachings of Aquinas as the basis of their theological position. In 1880 he was declared patron of all Roman Catholic educational establishments. In a monastery at Naples, near the cathedral of St Januarius, is still shown a cell in which he is said to have lived.

The writings of Thomas are of great importance for philosophy as well as for theology, for by nature and education he is the spirit of scholasticism incarnate. The principles on which his system rested were these. He held that there were two sources of knowledge—the mysteries of Christian faith and the truths of human reason. The distinction between these two was made emphatic by Aquinas, who is at pains, especially in his treatise *Contra Gentiles*, to make it plain that each is a distinct fountain of knowledge, but that revelation is the more important of the two. Revelation is a source of knowledge, rather than the manifestation in the world of a divine life, and its chief characteristic is that it presents men with mysteries, which are to be believed even when they cannot be understood. Revelation is not Scripture alone, for Scripture taken by itself does not correspond exactly with his description; nor is it church tradition alone, for church tradition must so far rest on Scripture. Revelation is a divine source of knowledge, of which Scripture and church tradition are the channels; and he who would rightly understand theology must familiarize himself with Scripture, the 251
teachings of the fathers, and the decisions of councils, in such a way as to be able to make part of himself, as it were, those channels along which this divine knowledge flowed. Aquinas's conception of reason is in some way parallel with his conception of revelation. Reason is in his idea not the individual reason, but the fountain of natural truth, whose chief channels are the various systems of heathen philosophy, and more especially the thoughts of Plato and the methods of Aristotle. Reason and revelation are separate sources of knowledge; and man can put himself in possession of each, because he can bring himself into relation to the church on the one hand, and the system of philosophy, or more strictly Aristotle, on the other. The conception will be made clearer when it is remembered that Aquinas, taught by the mysterious author of the writings of the pseudo-Dionysius, who so marvellously influenced medieval writers, sometimes spoke of a natural revelation, or of reason as a source of truths in themselves mysterious, and was always accustomed to say that reason as well as revelation contained two kinds of knowledge. The first kind lay quite beyond the power of man to receive it, the second was within man's reach. In reason, as in revelation, man can only attain to the lower kind of knowledge; there is a higher kind which we may not hope to reach.

But while reason and revelation are two distinct sources of truths, the truths are not contradictory; for in the last resort they rest on *one* absolute truth—they come from the one source of knowledge, God, the Absolute One. Hence arises the compatibility of philosophy and theology which was the fundamental axiom of scholasticism, and the possibility of a Summa Theologiae, which is a Summa Philosophiae as well. All the many writings of Thomas are preparatory to his great work the *Summa Theologiae*, and show us the progress of his mind training for this his life work. In the *Summa Catholicae Fidei contra Gentiles* he shows how a Christian theology is the sum and crown of all science. This work is in its design apologetic, and is meant to bring within the range of Christian thought all that is of value in Mahommedan science. He carefully establishes the necessity of revelation as a source of knowledge, not merely because it aids us in comprehending in a somewhat better way the truths already furnished by reason, as some of the Arabian philosophers and Maimonides had acknowledged, but because it is the absolute source of our knowledge of the mysteries of the Christian faith; and then he lays down the relations to be observed between reason and revelation, between philosophy and theology. This work, *Contra Gentiles*, may be taken as an elaborate exposition of the method of Aquinas. That method, however, implied a careful study and comprehension of the results which accrued to man from reason and revelation, and a thorough grasp of all that had been done by man in relation to those two sources of human knowledge; and so, in his preliminary writings, Thomas proceeds to master the two provinces. The results of revelation he found in the Holy Scriptures and in the writings of the fathers and the great theologians of the church; and his method was to proceed backwards. He began with Peter of Lombardy (who had reduced to theological order, in his famous book on the *Sentences*, the various authoritative statements of the church upon doctrine) in his *In Quatuor Sententiarum P. Lombardi libros*. Then came his deliverances upon undecided points in theology, in his *XII. Quodlibeta Disputata*, and his *Quaestiones Disputatae*. His *Catena Aurea* next appeared, which, under the form of a commentary on the Gospels, was really an exhaustive summary of the theological teaching of the greatest of the church fathers. This side of his preparation was finished by a close study of Scripture, the results of which are contained in his commentaries, *In omnes Epistolas Dim Apostoli Expositio*, his *Super Isaiam et Jeremiam*, and his *In Psalmos*. Turning now to the other side, we have evidence, not only from tradition but from his writings, that he was acquainted with Plato and the mystical Platonists; but he had the sagacity to perceive that Aristotle was *the* great representative of philosophy, and that his writings contained the best results and

method which the natural reason had as yet attained to. Accordingly Aquinas prepared himself on this side by commentaries on Aristotle's *De Interpretatione*, on his *Posterior Analytics*, on the *Metaphysics*, the *Physics*, the *De Anima*, and on Aristotle's other psychological and physical writings, each commentary having for its aim to lay hold of the material and grasp the method contained and employed in each treatise. Fortified by this exhaustive preparation, Aquinas began his *Summa Theologiae*, which he intended to be the sum of all known learning, arranged according to the best method, and subordinate to the dictates of the church. Practically it came to be the theological dicta of the church, explained according to the philosophy of Aristotle and his Arabian commentators. The *Summa* is divided into three great parts, which shortly may be said to treat of God, Man and the God-Man. The first and the second parts are wholly the work of Aquinas, but of the third part only the first ninety quaestiones are his; the rest of it was finished in accordance with his designs. The first book, after a short introduction upon the nature of theology as understood by Aquinas, proceeds in 119 questions to discuss the nature, attributes and relations of God; and this is not done as in a modern work on theology, but the questions raised in the physics of Aristotle find a place alongside of the statements of Scripture, while all subjects in any way related to the central theme are brought into the discourse. The second part is divided into two, which are quoted as *Prima Secundae* and *Secunda Secundae*. This second part has often been described as ethic, but this is scarcely true. The subject is man, treated as Aristotle does, according to his τέλος, and so Aquinas discusses all the ethical, psychological and theological questions which arise; but any theological discussion upon man must be mainly ethical, and so a great proportion of the first part, and almost the whole of the second, has to do with ethical questions. In his ethical discussions (a full account of which is given under Ethics) Aquinas distinguishes theological from natural virtues and vices; the theological virtues are faith, hope and charity; the natural, justice, prudence and the like. The theological virtues are founded on faith, in opposition to the natural, which are founded on reason; and as faith with Aquinas is always belief in a proposition, not trust in a personal Saviour, conformably with his idea that revelation is a new knowledge rather than a new life, the relation of unbelief to virtue is very strictly and narrowly laid down and enforced. The third part of the *Summa* is also divided into two parts, but by accident rather than by design. Aquinas died ere he had finished his great work, and what has been added to complete the scheme is appended as a *Supplementum Tertiae Partis*. In this third part Aquinas discusses the person, office and work of Christ, and had begun to discuss the sacraments, when death put an end to his labours.

The purely philosophical theories of Aquinas are explained in the article Scholasticism. In connexion with the problem of universals, he held that the diversity of individuals depends on the quantitative division of matter (*materia signata*), and in this way he attracted the criticism of the Scotists, who pointed out that this very matter is individual and determinate, and, therefore, itself requires explanation. In general, Aquinas maintained in different senses the real existence of universals *ante rem*, *in re* and *post rem*.

The best modern edition of the works of Aquinas is that prepared at the expense of Leo XIII. (Rome, 1882-1903). The Abbé Migne published a very useful edition of the *Summa Theologiae*, in four 8vo vols., as an appendix to his *Patrologiae Cursus Completus*; English editions, J. Rickaby (London, 1872), J.M. Ashley (London, 1888). See *Acta Sanct.*, vii. Martii; A. Touron, *La Vie de St Thomas d'Aquin, avec un exposé de sa doctrine et de ses ouvrages* (Paris, 1737); Karl Werner, *Der Heilige Thomas van Aquino* (1858); and R.B. Vaughan, *St Thomas of Aquin, his Life and Labours* (London, 1872): other lives by P. Cavanagh (London, 1890); E. Desmousseaux de Giuré (Paris, 1888); M. Didot (Louvain, 1894). For the philosophy of Aquinas, see Albert Stöckl, *Geschichte der Philosophie des Mittelalters*, ii.; B. Hauréau, *De la philosophie scolastique*, vol. ii.; J. Frohschammer, *Die Philos. d. Th. van A.* (Leipzig, 1889); K. Prantl, *Geschichte d. Logik*, vol. iii.; C.M. Schneider, *Natur, Vernunft, Gott* (Regensburg, 1883), *Das Wissen Gottes nach d. Lehre des Th. v. A.* (4 vols. Regensburg, 1884-1886), *Die socialistische Staatsidee beleuchtet durch Th. v. A.* (Paderborn, 1894); A. Harnack, *Hist, of Dogma* (trans. Wm. Gilchrist, London, 1899); Ueberweg's *History of Philosophy*, vol. i. See also H.C. O'Neill, *New Things and Old in St Thomas Aquinas* (1909), with biography.

(T. M. L.; J. M. M.)

AQUINO, a town and episcopal see of Campania, Italy, in the province of Caserta; it is 56 m. N.W. by rail from the town of Caserta, and 7½ m. N.W. of Cassino. Pop. (1901) 2672. The modern town, close to the ancient, is unimportant, though the canons of the cathedral have the privilege of wearing the mitre and *cappa magna* at great festivals. It is close to the site of the ancient Aquinum, a *municipium* in the time of Cicero, and made a colony by the Triumviri, the birthplace of Juvenal and of the emperor Pescennius Niger. The Via Latina traversed it; one of the gates through which it passed, now called Porta S. Lorenzo, is still well preserved, and there are remains within the walls (portions of which, built of large blocks of limestone, still remain) of two (so called) temples, a basilica and an amphitheatre (see R. Delbrück in *Röm. Mitteilungen*, 1903, p. 143). Outside, on the south is a well-preserved triumphal arch with composite capitals, and close to it the 11th-century basilica of S. Maria Libera, a handsome building in the Romanesque style, but now roofless. Several Roman inscriptions are built into it, and many others that have been found indicate the ancient importance of the place, which, though it does not appear in early history, is vouched for by Cicero and Strabo.[1] A colony was planted here by the Triumviri. St Thomas Aquinas was born in the castle of Roccasecca, 5 m. N.

See E. Grossi, *Aquinum* (Rome, 1907).

(T. As.)

1 According to H. Nissen, *Ital. Landeskunde* (Berlin, 1902), ii. 665, a road ran from here to Minturnae; but no traces of it are to be seen.

AQUITAINE, the name of an ancient province in France, the extent of which has varied considerably from time to time. About the time of Julius Caesar the name *Aquitania* was given to that part of Gaul lying between the Pyrenees and the Garonne, and its inhabitants were a race, or races, distinct from the Celts. The name Aquitania is probably a form of Auscetani, which in its turn is a lengthened form of Ausces, and is thus cognate with the words Basque and Wasconia, *i.e.* Gascony. Although many of the tribes of Aquitania submitted to Julius Caesar, it was not until about 28 B.C. that the district was brought under the Roman yoke. In keeping with the Roman policy of denationalization, the term Aquitania was extended, and under Augustus it included the whole of Gaul south and west of the Loire and the Allier, and thus ceased to possess ethnographical importance. In the 3rd century A.D. this larger Aquitania was divided into three parts: *Aquitania Prima*, the eastern part of the district between the Loire and the Garonne; *Aquitania Secunda*, the western part of the same district; and *Aquitania Tertia*, or *Novempopulana*, the region between the Garonne and the Pyrenees, or the original Aquitania. The seats of government were respectively Bourges, Bordeaux and Eauze; the province contained twenty-six cities, and was in the diocese of Vienne. Like the rest of Gaul, Aquitania absorbed a large measure of Roman civilization, and this continued to distinguish the district down to a late period. In the 5th century the Visigoths established themselves in Aquitania Secunda, and also in parts of Aquitania Prima and Novempopulana, but after the defeat of their king Alaric II. by the Franks under Clovis in 507, they were supplanted by their conquerors. Clovis and his successors extended their authority nominally to the Pyrenees, but, as Guizot has remarked, “the conquest of Aquitania by Clovis left it almost as alien to the people and king of Franks as it had formerly been.” Subsequently during the Merovingian period it was contended for by the feeble rulers of the various Frankish kingdoms, and was frequently partitioned among them; but the Aquitanians had little difficulty in effectually resisting this authority, although they did not establish themselves as a separate kingdom. About 628, indeed, they gathered around Charibert, or Haribert, a brother of the Frankish king, Dagobert I., in the hope of national independence; but after his death in 630 they returned to their former condition. But this effort, although a failure, brought about a certain measure of concord between the two principal races inhabiting the district, and so prepared the way for the stubborn resistance which, subsequently, the Aquitanians were able to offer to the Franks.

The first line of dukes began about 660 with one Felix, who, like his successor, Lupus, probably owned allegiance to the Frankish kings, and whose seat of government was Toulouse. About the end of the 7th century an adventurer named Odo, or Eudes, made himself master of this region. Attacked by the Saracens he inflicted on them a crushing defeat, but when they reappeared, he was obliged to invoke the aid of Charles Martel, who, as the price of his support, claimed and received the homage of his ally. Odo was succeeded by his son Hunald, who after carrying on a war against the Franks under Pippin the Short, retired to a convent, leaving both the kingdom and the conflict to Waifer, or Guaifer. For some years Waifer strenuously carried on an unequal struggle with the Franks, but he was assassinated in 768, and with him perished the national independence, although not the national individuality, of the Aquitanians. In 781 Charlemagne bestowed Aquitaine upon his young son, Louis, and as Louis was generally described as a king, Aquitaine is referred to during the Carolingian period as a kingdom, and not as a duchy. When Louis succeeded Charlemagne as emperor in 814, he granted Aquitaine to his son Pippin, on whose death in 838 the Aquitanians chose his son Pippin II. (d. 865) as their king. The emperor Louis I., however, opposed this arrangement and gave the kingdom to his youngest son Charles, afterwards the emperor Charles the Bald. Now followed a time of confusion and conflict which resulted eventually in the success of Charles, although from 845 to 852 Pippin was in possession of the kingdom. In 852 Pippin was imprisoned by Charles the Bald, who soon afterwards gave to the Aquitanians his own son Charles as their king. On the death of the younger Charles in 866, his brother Louis the Stammerer succeeded to the kingdom, and when, in 877, Louis became king of the Franks, Aquitaine was united to the Frankish crown.

A new period now begins in the history of Aquitaine. By a treaty made in 845 between Charles the Bald and Pippin II. the kingdom had been diminished by the loss of Poitou, Saintonge and Angoumois, which had been given to Rainulf I., count of Poitiers. Somewhat earlier than this date the title of duke of the Aquitanians had been revived, and this was now borne by Rainulf, although it was also claimed by the counts of Toulouse. The new duchy of Aquitaine, comprising the three districts already mentioned, remained in the hands of Rainulf’s successors, in spite of some trouble with their Frankish overlords, until 893 when Count Rainulf II. was poisoned by order of King Charles III. the Simple. Charles then bestowed the duchy upon William the Pious, count of Auvergne, the founder of the abbey of Cluny, who was succeeded in 918 by his nephew, Count William II., who died in 926. A succession of dukes followed, one of whom, William IV., fought against Hugh Capet, king of France, and another of whom, William V., called the Great, was able considerably to strengthen and extend his authority, although he failed in his attempt to secure the Lombard crown. William’s duchy almost reached the limits of the Roman Aquitania Prima and Secunda, but did not stretch south of the Garonne, a district which was in the possession of the Gascons. William died in 1030, and the names of William VI. (d. 1038), Odo or Eudes (d. 1039), who joined Gascony to his duchy, William VII. and William VIII. bring us down to William IX. (d. 1127), who succeeded in 1087, and made himself famous as a crusader and a troubadour. William X. (d. 1137) married his daughter Eleanor to Louis VII., king of France, and Aquitaine went as her dowry. When Eleanor was divorced from Louis and was married in 1152 to Henry II. of England the duchy passed to her new husband, who, having suppressed a revolt there, gave it to his son Richard. When Richard died in 1199, it reverted to Eleanor, and on her death five years later, was united to the English crown and henceforward followed the fortunes of the English possessions in France. Aquitaine as it came to the English kings stretched as of old from the Loire to the Pyrenees, but its extent was curtailed on the south-east by the wide lands of the counts of Toulouse. The name Guienne, a corruption of Aquitaine, seems to have come into use about the 10th century, and the subsequent history of Aquitaine is merged in that of Gascony (*q.v.*) and Guienne (*q.v.*).

See E. Desjardins, *Géographie historique el administrative de la Gaule romaine* (Paris, 1876, 93); A. Luchaire, *Les Origines linguistiques de l’Aquitaine* (Paris, 1877); A. Longnon, *Géographie de la Gaule au VI^e siècle* (Paris, 1876); A. Perroud, *Les Origines du premier duché d’Aquitaine* (Paris, 1881); and E. Mabille, *Le Royaume d’Aquitaine et ses marches sous les Carlovingiens* (Paris, 1870).

ARABESQUE, a word meaning simply “Arabian,” but technically used for a certain form of decorative design in flowing lines intertwined; hence comes the more metaphorical use of this word, whether in nature or in morals, indicating a fantastic or complicated interweaving of lines against a background. In decorative design the term is historically a misnomer. It is applied to the grotesque decoration derived from Roman remains of the early time of the empire, not to any style derived from Arabian or Moorish work. Arabesque and Moresque are really distinct; the latter is from the Arabian style of ornament, developed by the Byzantine Greeks for their new masters, after the conquests of the followers of Mahomet; and the former is a term pretty well restricted to varieties of cinquecento decoration, which have nothing in common with any Arabian examples in their details, but are a development derived from Greek and Roman grotesque designs, such as we find them in the remains of ancient palaces at Rome, and in ancient houses at Pompeii. These were reproduced by Raphael and his pupils in the decoration of some of the corridors of the Loggie of the Vatican at Rome: grotesque is thus a better name for these decorations than Arabesque. This technical Arabesque, therefore, is much more ancient than any Arabian or Moorish decoration, and has really nothing in common with it except the mere symmetrical principles of its arrangement. Pliny and Vitruvius give us no name for the extravagant decorative wall-painting in vogue in their time, to which the early Italian revivers of it seem to have given the designation of grotesque, because it, was first discovered in the arched or underground chambers (*grotte*) of Roman ruins—as in the golden house of Nero, or the baths of Titus. What really took place in the Italian revival was in some measure a supplanting of the Arabesque for the classical grotesque, still retaining the original Arabian designation, while the genuine Arabian art, the Saracenic, was distinguished as Moresque or Moorish. So it is now the original Arabesque that is called by its specific names of Saracenic, Moorish and Alhambresque, while the term Arabesque is applied exclusively to the style developed from the debased classical grotesque of the Roman empire.

There is still much of the genuine Saracenic element in Renaissance Arabesques, especially in that selected for book-borders and for silver-work, the details of which consist largely of the conventional Saracenic foliations. But the Arabesque developed in the Italian cinquecento work repudiated all the original Arabian elements and devices, and limited itself to the manipulating of the classical elements, of which the most prominent feature is ever the floriated or foliated scroll; and it is in this cinquecento decoration, whether in sculpture or in painting, that *Arabesque* has been perfected.

In the Saracenic, as the elder sister of the two styles, which was ingeniously developed by the Byzantine Greek artists for their Arabian masters in the early times of Mahommedan conquest, every natural object was proscribed; the artists were, therefore, reduced to making symmetrical designs from forms which should have no positive meaning; yet the Byzantine Greeks, who were Christians, managed to work even their own ecclesiastical symbols, in a disguised manner, into their tracery and diapers; as the lily, for instance. The cross was not so introduced; this, of course, was inadmissible; but neither was the crescent ever introduced into any of this early work in Damascus or Cairo. The crescent was itself not a Mahommedan device till after the conquest of Constantinople in 1453 A.D. The crescent, as the new moon, was the symbol of Byzantium; and it was only after that capital of the Eastern empire fell into the hands of the Turks that this symbol was adopted by them. The crescent and the cross became antagonist standards, therefore, first in the 15th century. And the crescent is not an element of original Moorish decoration.

The Alhambra diapers and original Majolica (Majorca) ware afford admirable specimens of genuine Saracenic or Moorish decoration. A conventional floriage is common in these diapers; tracery also is a great feature in this work, in geometrical combinations, whether rectilinear or curvilinear; and the designs are rich in colour; idolatry was in the reproduction of natural forms, not in the fanciful combination of natural colours. These curves and angles, therefore, or interlacings, chiefly in stucco, constitute the prominent elements of an Arabian ornamental design, combining also Arabic inscriptions; composed of a mass of foliation or floral forms conventionally disguised, as the exclusion of all natural images was the fundamental principle of the style in its purity. The Alhambra displays almost endless specimens of this peculiar work, all in relief, highly coloured, and profusely enriched with gold. The mosque of Tulun, in Cairo, A.D. 876, the known work of a Greek, affords the completest example of this art in its early time; and Sicily contains many remains of this same exquisite Saracenic decoration.

Such is the genuine Arabesque of the Arabs, but a very different style of design is implied by the Arabesque of the cinquecento, a purely classical ornamentation. This owes its origin to the excavation and recovery of ancient monuments, and was developed chiefly by the sculptors of the north, and the painters of central Italy; by the Lombardi of Venice, by Agostino Busti of Milan, by Bramante of Urbino, by Raphael, by Giulio Romano, and others of nearly equal merit. Very beautiful examples in sculpture of this cinquecento Arabesque are found in the churches of Venice, Verona and Brescia; in painting, the most complete specimens are those of the Vatican Loggie, and the Villa Madama at Rome and the ducal palaces at Mantua. The Vatican Arabesques, chiefly executed for Raphael by Giulio Romano, Gian Francesco Penni, and Giovanni da Udine, though beautiful as works of painting, are often very extravagant in their composition, ludicrous and sometimes aesthetically offensive; as are also many of the decorations of Pompeii. The main features of these designs are balanced scrolls in panels; or standards variously composed, but symmetrically scrolled on either side, and on the tendrils of these scrolls are suspended or placed birds and animals, human figures and chimeras, of any or all kinds, or indeed any objects that may take the fancy of the artist. The most perfect specimens of cinquecento Arabesque are certainly found in sculpture. As specimens of exquisite work may be mentioned the Martinengo tomb, in the church of the Padri Riformati at Brescia, and the façade of the church of Santa Maria del Miracoli there, by the Lombardi; and many of the carvings of the Château de Gaillon, France—all of which fairly illustrate the beauties and capabilities of the style.

See also Wornum, *Analysis of Ornament* (1874).

(R. N. W.)

ARABGIR, or Arabkir (Byz. *Arabraces*), a town of Turkey in Asia in the Mamuret el-Aziz or Kharput vilayet, situated near the confluence of the eastern and western Euphrates, but some miles from the right bank of the combined streams. Pop. about 20,000, of which the larger half is Mussulman. It is connected with Sivas by a *chaussée*, prolonged to the Euphrates. The inhabitants are enterprising and prosperous, many of them leaving their native city to push their fortunes elsewhere, while of those that remain the greater part is employed in the manufacture of silk and cotton goods, or in the production of fruit. The present town was built at a comparatively recent date; but about 2 m. north-east is the old town, now called Eski-Shehr, given (*c.* 1021) to Senekherim of Armenia by the emperor Basil II. It contains the ruins of a castle and of several Seljuk mosques. The Armenian population suffered severely during the massacres of 1895.

(D. G. H.)

ARABIA, a peninsula in the south-west of Asia, lying between 34º 30′ and 12º 45′ N., and 32º 30′ and 60º E., is bounded W. by the Red Sea, S. by the Gulf of Aden and the Indian Ocean, and E. by the Gulf of Oman and the Persian Gulf. Its northern or land boundary is more difficult to define; most authorities, however, agree in taking it from El Arish on the Mediterranean, along the southern border of Palestine, between the Dead Sea and the Gulf of Akaba, then bending northwards along the Syrian border nearly to Tadmur, thence eastwards to the edge of the Euphrates valley near Anah, and thence south-east to the mouth of the Shat el Arab at the head of the Persian Gulf,—the boundary so defined includes the northern desert, which belongs geographically to Arabia rather than to Syria; while on the same grounds lower Mesopotamia and Irak, although occupied by an Arab population, are excluded.

In shape, the peninsula forms a rough trapezium, with its greatest length from north-west to south-east. The length of its western side from Port Said to Aden is 1500 m.; its base from the Straits of Bab-el-Mandeb (or Bab al Mandab) to Ras el Had is 1300 m., its northern side from Port Said to the Euphrates 600 m.; its total area approximately 1,200,000 sq. m.

Geography

General Features.—In general terms Arabia may be described as a plateau sloping gently from south-west to north-east, and attaining its greatest elevation in the extreme south-west. The western escarpment of the plateau rises steeply from the Red Sea littoral to a height of from 4000 to 8000 ft., leaving a narrow belt of lowland rarely exceeding 30 m. in width between the shore and the foot-hills. On the north-east and east the plateau shelves gradually to the Euphrates and the Persian Gulf; only in the extreme east is this general easterly slope arrested by the lofty range of Jebel Akhdar, which from Ras Musandan to Ras el Had borders the coast of Oman.

Its chief characteristic is the bareness and aridity of its surface; one-third of the whole desert, and of the remainder only a small proportion is suited to settled life, owing to its scanty water-supply and uncertain rainfall. Its mountains are insufficient in elevation and extent to attract their full share of the monsoon rains, which fall so abundantly on the Abyssinian highlands on the other side of the Red Sea; for this reason Arabia has neither lakes nor forests to control the water-supply and prevent its too rapid dissipation, and the rivers are mere torrent beds sweeping down occasionally in heavy floods, but otherwise dry.

The country falls naturally into three main divisions, a northern, a central and a southern; the first includes the area between the Midian coast on the west and the head of the Persian Gulf on the east, a desert tract throughout, stony in the north, sandy in the south, but furnishing at certain seasons excellent pasturage; its population is almost entirely nomad and pastoral. The central zone includes Hejaz (or Hijaz), Nejd and El Hasa; much of it is a dry, stony or sandy steppe, with few wells or watering-places, and only occupied by nomad tribes; but the great wadis which intersect it contain many fertile stretches of alluvial soil, where cultivation is possible and which support a considerable settled population, with several large towns and numerous villages.

The third or southern division contains the highland plateaus of Asir and Yemen in the west, and J. Akhdar in the east, which with a temperate climate, due to their great elevation and their proximity to the sea, deserve, if any part of Arabia does, the name of Arabia Felix—the population is settled and agricultural, and the soil, wherever the rainfall is sufficient, is productive. The Batina coast of Oman, irrigated by the mountain streams of J. Akhdar, is perhaps the most fertile district in the peninsula; Hadramut, too, contains many large and prosperous villages, and the torrents from the Yemen highlands fertilize several oases in the Tehama (or Tihama) or lowlands of the western and southern coast. These favourable conditions of soil and climate, however, extend only a comparatively short distance into the interior, by far the larger part of which is covered by the great southern desert, the Dahna, or Ruba el Khali, empty as its name implies, and uninhabitable.

Exploration.—Before entering on a detailed description of the several provinces of Arabia, our sources of information will be briefly indicated. Except in the neighbourhood of Aden, no regular surveys exist, and professional work is limited to the marine surveys of the Indian government and the admiralty, which, while laying down the coast line with fair accuracy, give little or no topographical information inland. For the mapping of the whole vast interior, except in rare cases, no data exist beyond the itineraries of explorers, travelling as a rule under conditions which precluded the use of even the simplest surveying instruments. These journeys, naturally following the most frequented routes, often cover the same ground, while immense tracts, owing to their difficulty of access, remain unvisited by any European.

The region most thoroughly explored is Yemen, in the south-west corner of the peninsula, where the labours of a succession of travellers from Niebuhr in 1761 to E. Glaser and R. Manzoni in 1887 have led to a

fairly complete knowledge of all that part of the province west of the capital Sana; while in 1902-1904 the operations of the Anglo-Turkish boundary commission permitted the execution of a systematic topographical survey of the British protectorate from the Red Sea to the Wadi Bana, 30 m. east of Aden. North of Yemen up to the Hejaz border the only authority is that of E.F. Jomard's map, published in 1839, based on the information given by the French officers employed with Ibrahim Pasha's army in Asir from 1824 to 1827, and of J. Halévy in Nejran. On the south coast expeditions have penetrated but a short distance, the most notable exceptions being those of L. Hirsch and J.T. Bent in 1887 to the Hadramut valley. S.B. Miles, J.R. Wellsted, and S.M. Zwemer have explored Oman in the extreme east; but the interior south of a line drawn from Taif to El Katr on the Persian Gulf is still virgin ground. In northern Arabia the Syrian desert and the great Nafud (Nefud) have been crossed by several travellers, though a large area remains unexplored in the north-east between Kasim and the gulf. In the centre, the journeys of W. Palgrave, C. Doughty, W. Blunt and C. Huber have done much to elucidate the main physical features of the country. Lastly, in the north-west the Sinai peninsula has been thoroughly explored, and the list of travellers who have visited the Holy Cities and traversed the main pilgrim routes through Hejaz is a fairly long one, though, owing to the difficulties peculiar to that region, the hydrography of southern Hejaz is still incompletely known.

Modern Exploration in Yemen.

The story of modern exploration begins with the despatch of C. Niebuhr's mission by the Danish government in 1761. After a year spent in Egypt and the Sinai peninsula the party reached Jidda towards the end of 1762, and after a short stay sailed on to Lohaia in the north of Yemen, the exploration of which formed the principal object of the expedition; thence, travelling through the Tehama or lowlands, Niebuhr and his companions visited the towns of Bet el Fakih, Zubed and Mokha, then the great port for the coffee trade of Yemen. Continuing eastward they crossed the mountainous region and reached the highlands of Yemen at Uden, a small town and the centre of a district celebrated for its coffee. Thence proceeding eastwards to higher altitudes where coffee plantations give way to fields of wheat and barley, they reached the town of Jibla situated among a group of mountains exceeding 10,000 ft. above sea-level; and turning southwards to Taiz descended again to the Tehama via Hes and Zubed to Mokha. The mission, reduced in numbers by the death of its archaeologist, von Haven, again visited Taiz in June 1763, where after some delay permission was obtained to visit Sana, the capital of the province and the residence of the ruling sovereign or imam. The route lay by Jibla, passing the foot of the lofty Jebel Sorak, where, in spite of illness, Forskal, the botanist of the party, was able to make a last excursion; a few days later he died at Yarim. The mission continued its march, passing Dhamar, the seat of a university of the Zedi sect, then frequented by 500 students. Thence four marches, generally over a stony plateau dominated by bare, sterile mountains, brought them to Sana, where they received a cordial welcome from the imam, el Mahdi Abbas.

The aspect of the city must have been nearly the same as at present; Niebuhr describes the *enceinte* flanked by towers, the citadel at the foot of J. Nukum which rises 1000 ft. above the valley, the fortress and palace of the imams, now replaced by the Turkish military hospital, the suburb of Bir el Azab with its scattered houses and gardens, the Jews' quarter and the village of Rauda, a few miles to the north in a fertile, irrigated plain which Niebuhr compares to that of Damascus. After a stay of ten days at Sana the mission set out again for Mokha, travelling by what is now the main route from the capital to Hodeda, through the rich coffee-bearing district of J. Haraz, and thence southward to Mokha, where they embarked for India. During the next year three other members of the party died, leaving Niebuhr the sole survivor. Returning to Arabia a year later, he visited Oman and the shores of the Persian Gulf, and travelling from Basra through Syria and Palestine he reached Denmark in 1764 after four years' absence.

The period was perhaps specially favourable for a scientific mission of the sort. The outburst of fanaticism which convulsed Arabia twenty years later had not then reached Yemen, and Europeans, as such, were not exposed to any special danger. The travellers were thus able to move freely and to pursue their scientific enquiries without hindrance from either people or ruler. The results published in 1772 gave for the first time a comprehensive description not only of Yemen but of all Arabia; while the parts actually visited by Niebuhr were described with a fulness and accuracy of detail which left little or nothing for his successors to discover.

Asir.

C.G. Ehrenberg and W.F. Hemprich in 1825 visited the Tehama and the islands off the coast, and in 1836 P.E. Botta made an important journey in southern Yemen with a view to botanical research, but the next advance in geographical knowledge in south Arabia was due to the French officers, M.O. Tamisier, Chedufau and Mary, belonging to the Egyptian army in Asir; another Frenchman, L. Arnaud, formerly in the Egyptian service, was the first to visit the southern Jauf and to report on the rock-cut inscriptions and ruins of Marib, though it was not till 1869 that a competent archaeologist, J. Halévy, was able to carry out any complete exploration there. Starting from Sana, Halévy went north-eastward to El Madid, a town of 5000 inhabitants and the capital of the small district of Nihm; thence crossing a plateau, where he saw the ruins of numerous crenellated towers, he reached the village of Mijzar at the foot of J. Yam, on the borders of Jauf, a vast sandy plain, extending eastwards to El Jail and El Hazm, where Halévy made his most important discoveries of Sabaean inscriptions: here he explored Main, the ancient capital of the Minaeans, Kamna on the banks of the W. Kharid, the ancient Caminacum, and Kharibat el Beda, the Nesca of Pliny, where the Sabaean army was defeated by the Romans under Aelius Gallus in 24 B.C. From El Jail Halévy travelled northward, passing the oasis of Khab, and skirting the great desert, reached the fertile district of Nejran, where he found a colony of Jews, with whom he spent several weeks in the oasis of Makhlaf. An hour's march to the east he discovered at the village of Medinat el Mahud the ruins of the Nagra metropolis of Ptolemy. In June 1870 he at last reached the goal of his journey, Marib; here he explored the ruins of Medinat an Nahas (so called from its numerous inscriptions engraved on brass plates), and two hours to the east he found the famous dam constructed by the Himyarites across the W. Shibwan, on which the water-supply of their capital depended.

Jauf and Marib.

One other explorer has since visited Marib, the Austrian archaeologist, E. Glaser (1855-1908), who achieved more for science in Yemen than any traveller since Niebuhr. Under Turkish protection, he visited the territory of the Hashid and Bakil tribes north-east of Sana, and though their hostile attitude compelled him to return after reaching their first important town, Khamr, he had time to reconnoitre the plateau lying

between the two great wadis Kharid and Hirran, formerly covered with Himyaritic towns and villages; and to trace the course of these wadis to their junction at El Ish in the Dhu Husen country, and thence onward to the Jauf. In 1889 he succeeded, again under Turkish escort, in reaching Marib, where he obtained, during a stay of thirty days, a large number of new Himyaritic inscriptions. He was unable, however, to proceed farther east than his predecessors, and the problem of the Jauf drainage and its possible connexion with the upper part of the Hadramut valley still remains unsolved.

Exploration in Hadramut.

The earliest attempt to penetrate into the interior from the south coast was made in 1835 when Lieuts. C. Cruttenden and J.R. Wellsted of the "Palinurus," employed on the marine survey of the Arabian coast, visited the ruins of Nakb (el Hajar) in the W. Mefat. The Himyaritic inscriptions found there and at Husn Ghurab near Mukalla, were the first records discovered of ancient Arabian civilization in Hadramut. Neither of these officers was able to follow up their discoveries, but in 1843 Adolph von Wrede landed at Mukalla and, adopting the character of a pilgrim to the shrine of the prophet Hud, made his way northward across the high plateau into the W. Duwan, one of the main southern tributaries of the Hadramut valley, and pushed on to the edge of the great southern desert; on his return to the W. Duwan his disguise was detected and he was obliged to return to Mukalla. Though he did not actually enter the main Hadramut valley, which lay to the east of his track, his journey established the existence of this populous and fertile district which had been reported to the officers of the "Palinurus" as lying between the coast range and the great desert to the north. This was at last visited in 1893 by L. Hirsch under the protection of the sultan of Mukalla, the head of the Kaiti family, and practically ruler of all Hadramut, with the exception of the towns of Saiyun and Tarim, which belong to the Kathiri tribe. Starting like von Wrede from Mukalla, Hirsch first visited the W. Duwan and found ancient ruins and inscriptions near the village of Hajren; thence he proceeded north-eastward to Hauta in the main valley, where he was hospitably received by the Kaiti sultan, and sent on to his deputy at Shibam. Here he procured a Kathiri escort and pushed on through Saiyun to Tarim, the former capital. After a very brief stay, however, he was compelled by the hostility of the people to return in haste to Shibam, from which he travelled by the W. bin Ali and W. Adim back to Mukalla. J. Theodore Bent and his wife followed in the same track a few months later with a well-equipped party including a surveyor, Imam Sharif, lent by the Indian government, who made a very valuable survey of the country passed through. Both parties visited many sites where Himyaritic remains and inscriptions were found, but the hostile attitude of the natives, more particularly of the Seyyids, the religious hierarchy of Hadramut, prevented any adequate examination, and much of archaeological interest undoubtedly remains for future travellers to discover.

Exploration in Oman.

In Oman, where the conditions are more favourable, explorers have penetrated only a short distance from the coast. Niebuhr did not go inland from Muscat; the operations by a British Indian force on the Pirate coast in 1810 gave no opportunities for visiting the interior, and it was not till 1835 that J.R. Wellsted, who had already tried to penetrate into Hadramut from the south, landed at Muscat with the idea of reaching it from the north-east. Sailing thence to Sur near Ras el Had, he travelled southward through the country of the Bani bu Ali to the borders of the desert, then turning north-west up the Wadi Betha through a fertile, well-watered country, running up to the southern slopes of J. Akhdar, inhabited by a friendly people who seem to have welcomed him everywhere, he visited Ibra, Semed and Nizwa at the southern foot of the mountains. Owing to the disturbed state of the country, due to the presence of raiding parties from Nejd, Wellsted was unable to carry out his original intention of exploring the country to the west, and after an excursion along the Batina coast to Sohar he returned to India.

In 1876 Colonel S.B. Miles, who had already done much to advance geographical interests in south Arabia, continued Wellsted's work in Oman; starting from Sohar on the Batina coast he crossed the dividing range into the Dhahira, and reached Birema, one of its principal oases. His investigations show that the Dhahira contains many settlements, with an industrious agricultural population, and that the unexplored tract extending 250 m. west to the peninsula of El Katr is a desolate gravelly steppe, shelving gradually down to the salt marshes which border the shores of the gulf.

Exploration in Hejaz.

Leaving southern Arabia, we now come to the centre and north. The first explorer to enter the sacred Hejaz with a definite scientific object was the Spaniard, Badia y Leblich, who, under the name of Ali Bey and claiming to be the last representative of the Abbasid Caliphs, arrived at Jidda in 1807, and performed the pilgrimage to Mecca. Besides giving to the world the first accurate description of the holy city and the Haj ceremonies, he was the first to fix the position of Mecca by astronomical observations, and to describe the physical character of its surroundings. But the true pioneer of exploration in Hejaz was J.L. Burckhardt, who had already won a reputation as the discoverer of Petra, and whose experience of travel in Arab lands and knowledge of Arab life qualified him to pass as a Moslem, even in the headquarters of Islam. Burckhardt landed in Jidda in July 1814, when Mehemet Ali had already driven the Wahhabi invaders out of Hejaz, and was preparing for his farther advance against their stronghold in Nejd. He first visited Taif at the invitation of the pasha, thence he proceeded to Mecca, where he spent three months studying every detail of the topography of the holy places, and going through all the ceremonies incumbent on a Moslem pilgrim. In January 1815 he travelled to Medina by the western or coast route, and arrived there safely but broken in health by the hardships of the journey. His illness did not, however, prevent his seeing and recording everything of interest in Medina with the same care as at Mecca, though it compelled him to cut short the further journey he had proposed to himself, and to return by Yambu and the sea to Cairo, where he died only two years later.

His striking successor, Sir Richard Burton, covered nearly the same ground thirty-eight years afterwards. He, too, travelling as a Moslem pilgrim, noted the whole ritual of the pilgrimage with the same keen observation as Burckhardt, and while amplifying somewhat the latter's description of Medina, confirms the accuracy of his work there and at Mecca in almost every detail. Burton's topographical descriptions are fuller, and his march to Mecca from Medina by the eastern route led him over ground not traversed by any other explorer in Hejaz: this route leads at first south-east from Medina, and then south across the lava beds of the Harra, keeping throughout its length on the high plateau which forms the borderland between Hejaz and Nejd. His original intention had been after visiting Mecca to find his way across the peninsula to Oman,

but the time at his disposal (as an Indian officer on leave) was insufficient for so extended a journey; and his further contributions to Arabian geography were not made until twenty-five years later, when he was deputed by the Egyptian government to examine the reported gold deposits of Midian. Traces of ancient workings were found in several places, but the ores did not contain gold in paying quantities. Interesting archaeological discoveries were made, and a valuable topographical survey was carried out, covering the whole Midian coast from the head of the Gulf of Akaba to the mouth of the Wadi Hamd, and including both the Tehama range and the Hisma valley behind it; while the importance of the W. Hamd and the extent of the area drained by its tributaries was for the first time brought to light.

Burckhardt had hoped in 1815 that the advance of the Egyptian expedition would have given him the opportunity to see something of Nejd, but he had already left Arabia before the overthrow of the Wahhabi power by Ibrahim Pasha had opened Nejd to travellers from Hejaz, and though several European officers accompanied the expedition, none of them left any record of his experience. It is, however, to the Egyptian conquest that the first visit of a British traveller to Nejd is due. The Indian government, wishing to enter into relations with Ibrahim Pasha, as *de facto* ruler of Nejd and El Hasa, with a view to putting down piracy in the Persian Gulf, which was seriously affecting Indian trade, sent a small mission under Captain G.F. Sadlier to congratulate the pasha on the success of the Egyptian arms, and no doubt with the ulterior object of obtaining a first-hand report on the real situation. On his arrival at Hofuf, Sadlier found that Ibrahim had already left Deraiya, but still hoping to intercept him before quitting Nejd, he followed up the retreating Egyptians through Yemama, and Wushm to Ras in Kasim, where he caught up the main body of Ibrahim's army, though the pasha himself had gone on to Medina. Sadlier hesitated about going farther, but he was unable to obtain a safe conduct to Basra, or to return by the way he had come, and was compelled reluctantly to accompany the army to Medina. Here he at last met Ibrahim, but though courteously received, the interview had no results, and Sadlier soon after left for Yambu, whence he embarked for Jidda, and after another fruitless attempt to treat with Ibrahim, sailed for India. If the political results of the mission were *nil*, the value to geographical science was immense; for though no geographer himself, Sadlier's route across Arabia made it possible for the first time to locate the principal places in something like their proper relative positions; incidentally, too, it showed the practicability of a considerable body of regular troops crossing the deserts of Nejd even in the months of July and August.

Exploration in Nejd.

Sadlier's route had left Jebel Shammar to one side; his successor, G.A. Wallin, was to make that the objective of his journey. Commissioned by Mehemet Ali to inform him about the situation in Nejd brought about by the rising power of Abdallah Ibn Rashid, Wallin left Cairo in April 1845, and crossing the pilgrim road at Ma'an, pushed on across the Syrian desert to the Wadi Sirhan and the Jauf oasis, where he halted during the hot summer months. From the wells of Shakik he crossed the waterless Nafud in four days to Jubba, and after a halt there in the nomad camps, he moved on to Hail, already a thriving town, and the capital of the Shammar state whose limits included all northern Arabia from Kasim to the Syrian border. After a stay in Hail, where he had every opportunity of observing the character of the country and its inhabitants, and the hospitality and patriarchal, if sometimes stern, justice of its chief, he travelled on to Medina and Mecca, and returned thence to Cairo to report to his patron. Early in 1848 he again returned to Arabia, avoiding the long desert journey by landing at Muwela, thence striking inland to Tebuk on the pilgrim road, and re-entering Shammar territory at the oasis of Tema, he again visited Hail; and after spending a month there travelled northwards to Kerbela and Bagdad.

The effects of the Egyptian invasion had passed away, and central Arabia had settled down again under its native rulers when W.G. Palgrave made his adventurous journey through Nejd, and published the remarkable narrative which has taken its place as the classic of Arabian exploration. Like Burton he was once an officer in the Indian army, but for some time before his journey he had been connected with the Jesuit mission in Syria. By training and temperament he was better qualified to appreciate and describe the social life of the people than their physical surroundings, and if the results of his great journey are disappointing to the geographer, his account of the society of the oasis towns, and of the remarkable men who were then ruling in Hail and Riad, must always possess an absorbing interest as a portrait of Arab life in its freest development.

Palgrave's journey to Nejd.

Following Wallin's route across the desert by Ma'an and Jauf, Palgrave and his companion, a Syrian Christian, reached Hail in July 1862; here they were hospitably entertained by the amir Talal, nephew of the founder of the Ibn Rashid dynasty, and after some stay passed on with his countenance through Kasim to southern Nejd. Palgrave says little of the desert part of the journey or of its Bedouin inhabitants, but much of the fertility of the oases and of the civility of the townsmen; and like other travellers in Nejd he speaks with enthusiasm of its bright, exhilarating climate. At Riad, Fesal, who had been in power since the Egyptian retirement, was still reigning; and the religious tyranny of Wahhabism prevailed, in marked contrast to the liberal régime of Talal in Jebel Shammar. Still, Palgrave and his companions, though known as Christians, spent nearly two months in the capital without molestation, making short excursions in the neighbourhood, the most important of which was to El Kharfa in Aflaj, the most southerly district of Nejd. Leaving Riad, they passed through Yemama, and across a strip of sandy desert to El Hasa where Palgrave found himself in more congenial surroundings. Finally, a voyage to the Oman coast and a brief stay there brought his adventures in Arabia to a successful ending.

Charles Doughty, the next Englishman to visit northern Arabia, though he covered little new ground, saw more of the desert life, and has described it more minutely and faithfully than any other explorer. Travelling down from Damascus in 1875 with the Haj caravan, he stopped at El Hajr, one of the pilgrim stations, with the intention of awaiting the return of the caravan and in the meantime of exploring the rock-cut tombs of Medain Salih and El Ala. Having successfully completed his investigations and sent copies of inscriptions and drawings of the tombs to Renan in Paris, he determined to push on farther into the desert. Under the protection of a sheikh of the Fukara Bedouin he wandered over the whole of the borderland between Hejaz and Nejd. Visiting Tema, where among other ancient remains he discovered the famous inscribed stone, afterwards acquired by Huber for the Louvre. Next summer he went on to Hail and thence back to Khaibar, where the negro governor and townsmen, less tolerant than his former Bedouin hosts, ill-treated him and even threatened his life. Returning to Hail in the absence of the amir, he

Doughty.

was expelled by the governor; he succeeded, however, in finding protection at Aneza, where he spent several months, and eventually after many hardships and perils found his way to the coast at Jidda.

Three years later Mr Wilfrid and Lady Anne Blunt made their expedition to J. Shammar. In their previous travels in Syria they had gained the confidence and friendship of a young sheikh whose family, though long settled at Tadmur, came originally from Nejd, and who was anxious to renew the connexion with his kinsmen by seeking a bride among them. In his company the Blunts set out from Damascus, and travelled across the Syrian desert by the Wadi Sirhan to Jauf. Here the sheikh found some of his relations and the matrimonial alliance was soon arranged; but though the object of the journey had been attained, the Blunts were anxious to visit Hail and make the acquaintance of the amir Ibn Rashid, of whose might and generosity they daily heard from their hosts in Jauf. The long stretch of waterless desert between Jauf and J. Shammar was crossed without difficulty, and the party was welcomed by the amir and hospitably entertained for a month, after which they travelled northwards in company with the Persian pilgrim caravan returning to Kerbela and Bagdad.

In 1883 the French traveller, C. Huber, accompanied by the archaeologist, J. Euting, followed the same route from Damascus to Hail. The narrative of the last named forms a valuable supplement to that published by the Blunts, and together with Doughty's, furnishes as complete a picture as could be wished for of the social and political life of J. Shammar, and of the general nature of the country. Huber's journal, published after his death from his original notes, contains a mass of topographical and archaeological detail of the greatest scientific value: his routes and observations form, in fact, the first and only scientific data for the construction of the map of northern Arabia. To archaeology also his services were of equal importance, for, besides copying numerous inscriptions in the district between Hail and Tema, he succeeded in gaining possession of the since famous Tema stone, which ranks with the Moabite stone among the most valuable of Semitic inscriptions. From Hail Huber followed nearly in Doughty's track to Aneza and thence across central Nejd to Mecca and Jidda, where he despatched his notes and copies of inscriptions. A month later, in July 1884, he was murdered by his guides a few marches north of Jidda, on his way back to Hail.

Huber.

One other traveller visited Hail during the lifetime of the amir Mahommed—Baron E. Nolde—who arrived there in 1893, not long after the amir had by his victory over the combined forces of Riad and Kasim brought the whole of Nejd under his dominion. Nolde crossed the Nafud to Haiyania by a more direct track than that from Shakik to Jubba. The amir was away from his capital settling the affairs of his newly acquired territory; Nolde therefore, after a short halt at Hail, journeyed on to Ibn Rashid's camp somewhere in the neighbourhood of Shakra. Here he was on new ground, but unfortunately he gives little or no description of his route thither, or of his journey northwards by the Persian pilgrim road, already traversed by Huber in 1881. His narrative thus, while containing much of general interest on the climate and on the animal life of northern Arabia, its horses and camels in particular, adds little to those of his predecessors as regards topographical detail.

If the journeys detailed above be traced on the map they will be found to cover the northern half of the peninsula above the line Mecca-Hofuf, with a network of routes, which, though sometimes separated by wide intervals, are still close enough to ensure that no important geographical feature can have been overlooked, especially in a country whose general character varies so little over wide areas. In the southern half, on the other hand, except in Nejran and Jauf, no European traveller has penetrated 100 m. in a direct line from the coast. The vast extent of the Dahna, or great southern desert, covering perhaps 250,000 sq. m., accounts for about a third of this area, but some of the most favoured districts in Arabia—Asir and northern Yemen—remain unexplored, and the hydrography of the Dawasir basin offers some interesting problems, while a great field remains for the archaeologist in the seat of the old Sabaean kingdom from Jauf to the Hadramut valley.

General results of exploration.

Topographical Details.—Beginning from the north-west, the Sinai peninsula belongs to Egypt, though geographically part of Arabia. It is bounded on the E. by a line drawn from Ar Rafa, a few miles E. of El Arish on the Mediterranean, to the head of the Gulf of Akaba; and on the W. by the Suez Canal; its length from El Arish to its most southern point is 240 m., and its breadth from Suez to Akaba is nearly 160 m. The greater part drains to the Mediterranean, from which the land rises gradually to the summit of the Tih plateau. The deep depression of Wadi Feran separates the Tih from the higher mass of Sinai (*q.v.*), in which J. Katherine attains a height of 8500 ft.; except in W. Feran there is little cultivable land, the greater part consisting of bare, rocky hills and sandy valleys, sparsely covered with tamarisk and acacia bushes. The Egyptian pilgrim road crosses the peninsula from Suez to Akaba, passing the post of An Nakhl, with a reservoir and a little cultivation, about half way; a steep descent leads down from the edge of the Tih plateau to Akaba.

Sinai Peninsula.

The rest of the northern borderland is covered by the Syrian desert, extending from the borders of Palestine to the edge of the Euphrates valley. This tract, known as the Hamad, is a gravelly plain unbroken by any considerable range of hills or any continuous watercourse except the Wadi Hauran, which in rainy seasons forms a succession of pools from J. Hauran to the Euphrates. Its general slope is to the north-east from the volcanic plateau of the Harra south of J. Hauran to the edge of the Euphrates valley. The Wadi Sirhan, a broad depression some 500 ft. below the average level of the Hamad, crosses it from north-east to south-west between Hauran and Jauf; it has a nearly uniform height above sea-level of 1850 ft., and appears to be the bed of an inland sea rather than a true watercourse. Water is found in it a few feet below the surface, and a little cultivation is carried on at the small oases of Kaf and Ithri, whence salt produced in the neighbouring salt lakes is exported. The W. Sirhan is continuous with the depression known as the Jauf, situated on the northern edge of the Nefud or Nafud, and the halfway station between Damascus and Hail; and it is possible that this depression continues eastward towards the Euphrates along a line a little north of the thirtieth parallel, where wells and pasturages are known to exist. Jauf is a small town consisting, at the time of the Blunts' visit in 1879, of not more than 500 houses. The town with its gardens, surrounded by a mud wall, covers a space of 2 m. in length by half a mile in width; the basin in which it lies is barely 3 m. across, and except for the palm gardens and a few patches of corn, it is a dead flat of white sand, closed in by high sandstone cliffs, beyond which lies the open desert. The oases of Sakaka and

Syrian desert.

Kara are situated in a similar basin 15 m. to the east; the former a town of 10,000 inhabitants and somewhat larger than Jauf according to Huber.

A short distance south of Jauf the character of the desert changes abruptly from a level black expanse of gravel to the red sands of the Nafud. The northern edge of this great desert follows very nearly the line of the thirtieth parallel, along which it extends east and west for a length of some 400 m.; its breadth from north to south is 200 m. Though almost waterless, it is in fact better wooded and richer in pasture than any part of the Hamad; the sand-hills are dotted with *ghada*, a species of tamarisk, and other bushes, and several grasses and succulent plants —among them the *adar*, on which sheep are said to feed for a month without requiring water—are found in abundance in good seasons. In the spring months, when their camels are in milk, the Bedouins care nothing for water, and wander far into the Nafud with their flocks in search of the green pasture which springs up everywhere after the winter rains. A few wells exist actually in the Nafud in the district called El Hajra, near its north-eastern border, and along its southern border, between J. Shammar and Tema, there are numerous wells and artificial as well as natural reservoirs resorted to by the nomad tribes.

The Nafud.

Owing to the great extent of the Nafud desert, the formation of sand-dunes is exemplified on a proportionate scale. In many places longitudinal dunes are found exceeding a day's journey in length, the valleys between which take three or four hours to cross; but the most striking feature of the Nafud are the high crescent-shaped sand-hills, known locally as *falk* or *falj*, described by Blunt and Huber, who devoted some time to their investigation. The falks enclose a deep hollow (known as *ka'r*), the floor of which is often hard soil bare of sand, and from which the inner slopes of the falk rise as steeply as the sand will lie (about 50°). On the summit of the falk there is generally a mound known as *tas* or *barkhus* composed of white sand which stands out conspicuously against the deep red of the surrounding deserts; the exterior slopes are comparatively gentle. The falks are singularly uniform in shape, but vary greatly in size; the largest were estimated by Huber and Euting at 1¼ m. across and 330 ft. deep. They run in strings irregularly from east to west, corresponding in this with their individual direction, the convex face of the falk being towards the west, *i.e.* the direction of the prevailing wind, and the cusps to leeward. In the south of the Nafud, where Huber found the prevailing wind to be from the south, the falks are turned in that direction. Though perhaps subject to slight changes in the course of years, there is no doubt that these dunes are practically permanent features; the more prominent ones serve as landmarks and have well-known distinctive names. The character of the vegetation which clothes their slopes shows that even superficial changes must be slight. The general level of the Nafud was found by Huber's observations to be about 3000 ft. above sea-level; the highest point on the Jauf-Hail route is at Falk Alam, the rocky peaks of which rise 200 or 300 ft. above the surface of the sand. Other peaks cropping out of the Nafud are Jebel Tawil, near the wells of Shakik, and J. Abrak Rada, a long black ridge in the middle of the desert.

The high plateau which from. J. Hauran southward forms the main watershed of the peninsula is covered in places by deep beds of lava, which from their hardness have preserved the underlying sandstones from degradation, and now stand up considerably above the general level. These tracts are known as *harra*; the most remarkable is the Harrat El Awerid, west of the Haj route from Tebuk to El Ala, a mountain mass 100 m. in length with an average height of over 5000 ft., and the highest summit of which, J. Anaz, exceeds 7000 ft. The harra east of Khaibar is also of considerable extent, and the same formation is found all along the Hejaz border from Medina to the Jebel el Kura, east of Mecca. The surface of the harra is extremely broken, forming a labyrinth of lava crags and blocks of every size; the whole region is sterile and almost waterless, and compared with the Nafud it produces little vegetation; but it is resorted to by the Bedouin in the spring and summer months when the air is always fresh and cool. In winter it is cold and snow often lies for some time.

The Harra.

Hejaz, if we except the Taif district in the south, which is properly a part of the Yemen plateau, forms a well-marked physical division, lying on the western slope of the peninsula, where that slope is at its widest, between the Harra and the Red Sea. A high range of granite hills, known as the Tehama range, the highest point of which, J. Shar, in Midian, exceeds 6500 ft., divides it longitudinally into a narrow littoral and a broader upland zone 2000 or 3000 ft. above the sea. Both are generally bare and unproductive, the uplands, however, contain the fertile valleys of Khaibar and Medina, draining to the Wadi Hamd, the principal river system of western Arabia; and the Wadi Jadid or Es Safra, rising in the Harra between Medina and Es Safina, which contain several settlements, of which the principal produce is dates. The quartz reefs which crop out in the granite ranges of the Tehama contain traces of gold. These and the ancient copper workings were investigated by Burton in 1877. The richer veins had evidently been long ago worked out, and nothing of sufficient value to justify further outlay was discovered. The coast-line is fringed with small islets and shoals and reefs, which make navigation dangerous. The only ports of importance are Yambu and Jidda, which serve respectively Medina and Mecca; they depend entirely on the pilgrim traffic to the holy cities, without which they could not exist.

Hejaz.

The great central province of Nejd occupies all inner Arabia between the Nafud and the southern desert. Its northern part forms the basin of the Wadi Rumma, which, rising in the Khaibar harra, runs north-eastward across the whole width of Nejd, till it is lost in the sands of the eastern Nafud, north of Aneza. The greater portion of this region is an open steppe, sandy in places and in others dotted with low volcanic hills, but with occasional ground water and in favourable seasons furnishing support for a considerable pastoral population. Its elevation varies from about 5000 ft. in the west to 2500 ft. in the east. In Jebel Shammar, Kasim and Wushm, where the water in the wadi beds rises nearly to the ground level, numerous fertile oases are found with thriving villages and towns.

Nejd.

Jebel Shammar, from which the northern district of Nejd takes its name, is a double range of mountains some 20 m. apart, rising sharply out of the desert in bare, granite cliffs. J. Aja, the western and higher of the two ranges, has a length of about 100 m. from north-east to south-west, where it merges into the high plateau extending from and continuous with the Khaibar harra. The highest point, J. Kara, near its north-eastern extremity, is about 4600 ft. above sea-level, or 1600 ft. above the town of Hail, which, like most of the larger villages, lies along the wadi bed at the foot of J. Aja. The town, which has risen with the fortunes of the Ibn Rashid family to be the capital of Upper Nejd, is at the mouth of the valley between the twin ranges, about 2 m. from the foot of J. Aja, and contained at the time of Nolde's visit in 1893 about 12,000 inhabitants.

The principal tributaries of the W. Rumma converge in lower Kasim, and at Aneza Doughty says its bed is 3

m. wide from bank to bank. Forty years before his visit a flood is said to have occurred, which passed down the river till it was blocked by sand-drifts at Thuwerat, 50 m. lower down, and for two years a lake stood nearly 100 m. long, crowded by waterfowl not known before in that desert country. Below this its course has not been followed by any European traveller, but it may be inferred from the line of watering-places on the road to Kuwet, that it runs out to the Persian Gulf in that neighbourhood.

East of Kasim the land rises gradually to the high plateau culminating in the ranges of Jebel Tuwek and J. Arid. The general direction of these hills is from north-west to south-east. On the west they rise somewhat steeply, exposing high cliffs of white limestone, which perhaps gave Palgrave the impression that the range is of greater absolute height than is actually the case. J. Tuwek in any case forms an important geographical feature in eastern Nejd, interrupting by a transverse barrier 200 m. in length the general north-easterly slope of the peninsula, and separating the basin of the W. Rumma from that of the other great river system of central Arabia, the Wadi Dawasir. The districts of Suder and Wushm lie on its northern side, Arid in the centre, and Aflaj, Harik and Yemama on its south, in the basin of the W. Dawasir; the whole of this hilly region of eastern Nejd is, perhaps, rather a rolling down country than truly mountainous, in which high pastures alternate with deep fertile valleys, supporting numerous villages with a large agricultural population. The W. Hanifa is its principal watercourse; its course is marked by an almost continuous series of palm groves and settlements, among which Deraiya the former, and Riad the present, capital of the Ibn Saud kingdom are the most extensive. Its lower course is uncertain, but it probably continues in a south-east direction to the districts of El Harik and Yemama when, joined by the drainage from Aflaj and the W. Dawasir, it runs eastward till it disappears in the belt of sandy desert 100 m. in width that forms the eastern boundary of Nejd, to reappear in the copious springs that fertilize El Hasa and the Bahrein littoral.

As regards the unexplored southern region, Palgrave's informants in Aflaj, the most southerly district visited by him, stated that a day's march south of that place the Yemen road enters the W. Dawasir, up which it runs for ten days, perhaps 200 m., to El Kura, a thinly peopled district on the borders of Asir; this accords with the information of the French officers of the Egyptian army in that district, and with that of Halévy, who makes all the drainage from Nejran northward run to the same great wadi. Whether there be any second line of drainage in southern Nejd skirting the edge of the great desert and following the depression of the W. Yabrin must remain a matter of conjecture. Colonel Miles concluded, from his enquiries, that the low salt swamp, extending inland for some distance from Khor ed Duwan, in the bay east of El Katr, was the outlet of an extensive drainage system which may well be continuous with the W. Yabrin and extend far into the interior, if not to Nejran itself.

Unexplored region of S. Nejd.

East of Nejd a strip of sandy desert 50 m. in width extends almost continuously from the great Nafud to the Dahna. East of this again a succession of stony ridges running parallel to the coast has to be crossed before El Hasa is reached. This province, which skirts the Persian Gulf from the mouth of the Euphrates to the frontiers of Oman, is low and hot; its shores are flat, and with the exception of Kuwet at the north-west corner of the gulf, it possesses no deep water port. North of Katif it is desert and only inhabited by nomads; at Katif, however, and throughout the district to the south bordering on the Gulf of Bahrein there are ample supplies of underground water, welling up in abundant springs often at a high temperature, and bringing fertility to an extensive district of which El Hofuf, a town of 15,000 to 20,000 inhabitants, is the most important centre.

El Hasa.

South-western Arabia, from the twenty-first parallel down to the Gulf of Aden, including the Taif district of Hejaz, Asir and Yemen, forms one province geographically. Throughout its length it consists of three zones, a narrow coastal strip, rarely exceeding 20 m. in width, a central mountainous tract, embracing the great chain which runs parallel to the coast from near Taif to within 50 m. of Aden, and an inner plateau falling gradually to the north-east till it merges in the Nejd steppes or the sands of the great desert.

South-western Arabia.

The lowland strip or Tehama consists partly of a gravelly plain, the *Khabt*, covered sparsely with acacia and other desert shrubs and trees, and furnishing pasturage for large flocks of goats and camels; and partly of sterile wastes of sand like the *Ramla*, which extends on either side of Aden almost from the seashore to the foot of the hills. The Tehama is, however, by no means all desert, the mountain torrents where they debouch into the plain have formed considerable tracts of alluvial soil of the highest degree of fertility producing in that warm equable climate two and even three crops in the year. The flood-water is controlled by a system of dams and channels constructed so as to utilize every drop, and the extent of cultivation is limited more by the supply of water available than by the amount of suitable soil. These districts support a large settled population and several considerable towns, of which Bet el Fakih and Zubed in the western and Lahej in the southern Tehama, with 4000 to 6000 inhabitants, are the most important. There are signs that this coastal strip was until a geologically recent period below sea-level; and that the coast-line is still receding is evidenced by the history of the town of Muza, once a flourishing port, now 20 m. inland; while Bet el Fakih and Zubed, once important centres of the coffee trade, have lost their position through the silting up of the ports which formerly served them.

The jebel or mountain-land is, however, the typical Yemen, the *Arabia Felix* of the ancients. Deep valleys winding through the barren foothills lead gradually up to the higher mountains, and as the track ascends the scenery and vegetation change their character; the trees which line the banks of the wadi are overgrown with creepers, and the running stream is dammed at frequent intervals, and led off in artificial channels to irrigate the fields on either side; the steeper parts of the road are paved with large stones, substantially built villages, with their masonry towers or *dars*, crowning every height, replace the collection of mud walls and brushwood huts of the low country; while tier above tier, terraced fields cover the hill slopes and attest the industry of the inhabitants and the fertility of their mountains. On the main route from Hodeda to Sana the first coffee plantations are reached at Usil, at an altitude of 4300 ft., and throughout the western slopes of the range up to an altitude of 7000 ft. it is the most important crop. Jebel Haraz, of which Manakha, a small town of 3000 inhabitants is the chief place, is described by Glaser as one vast coffee garden. Here the traveller ascending from the coast sees the first example of the jebel or highland towns, with their high three-storeyed houses, built of quarried stone, their narrow façades pierced with small windows with whitewashed borders and ornamented with varied arabesque patterns; each dar has the appearance of a small castle complete in itself, and the general effect is rather that of a cluster of separate forts than of a town occupied by a united community.

The scenery in this mountain region is of the most varied description; bare precipitous hill-sides seamed with dry, rocky watercourses give place with almost startling rapidity to fertile slopes, terraced literally for thousands of feet. General Haig in describing them says: “One can hardly realize the enormous labour, toil and perseverance that these represent; the terrace walls are usually 5 to 8 ft. in height, but towards the top of the mountains they are sometimes as much as 15 or 18 ft.; they are built entirely of rough stone without mortar, and I reckon that on an average each wall retains not more than twice its own height in breadth, and I do not think I saw a single break in them unrepaired.”

The highest summits as determined by actual survey are between 10,000 and 11,000 ft. above sea-level. J. Sabur, a conspicuous mass in the extreme south, is 9900 ft., with a fall to the Taiz valley of 5000 ft.; farther north several points in the mountains above Ibb and Yarim attain a height of 10,500 ft., and J. Hadur, near the Sana-Hodeda road, exceeds 10,000 ft. From the crest of the range there is a short drop of 2000 or 3000 ft. to the broad open valleys which form the principal feature of the inner plateau. The town of Yarim lies near its southern extremity at an altitude of about 8000 ft.; within a short distance are the sources of the W. Yakla, W. Bana and W. Zubed, running respectively east and south and west. The first named is a dry watercourse ultimately joining the basin of the W. Hadramut; the two others run for a long distance through fertile valleys and, like many of the wadis on the seaward side of the range, have perennial streams down to within a few miles of the sea. Sana, the capital of Yemen, lies in a broad valley 7300 ft. above sea-level, sloping northwards to the W. Kharid which, with the Ghail Hirran, the sources of which are on the eastern slopes of J. Hadur, run north-eastward to the Jauf depression. The Arhab district, through which these two great wadis run, was formerly the centre of the Himyar kingdom; cultivation is now only to be found in the lower parts on the borders of the watercourses, all above being naked rock from which every particle of soil has been denuded. In the higher parts there are fine plains where Glaser found numerous Himyaritic remains, and which he considers were undoubtedly cultivated formerly, but they have long fallen out of cultivation owing to denudation and desiccation—the impoverishment of the country from these causes is increasing. Eastward the plateau becomes still more sterile, and its elevation probably falls more rapidly till it reaches the level of the Jauf and Nejran valleys on the borders of the desert. The water-parting between central and southern Arabia seems to be somewhere to the south of Nejran, which, according to Halévy, drains northward to the W. Dawasir, while the Jauf is either an isolated depression, or perhaps forms part of the Hadramut basin.

Asir.

Farther north, in Asir, the plateau is more mountainous and contains many fertile valleys. Of these may be mentioned Khamis Mishet and the Wadi Shahran rising among the high summits of the maritime chain, and the principal affluents of the Wadi Besha; the latter is a broad well-watered valley, with numerous scattered hamlets, four days’ journey (perhaps 80 m.) from the crest of the range. Still farther north is the Wadi Taraba and its branches running down from the highland district of Zahran. The lower valleys produce dates in abundance, and at higher elevations wheat, barley, millets and excellent fruit are grown, while juniper forests are said to cover the mountain slopes. In Yemen this tree was probably more common formerly; the place-name Arar, signifying juniper, is still often found where the tree no longer exists.

Coast of Yemen.

The western coast of Yemen, like that of Hejaz, is studded with shoals and islands, of which Perim in the Straits of Bab-el-Mandeb, Kamaran, the Turkish quarantine post, 40 m. north of Hodeda, and the Farsan group, off the Abu Arish coast, are the principal. Hodeda is the only port of any importance since the days of steamships began; the other ports, Mokha, Lohaia and Kanfuda merely share in the coasting trade. The south coast is free from the shoals that imperil the navigation of the Red Sea, and in Aden it possesses the only safe natural harbour on the route between Suez and India. Several isolated volcanic hills crop out on the shore line between Aden and the straits; the most remarkable are J. Kharaz, 2500 ft., and J. Shamshan, 1700 ft., at the base of which Aden itself is built. In both of these the crater form is very clearly marked. A low maritime plain, similar to the Tehama of the western coast, extends for some 200 m. east of the Straits of Bab-el-Mandeb, backed by mountains rising to 7000 ft. or more; farther east the elevation of the highland decreases steadily, and in the Hadramut, north of Mukalla, does not much exceed 4000 ft. The mountain chain, too, is less distinctly marked, and becomes little more than the seaward escarpment of the plateau which intervenes between the coast and the Hadramut valley. This valley runs nearly east and west for a distance of 500 m. from the eastern slopes of the Yemen highlands to its mouth on the Mahra coast near Sihut. The greater part of it is desert, but a short stretch lying between the 48th and 50th meridians is well watered and exceptionally fertile. This begins a little to the east of Shabwa, the ancient capital, now half buried in the advancing sand, and for a distance of over 70 m. a succession of villages and towns surrounded by fields and date groves extends along the main valley and into the tributaries which join it from the south. Shibam, Saiyun and Tarim are towns of 6000 or more inhabitants, and Hajren and Haura in the W. Duwan are among the larger villages. Himyaritic remains have been found here and in the W. Mefat which enters the Gulf of Aden near Balhaf. A few small fishing villages or ports are scattered along the coast, but except Mukalla and Shihr none is of any importance.

Hadramut.

The Gara coast was visited by the Bents, who went inland from Dhafar, one of the centres of the old frankincense trade, to the crest of the plateau. The narrow coastal strip seems to be moderately fertile, and the hills which in places come down to the seashore are covered with trees, among which the frankincense and other gum-bearing trees are found. On the plateau, which has an altitude of 4000 ft., there is good pasturage; inland the country slopes gently to a broad valley beyond which the view was bounded by the level horizon of the desert.

Oman.

Oman (*q.v.*) includes all the south-eastern corner of the peninsula. Its chief feature is the lofty range of J. Akhdar, 10,000 ft. above sea-level. Like the great range of western Arabia, it runs parallel to the coast; it differs, however, from the western range in that its fall on the landward side is as abrupt and nearly as great as on its seaward side. Its northern extremity, Ras Musandan, rises precipitously from the straits of Hormuz; farther south the range curves inland somewhat, leaving a narrow but fertile strip, known as the Batina coast, between it and the sea, and containing several populous towns and villages of which Sohar, Barka and Sib are the chief. Muscat, the capital of the province and the principal port on the coast, is surrounded on three sides by bare, rocky hills, and has the reputation of being the hottest place in Arabia. Zwemer says the fertility of the highland region of J. Akhdar is wonderful and is in striking contrast to the barrenness of so much of the coast; water issues in perennial springs from many rocky clefts, and is carefully husbanded by the ingenuity of the people; underground channels, known

here as *faluj*, precisely similar to the *kanat* or *karez* of Persia and Afghanistan, are also largely used. The principal villages on the eastern slopes are Rustak, Nakhl and Semail in the well-watered valley of the same name; on the western slopes are Tanuf and Nizwa, lying immediately below the highest summit of the range; Semed, Ibra and Bidiya in the W. Betha are all well-built villages with palm-groves and irrigated fields. In the north-west the Dhahira district sloping towards the Jewasimi coast is more steppe-like in character; but there two oases of great fertility are found, of which Birema, visited by both Miles and Zwemer, supports a population of 15,000. West of Abu Dhabi a low flat steppe with no settled inhabitants extends up to the Katr peninsula, merging on the north into the saline marshes which border the Persian Gulf, and on the south into the desert.

The southern desert.

The great desert known as the Dahna or the Rub'a el Khali ("the empty quarter") is believed to cover all the interior of southern Arabia from the borders of Yemen in the west to those of Oman in the east. Halévy in Nejran, Von Wrede in Hadramut, and Wellsted in Oman reached its edge, though none of them actually entered it, and the guides accompanying them all concurred in describing it as uninhabitable and uncrossed by any track. Its northern fringe is no doubt frequented by the Bedouin tribes of southern Nejd after the rains, when its sands, like those of the northern desert, produce herbage; but towards the east, according to Burckhardt's information, it is quite without vegetation even in the winter and spring. The farthest habitable spot to the south of Nejd is the Wadi Yabrin, which L. Pelly heard of from the Ahl Murra Bedouins as once a fertile district, and which still produces dates, though, owing to malaria, it is now deserted; thence southward to the Hadramut valley no communication is known to exist.

[*Geology.*—The geological structure of Arabia is very similar to that of Egypt. The oldest rocks consist of granite and schist, penetrated by intrusive dykes, and upon this foundation rest the flat-lying sedimentary deposits, beginning with a sandstone like the Nubian sandstone of Egypt. In the northern part of Arabia the crystalline rocks form a broad area extending from the peninsula of Sinai eastwards to Hail and southwards at least as far as Mecca. Towards the north the crystalline floor is overlaid by the great sandstone series which covers nearly the whole of the country north of Hail. Upon the sandstone rest a few scattered outliers of limestone, probably of Cretaceous age, the largest of which occur near Jauf and east of Bureda. Over both sandstone and granite great sheets of lava have been poured, and these, protecting the softer beds beneath from further denudation, now stand up as the high plateaus and hills called *harra*. Volcanic cones still exist in large numbers, and the sheets of lava appear as fresh as any recent flows of Etna or Vesuvius. Arabian manuscripts describe an eruption on the harra near Medina in A.D. 1256. In the south of Arabia the crystalline floor appears at intervals along the southern coast and on the shores of the Gulf of Oman. At Marbat the granite is overlaid by sandstone, presumably the Nubian sandstone: this is followed by marls containing Cenomanian fossils; and these are overlaid by Upper Cretaceous limestones, upon which rest isolated patches of *Alveolina* limestone. Generally, however, the Cretaceous beds do not appear, and the greater part of southern Arabia seems to be formed of *Alveolina* and nummulite limestones of Tertiary age. An extinct volcano occurs at Aden, and volcanic rocks are found at other places near the Straits of Bab-el-Mandeb. Throughout the whole of Arabia, so far as is known, the sedimentary beds show no signs of any but the most gentle folding. Faulting, however, is by no means absent, and some of the faults are of considerable magnitude. The Gulf of Akaba is a strip of country which has been let down between two parallel faults, and several similar faulted troughs occur in the Sinai peninsula. The Red Sea itself is a great trough bounded by faults along each side.]

Climate.—Owing to its low latitude and generally arid surface, Arabia is on the whole one of the hottest regions of the earth; this is especially the case along the coasts of the Persian Gulf and the southern half of the Red Sea, where the moist heat throughout the year is almost intolerable to Europeans. In the interior of northern and central Arabia, however, where the average level of the country exceeds 3000 ft., the fiery heat of the summer days is followed by cool nights, and the winter climate is fresh and invigorating; while in the highlands of Asir and Yemen in the south-west, and of Oman in the east, the summer heat is never excessive, and the winters are, comparatively speaking, cold.

In the northern desert the temperature is subject to extreme variations. Nolde states that on the 1st of February 1893 in the desert north of Hail the thermometer fell from 78° a little before sunset to 18° a quarter of an hour after. The midday temperatures recorded by Huber at Hail during January and the first half of February average about 65° F., and water froze on several nights; at Medina the winters are cold and night frosts of frequent occurrence, and these conditions prevail over all the western part of the Nejd plateau. In the east where the elevation is lower the climate is warmer. In the elevated highland district which extends from Taif to within 50 m. of Aden, the summer heat is tempered by the monsoon winds, and the seasonal variation of temperature is less marked. From observations made at Sana by Manzoni, Deflers and Glaser, the mean temperature for the year of that city at an altitude of 7300 ft. and in 15° 22′ N. appears to be 60° F.; for July the mean maximum was 77°, mean minimum 54°; for January the figures were 62°and 40° respectively, the lowest recorded temperature in 1878 was 26.6° on the 26th of January. At Aden at the sea-level the mean temperature for the year is 83°; the highest observed temperature in 1904 was 97.3°, the lowest 67.4°.

The rainfall throughout northern and central Arabia is chiefly in the winter months between October and April, and is scanty and irregular. Doughty states that in 1876 rain to wet the ground had not fallen for three years at Medain Salih; in that year showers fell on the 29th of December and on two days in January and again in March. After a very hot summer the bright weather changed to clouded skies on the 2nd of October, rain fell tempestuously the same evening, and there were showery days and nights till the 14th. The autumn rains fell that year abundantly in the Nafud towards Jauf, but very little in the basin of the W. Hamd (on the western slope). Doughty adds that the Nejd highlands between Kasim and Mecca are watered yearly by seasonable rains, which at Taif are expected about the end of August and last commonly from four to six weeks. This appears to be about the northern limit reached by the south-west monsoon, which from June to September brings a fairly abundant rainfall to the Yemen highlands, though the Tehama remains almost entirely rainless. The rainfall is heaviest along the western fringe of the plateau, and penetrates inland in decreasing quantity over a zone which perhaps extends to 100 m. in width. In good seasons it is sufficient for the cultivation of the summer crop of millet, and for the supply of the perennial streams and springs, on which the irrigation of the winter crops of wheat and barley depend. The amount measured at Dhala at the extreme south of the plateau at an elevation of 4800 ft. was in 1902 as follows:—June, 4.0 in.; July, 5.5; August, 5.8; September, 1.9. Only slight showers were recorded in the other months of the year. At higher elevations the

rainfall is no doubt heavier; Manzoni mentions that at Sana there was constant rain throughout August and September 1878, and that the thermometer during August did not reach 65°. In the Tehama occasional showers fall during the winter months; at Aden the average rainfall for the year is 2.97 in., but during 1904 only 0.5 in. was recorded. Snow falls on the Harra and on the Tehama range in northern Arabia, and Nolde records a fall of snow which lay on the Nafud on the 1st of February 1893. It also falls on J. Akhdar in Oman, but is very rarely known on the Yemen mountains, probably because the precipitation during the winter months is so slight.

The prevailing winds in northern Arabia as far as is known are from the west; along the southern coast they are from the east; at Sana there is generally a light breeze from the north-north-west from 9 to 11 A.M., from noon till 4 P.M. a steady and often strong wind blows from the south-south-east, which dies away later. The climate is extremely dry, but this is compensated for by the heavy mists which sweep up from the plains during the rainless months and exercise a most beneficial effect in the coffee-growing districts. This phenomenon is known as the sukhemani or amama. In the morning the Tehama, as seen from the mountain tops, appears buried in a sea of white cloud; towards noon the clouds drift up the mountain slopes and cover the summits with wreaths of light mist charged with moisture which condenses on the trees and vegetation; in the afternoon they disappear, and the evenings are generally clear and still.

Fauna.—The wild animals of Arabia are all of the desert-loving type: antelopes and gazelles are found in small numbers throughout the peninsula; the latter are similar to the *chikara* or ravine deer of India. The larger antelopes, so common on the African side of the Gulf of Aden, are not found, except one variety, the *Oryx beatrix* (called by the Arabs, wild cow), which is an inhabitant of the Nafud between Tema and Hail; it is about the size of a donkey, white, and with long straight horns. Hares are numerous both in the desert and in cultivated tracts. In the Yemen mountains the *wal*, a wild goat with massive horns, similar to the Kashmir ibex, is found; monkeys also abound. Among smaller animals the jerboa and other descriptions of rat, and the *wabar* or cony are common; lizards and snakes are numerous, most of the latter being venomous. Hyenas, wolves and panthers are found in most parts of the country, and in the mountains the leopard and wild cat. Of birds the ostrich is found in the Nafud and in the W. Dawasir. Among game birds the bustard, guinea fowl, sand grouse (*kata*), blue rock, green pigeon, partridge, including a large chikor (*akb*) and a small species similar to the Punjab sisi; quail and several kinds of duck and snipe are met with. In the cultivated parts of Yemen and Tehama small birds are very numerous, so also are birds of prey, vultures, kites and hawks.

Insects of all sorts abound; scorpions, centipedes, spiders, and an ugly but harmless millipede known in Yemen as *hablub* are very common in summer. Ants and beetles too are very numerous, and anthills are prominent features in many places. Locusts appear in great swarms and do much damage; fires are lighted at night to attract them, and large quantities are caught and eaten by the poorer people. Bees are kept, and in Yemen and Hadramut the honey is exceptionally good.

Of domesticated animals the camel is far the most useful to the Arab. Owing to its endurance of thirst the long desert journeys which separate the populous centres are made practicable, and in the spring months, when green forage is plentiful in the desert, the Bedouins pitch their camps for long periods far from any water, and not only men but horses subsist on camel's milk. The Arabian camel belongs to the one-humped species, though there are many varieties differing in appearance as much as the thoroughbred race-horse from the English cart-horse. The ordinary load for a pack camel is about 400 lb, and in hot weather good camels will march 20 to 25 m. daily and only require water every third or fourth day: in cool weather, with ample green fodder they can go twenty-five days or more without drinking. A good *dalul* or riding camel will carry his rider 100 m. a day for a week on end. Nolde gives an instance from his own experience of a camel rider covering 62 m. in seven hours. The pure-bred riding camel is only found in perfection in inner Arabia; for some unexplained reason when taken out of their own country or north of the 30th degree they rapidly degenerate.

Camel.

The horse does not occupy the important position in the Bedouin economy that is popularly supposed. In Nejd the number of horses is, comparatively speaking, very small; the want of water in the Nafud where alone forage is obtainable, and the absence of forage in the neighbourhood of the towns makes horse-breeding on a large scale impracticable there. Horses are in fact only kept by the principal sheiks, and by far the larger proportion of those now in Nejd are the property of the amir and his family. These are kept most of the year in the Nafud, five or ten days' march from Hail, where they find their own food on the desert herbage. When a raid is in contemplation, they are brought in and given a little barley for a few weeks. Reared in this way they are capable of marvellous endurance, marching during a raid twenty hours a day for eight or ten days together. As a rule, they are only mounted at the moment of attack, or in pursuit. Water and forage have to be carried for them on camels.

Horse.

The great majority of the horses that come into the market as Arabs, are bred in the northern desert and in Mesopotamia, by the various sections of the Aneza and Shammar tribes, who emigrated from Nejd generations ago, taking with them the original Nejd stock. In size and appearance, and in everything but endurance, these northern horses are admittedly superior to the true Nejdi. A few of the latter are collected by dealers in the nomad camps and exported chiefly from Kuwet. The amir Mahommed Ibn Rashid used to send down about one hundred young horses yearly.

Asses of excellent quality are bred all over the country; they are much used as mounts by the richer townsmen. Except in the settled districts horned cattle are not numerous; they are similar to the Indian humped cattle, but are greatly superior in milking qualities. The great wealth of the Arabs is in their flocks of sheep and goats; they are led out to pasture soon after sunrise, and in the hotter months drink every second day. In the spring when the succulent *ashub* and *adar* grow plentifully in the desert, they go for weeks without drinking. They are milked once a day about sunset by the women (the men milk the camels), and a large proportion of the milk is made into *samn*, clarified butter, or *marisi*, dried curd. The wool is not of much value, and is spun by the women and woven into rugs, and made up into saddlebags or into the black Bedouin tents.

Flora.—The flora of Arabia has been investigated by P. Forskal, the botanist of Niebuhr's mission, P.E. Botta, G. Schweinfurth and A. Deflers, to whose publications the technical reader is referred. Its general type approaches more closely to the African than to that of southern Asia. In the higher regions the principal trees are various species of fig, tamarind, carob and numerous kinds of cactiform *Euphorbia*, of which one, the *Euphorbia arborea*, grows to a height of 20 ft. Of Coniferae the juniper is found on the higher slopes of J.

Sabur near Taiz, where Botta describes it as forming an extensive forest and growing to a large size; it is also found in the range overlooking the W. Madin, 50 m. W. of Aden. Considerable forests are said to exist in Asir, and Burton found a few fine specimens which he regarded as the remains of an old forest, on the Tehama range in Midian. On the rocky hill-sides in Yemen the *Adenium Obesum* is worthy of notice, with its enormous bulb-like stems and brilliant red flowers. Some fine aloes or agaves are also found. In the cultivated upland valleys all over Arabia the *Zisyphus jujuba*, called by some travellers lotus, grows to a large tree; its thorny branches are clipped yearly and used to fence the cornfields among which it grows. In the broad sandy wadi beds the tamarisk (*athl*) is everywhere found; its wood is used for making domestic implements of all sorts. Among fruit trees the vine, apricot, peach, apple, quince, fig and banana are cultivated in the highlands, and in the lower country the date palm flourishes, particularly throughout the central zone of Arabia, in Hejaz, Nejd and El Hasa, where it is the prime article of food. A hundred kinds of date are said to grow at Medina, of which the *birni* is considered the most wholesome; the *halwa* and the *jalebi* are the most delicately flavoured and sell at very high rates; the *khulas* of El Hasa is also much esteemed.

Of cereals the common millets, *dhura* and *dukhn*, are grown in all parts of the country as the summer crop, and in the hot irrigated Tehama districts three crops are reaped in the year; in the highlands maize, wheat and barley are grown to a limited extent as the winter crop, ripening at the end of March or in April. Among vegetables the common kinds grown include radishes, pumpkins, cucumbers, melons, potatoes, onions and leeks. Roses are grown in some places for the manufacture of *atr*, or attar of roses; mignonette, jasmine, thyme, lavender and other aromatic plants are favourites in Yemen, when the Arabs often stick a bunch in their head-dress.

Coffee.

Of the products special to Arabia coffee comes first; it is nowhere found wild, and is believed to have been introduced from Abyssinia in the 6th century A.D. It thrives on the seaward slopes of the western range in the zone of the tropical rains, at altitudes between 4000 and 7000 ft. The principal centres of production are the upper valleys of the W. Surdad, between Kaukaban and Manakha, and particularly on J. Haraz; in the Wadi Zubed west of Uden; in Hajaria on the slopes of J. Sabur, and in the Yafa district north-east of Aden. It is planted in terraces on the mountain slopes; shady trees, such as tamarind and fig, are planted in the border as a protection from the sun, and the terraces are irrigated by channels led from a neighbouring rivulet or spring. The plants are raised from seedlings, and when six or seven weeks old they are transplanted in rows 4 to 6 ft. apart; they require watering twice a month, and bear in two to four years. The berries are dried in the sun and sent down to Hodeda or Aden, where they are subjected to a process for separating the husk from the bean; the result is about 50% of cleaned berries, *bun safi*, which is exported, and a residue of husk or *kishr*, from which the Yemenis make their favourite beverage.

Another plant universally used as a stimulant in Southern Arabia is *khat* (*Catha edulis*). The best is grown on J. Sabur and the mountainous country round Taiz. It is a small bush propagated from cuttings which are left to grow for three years; the leaves are then stripped, except a few buds which develop next year into young shoots, these being cut and sold in bunches under the name of *khat mubarak*; next year on the branches cut back new shoots grow; these are sold as *khat malhani*, or second-year kat, which commands the highest price. The bush is then left for three years, when the process is repeated. The leaves and young shoots are chewed; they have stimulating properties, comparable with those of the coca of Peru.

The aromatic gums for which Arabia was famed in ancient times are still produced, though the trade is a very small one. The tree from which myrrh is extracted grows in many places, but the industry is chiefly carried on at Suda, 60 m. north-north-east of Sana. Longitudinal slits are made in the bark, and the gum is caught in cups fixed beneath. The balsam of Mecca is produced in the same way, chiefly in the mountains near the W. Safra between Yambu and Medina.

The stony plains which cover so large a part of the country are often covered with acacia jungle, and in the dry water-courses a kind of wild palm, the *dom*, abounds, from the leaves of which baskets and mats are woven. Brushwood and rough pasturage of some sort is found almost everywhere, except in the neighbourhood of the larger settlements, where forage and firewood have to be brought in from long distances. The Nafud sands, too, are tufted in many places with bushes or small trees, and after the winter rains they produce excellent pasture.

Population.—The people, according to their own traditions, are derived from two stocks, the pure Arabs, descended from Kahtan or Joktan, fourth in descent from Shem; and the Mustarab or naturalized Arabs, from Ishmael. The former are represented at the present day by the inhabitants of Yemen, Hadramut and Oman, in general a settled agricultural population; the latter by those of Hejaz, Nejd, El Hasa, the Syrian desert and Mesopotamia, consisting of the Bedouin or pastoral tribes (see ARABS and BEDOUINS). This distinction between the characteristics of the two races is only true in a general sense, for a considerable population of true Bedouin origin has settled down to agricultural life in the oases of Hejaz and Nejd, while in southern Arabia the tribes dwelling on the fringe of the great desert have to a certain extent adopted the nomad life.

Both among the nomad and settled Arabs the organization is essentially tribal. The affairs of the tribe are administered by the sheiks, or heads of clans and families; the position of sheik in itself gives no real governing power, his word and counsel carry weight, but his influence depends on his own personal qualities. All matters affecting the community are discussed in the *majlis* or assembly, to which any tribesman has access; here, too, are brought the tribesmen's causes; both sides plead and judgment is given impartially, the loser is fined so many head of small cattle or camels, which he must pay or go into exile. Murder can be expiated by the payment of *diya* or blood-money, if the kinsmen of the murdered man consent; they may, however, claim the life of the murderer, and long and troublesome blood feuds often ensue, involving the relatives of both sides for generations.

Apart from the tribesmen there is in Hejaz and south Arabia a privileged, religious class, the Sharifs or Seyyids, who claim descent from Mahomet through his daughter Fatima. Until the Egyptian invasion in 1814 the Sharifs of Mecca were the recognized rulers of Hejaz, and though the Turks have attempted to suppress their importance, the Sharif still executes justice according to the Mahommedan law in the holy cities, though, nominally, as a Turkish official. In Yemen and Hadramut many villages are occupied exclusively by this religious hierarchy, who are known as Ashraf, Sada or Kudha (*i.e.* Sharifs, Seyyids or Kadhis); the

religious affairs of the tribes are left in their hands; they do not, however, interfere in tribal matters generally, or join in fighting.

Below these two classes, which may be looked on as the priestly and the military castes, there is, especially in the settled districts, a large population of artisans and labourers, besides negro slaves and their descendants, slave or free. The population of Khaibar consists almost entirely of the latter, and in Hail Huber estimates the pure Arab inhabitants at only one-third of the whole. In the desert, too, there is a widely scattered tribe, the Salubi, which from its name (*Salib*, cross) is conjectured to be of early Christian origin; they are great hunters, killing ostriches and gazelles; the Arabs despise them as an inferior race, but do not harm them; they pay a small tax to the tribe under whose protection they live, and render service as labourers, for which they receive in the spring milk and cheese; at the date harvest they get wages in kind; with this, and the produce of the chase, they manage to exist in the desert without agriculture or flocks.

The Jews in Arabia.

In southern Arabia the Jews form a large element in the town population. According to one authority their presence in Yemen dates from the time of Solomon, others say from the capture of Jerusalem by Nebuchadrezzar. Manzoni estimated their number in Sana in 1878 at 1700 out of a total population of 20,000; at Aden they are a numerous and wealthy community, with agents in most of the towns of Yemen. Even in remote Nejran, Halévy, himself a Jew, found a considerable colony of his co-religionists. They wear a distinctive garb and are not allowed to carry arms or live in the same quarter as Moslems. Another foreign element of considerable strength in the coast towns of Muscat, Aden and Jidda, is the British Indian trading class; many families of Indian origin also have settled at Mecca, having originally come as pilgrims.

Estimates of the population of Arabia vary enormously, and the figures given in the following table can only be regarded as a very rough approximation:—

Hejaz	300,000
Yemen and Asir	1,800,000
Nejd	1,000,000
Hadramut	150,000
Oman	1,000,000
El Hasa	300,000
Syrian desert and border	275,000
	4,825,000

Communications.—The principal land routes in Arabia are those leading to the holy cities. In the present day the Syrian pilgrim route, or Darb el Haj, from Damascus to Medina and Mecca is the most used. The annual pilgrim caravan or haj, numbering some 6000 people with 10,000 pack animals, is escorted by a few Turkish irregulars known as *agel*; small fortified posts have been established at the regular halting-places some 30 m. apart, each furnished with a well and reservoir, and for the further protection of the haj, payments are made to the Bedouin tribes through whose territories the route passes. The road is a mere camel track across the desert, the chief places passed are Ma’an on the Syrian border, a station on the old Sabaean trade route to Petra, and Medain Salih, the site of the rock-cut tombs and inscriptions first brought to notice by Doughty. From Medina the route usually followed descends the W. Safra to Badr Hunen, whence it keeps near the coast passing Rabigh and Khulesa to Mecca. The total distance, 1300 m., is covered in forty days.

The Egyptian pilgrim route from Cairo, across the Sinai peninsula and down the Midian coast to El Wijh, joins the Syrian route at Badr Hunen. It also was formerly provided with stations and reservoirs, but owing to the greater facilities of the sea journey from Suez to Jidda it is now little used. Another important route is that taken by the Persian or Shia pilgrims from Bagdad and Kerbela across the desert, by the wells of Lina, to Bureda in Kasim; thence across the steppes of western Nejd till it crosses the Hejaz border at the Ria Mecca, 50 m. north-east of the city. It lies almost entirely in the territory of the amir Ibn Rashid of J. Shammar, who derives a considerable revenue from the pilgrimage. The old reservoirs on this route attributed to Zubeda, wife of Harun al Rashid, were destroyed during the Wahhabi raids early in the 19th century, and have not been repaired. The Yemen pilgrim route, known as the Haj el Kabsi, led from Sada through Asir to Taif and Mecca, but it is no longer used.

The principal trade routes are those leading from Damascus to Jauf and across the Nafud to Hail. Other important routes leading to Nejd are those from Kuwet to Hail, and from El Hasa to Riad respectively. In the west and south the principal routes, other than those already mentioned, are from Yambu to Medina, from Jidda to Mecca, Hodeda to Sana, Aden to Sana, and from Mukalla to the Hadramut valley. Railway construction has begun in Arabia, and in 1908 the Hejaz line, intended to connect Damascus with Mecca, had reached Medina, 500 m. south of Ma’an. This line is of great strategical importance, as strengthening the Turkish hold on the Red Sea provinces. But the principal means of commercial communication for a country like Arabia must always be by sea. Bahrein, Kuwet and Muscat are in steam communication with India, and the Persian Gulf ports; all the great lines of steamships call at Aden on their way between Suez and the East, and regular services are maintained between Suez, Jidda, Hodeda and Aden, as well as to the ports on the African coast, while native coasting craft trade to the smaller ports on the Red Sea and Indian Ocean.

Commerce.—The total value of the trade of Aden for 1904 amounted to over £6,000,000. The imports to Jidda in the same year were £1,405,000, largely consisting of rice, wheat and other food stuffs from India; the exports, which have dwindled away in late years, amounted in 1904 to only £25,000. To balance the exports and imports specie was exported in the three years 1902-1904 amounting to £2,319,000; a large proportion of this was perhaps provided by cash brought into the country by pilgrims.

The pilgrim traffic increased largely in 1904 as compared with previous years; 74,600 persons landed at Jidda, 18,000 of whom were from British India, 13,000 from Java and the Straits Settlements, and the remainder from Turkish territory, Egypt and other countries: 235 out of a total of 334 steamships engaged in this traffic were British.

The trade of Hodeda, which contributes by far the largest share to that of Turkish Yemen, fell off considerably during the period from 1901-1905, chiefly owing to the disturbed state of the country. In the latter year the imports amounted to £467,000, and the exports to £451,000; coffee, the mainstay of Yemen trade, shows a serious decline from £302,000 in 1902 to £229,000 in 1904; this is attributable partly to the great increase of production in other countries, but mainly to the insecurity of the trade routes and the exorbitant transit dues levied by the Turkish administration.

Oman, through its chief port Muscat, had a total trade of about £550,000, two-thirds of which is due to imports and one-third to exports. The chief items of imports are arms and ammunition, rice, coffee and piece goods; the staple export is dates, which in a good year accounts for nearly half the total; much of the trade is in the hands of British Indians, and of the shipping 92% is British.

The principal trade centre of the Arabian side of the Persian Gulf is Bahrein; the total volume of trade of which amounted in 1904 to £1,900,000, nearly equally divided between imports and exports; rice, piece goods, &c., form the bulk of the former, while pearls are the most valuable part of the latter.

(R. A. W.)

Antiquities

Arabia cannot be said to be “destitute of antiquities,” but the material for the study of these is still very incomplete. The difficulties in the way of travelling in Arabia with a view to scientific investigation are such that little or nothing is being done, and the systematic work which has given such good results in Egypt, Palestine and Babylonia-Assyria is unknown in Arabia. Yet the passing notes of travellers from the time of Carsten Niebuhr show that antiquities are to be found.

Prehistoric Remains.—Since prehistoric remains must be studied where they are found, the difficulty in the way of exploration makes itself severely felt. That such remains exist seems clear from the casual remarks of travellers. Thus Palgrave (*Central and Eastern Arabia*, vol. i. ch. 6) speaks of part of a circle of roughly shaped stones taken from the adjacent limestone mountains in the Nejd. Eight or nine of these stones still exist, some of them 15 ft. high. Two of them, 10 to 12 ft. apart, still bear their horizontal lintel. They are all without ornament. Palgrave compares them with the remains at Stonehenge and Karnak. Doughty (*Arabia Deserta*, vol. ii.), travelling in north-west Arabia, saw stones of granite in a row and “flagstones set edgewise” (though he does not regard these as religious), also “round heaps, perhaps barrows,” and “dry-built round chambers,” which may be ancient tombs. J.T. Bent (*Southern Arabia*, pp. 24 ff.) explored one of several mounds in Bahrein. It proved to be a tomb, and the remains in it are said to be Phoenician.

Castles and Walls.—In the south of Arabia, where an advanced civilization existed for centuries before the Christian era, the ruins of castles and city-walls are still in existence, and have been mentioned, though not examined carefully, by several travellers. In Yemen and Hadramut especially these ruins abound, and in some cases inscriptions seem to be still *in situ*. Great castles are often mentioned in early Arabian literature. One in the neighbourhood of San‘a was described as one of the wonders of the world by Qazwīnī (*Athār ul-Bilād*, p. 33, ed. Wüstenfeld, Göttingen, 1847, cf. *Journal of the German Oriental Society*, vol. 7, pp. 472, 476, and for other castles vol. 10, pp. 20 ff.). The ruins of the city of Ma’rib, the old Sabaean capital, have been visited by Arnaud, Halévy and Glaser, but call for further description, as Arnaud confined himself to a description of the dike (see below), while Halévy and Glaser were interested chiefly in the inscriptions.

Wells and Dikes.—From the earliest times the conservation of water has been one of the serious cares of the Arabs. All over the country wells are to be found, and the masonry of some of them is undoubtedly ancient. Inscriptions are still found in some of these in the south. The famous well Zemzem at Mecca is said to belong to the early times, when the eastern traffic passed from the south to the north-west of Arabia through the Hejaz, and to have been rediscovered shortly before the time of Mahomet. Among the most famous remains of Ma’rib are those of a great dike reminding one of the restored tanks familiar to visitors at Aden. These remains were first described by Arnaud (*Journal asiatique*, January 1874, with plan). Their importance was afterwards emphasized by Glaser’s publication of two long inscriptions concerning their restoration in the 5th and 6th centuries A.D. (“Zwei Inschriften über den Dammbruch von Marib,” in the *Mitteilungen der Vorderasiatischen Gesellschaft*, Berlin, 1897). Another dike about 150 yds. long was seen by W.B. Harris at Hîrran in Yemen. Above it was a series of three tanks (*A Journey through the Yemen*, p. 279, London, 1893).

Stones and Bronzes.—The 19th century has brought to the museums of Europe (especially to London, Paris, Berlin and Vienna) a number of inscriptions in the languages of Minea and Saba, and a few in those of Hadramut and Katabania (Qatta-bania). These inscriptions are generally on limestone or marble or on tablets of bronze, and vary from a few inches to some feet in length and height. In some cases the originals have been brought to Europe, in other cases only squeezes of the inscriptions. The characters employed are apparently derived from the Phoenician (cf. Lidzbarski’s *Ephemeris*, vol. i. pp. 109 ff.). The languages employed have been the subject of much study (cf. F. Hommel’s *Süd-arabische Chrestomathie*, Munich, 1893), but the archaeological value of these remains has not been so fully treated. Very many of them are votive inscriptions and contain little more than the names of gods and princes or private men. A few are historical, but being (with few and late exceptions) undated, have given rise to much controversy among scholars. Their range seems to be from about 800 B.C. (or 1500 B.C. according to E. Glaser) to the 6th century A.D. Few are still *in situ*, the majority having been taken from their original positions and built into houses, mosques or wells of more recent date. Among these remains are altars, and bases for statues of gods or for golden images of animals dedicated to gods. The earlier stones are devoid of ornamentation, but the later stones and bronzes are sometimes ornamented with designs of leaves, flowers, ox-heads, men and women. Some bear figures of the conventionalized sacred tree with worshippers, similar to Babylonian designs. Besides these there are gravestones, stelae with human heads, fragments of limestone, architectural designs as well as bronze castings of camels, horses, mice, serpents, &c. (cf. D.H. Müller’s *Südarabische Alterthümer im Kunsthistorischen Museum*, Vienna, 1899, with plates).

Seals, Weights and Coins.—The Vienna Museum possesses a small number of seals and gems. The seals are

inscribed with Sabaean writing and are of bronze, copper, silver and stone. The gems of onyx, carnelian and agate are later and bear various figures, and in some cases Arabic inscriptions. One or two weights are also in existence. A number of coins have been brought to the British Museum from Aden, San'a and Ma'rib. Others were purchased by G. Schlumberger in Constantinople; others have been brought to Europe by Glaser, and are now in the Vienna Museum. These are imitations of Greek models, while the inscriptions are in Sabaean characters (cf. B.V. Head, in the *Numismatic Chronicle*, 1878, pp. 273-284; G. Schlumberger, *Le Trêsor de San'a*, Paris, 1880; D.H. Müller, *op. cit.* pp. 65 ff. and plates).

For the problem of Arabic antiquities in Rhodesia see RHODESIA and ZIMBABWE.

(G. W. T.)

HISTORY

Introduction.—Arabia is a land of Semites, and is supposed by some scholars to have been the original home of the Semitic peoples. Although this cannot be said to be proved, the studies, linguistic and archaeological, of Semitic scholars have shown it to be probable. The dispersion from Arabia is easy to imagine. The migration into Babylonia was simple, as there are no natural boundaries to separate it from north-east Arabia, and similar migrations have taken place in historic times. That of the Aramaeans at an early period is likewise free from any natural hindrance. The connexion with Palestine has always been close; and the Abyssinian settlement is probably as late as the beginning of the Christian era. Of these migrations, however, history knows nothing, nor are they expressed in literature. Arabian literature has its own version of prehistoric times, but it is entirely legendary and apocryphal. It was, and still is, the custom of Arabian historians to begin with the creation of the world and tell the history from then to the time of which they are writing. Consequently even the more sober histories contain a mass of fables about early days. Many of these, taken in part from Jewish and Christian sources, find a place in the Koran. Of all these stories current at the time of Mahomet, the only ones of any value are the accounts of the "days of the Arabs," *i.e.* accounts of some famous inter-tribal battles in Arabia.

Authorities.—Until recently the Arab traditions were practically the only source for the pre-Islamic history of Arabia. The Old Testament references to Arabs were obscure. The classical accounts of the invasion of Aelius Callus in 26 B.C. threw little light on the state of Arabia at the time, still less on its past history. The Greek writers from Theophrastus in the 4th century B.C. to Ptolemy in the 2nd century A.D. mention many names of Arabian peoples and describe the situation of their cities, but contribute little to their history, and that little could not be controlled. The same applies to the information of Pliny in his *Natural History*. In the 19th century the discovery and decipherment of the Assyrian inscriptions gave a slight glance into the relations between Arabs and Assyrians from the 8th century B.C. But the great contribution of the century to the early history of Arabia was the collecting and translating of numerous early Arabian inscriptions (cf. section *Antiquities* above), which have done service both by their own indication of a great civilization in Arabia for nearly (or more than) a thousand years before the Christian era, and by the new stimulus which they gave to the study and appreciation of the materials in the Assyrian inscriptions, the Old Testament, and the Greek and Roman writers. At the same time the facts that the inscriptions are undated until a late period, that few are historical in their contents, and for the most part yield only names of gods and rulers and domestic and religious details, and that our collection is still very incomplete, have led to much serious disagreement among scholars as to the reconstruction of the history of Arabia in the pre-Christian centuries.

All scholars, however, are agreed that the inscriptions reach as far back as the 9th century B.C. (some say to the 16th) and prove the existence of at least four civilized kingdoms during these centuries. These are the kingdoms of Ma'īn (Minaean), of Saba (Sabaean), of Hadramaut (Hadramut) and of Katabania (Katabanū). Of the two latter little is known. That of Hadramut had kings from the time of the Minaeans to about A.D. 300, when it was conquered by Ethiopia. The limits of the kingdom of Katabania are not known, but it has its own inscriptions.

As to the Sabaean kingdom there is fair agreement among scholars. The inscriptions go back to 800 B.C. or earlier, and the same applies to the kingdom. A queen of this people (the "Queen of Sheba") is said (1 Kings x.) to have visited Solomon about 950 B.C. There is, however, no mention of such a queen in the inscriptions. An Assyrian inscription mentions Ith'amara the Sabaean who paid tribute to Sargon in 715 B.C. At this time the Sabaeans must have been in north Arabia unless the inscription refers to a northern colony of the southern Sabaeans. The former opinion is held by E. Glaser, who thinks that in the 9th and 8th centuries they moved down along the west coast to the south, where they conquered the Minaeans (see below). The Sabaean rule is generally divided into periods indicated by the titles given to their rulers. In the first of these ruled the Makarib, who seem to have been priest-kings. Their first capital was at Ṣirwāḥ. Ten such rulers are mentioned in the inscriptions. Their rule extended from the 9th to the 6th century. The second period begins about 550 B.C. The rulers are known as "kings of Saba." Their capital was Ma'rib. The names of seventeen of these kings are known from the inscriptions. Their sway lasted until about 115 B.C., when they were succeeded by the Himyarites. During this period they were engaged in constant strife with the neighbouring kingdoms of Hadramut and Katabania. The great prosperity of south-west Arabia at this time was due in large measure to the fact that the trade from India with Egypt came there by sea and then went by land up the west coast. This trade, however, was lost during this period, as the Ptolemies established an overland route from India to Alexandria. The connexion of Saba with the north, where the Nabataeans (*q.v.*) had existed from about 200 B.C., was now broken. The decay that followed caused a number of Sabaeans to migrate to other parts of Arabia.

The Minaean kingdom extended over the south Arabian Jauf, its chief cities being Karnau, Ma'īn and Yathil. Some twenty-five kings are known from the inscriptions; of these twenty are known to be related to one another. Their history must thus cover several centuries. As inscriptions in the Minaean language are found in al-'Ula in north Arabia, it is probable that they had colonies in that district. With regard to their date opinion is very much divided; some, with E. Glaser and F. Hommel, maintaining that their kingdom existed prior to that of Saba, probably from about 1500 B.C. or earlier until the Sabaeans came from their home in the

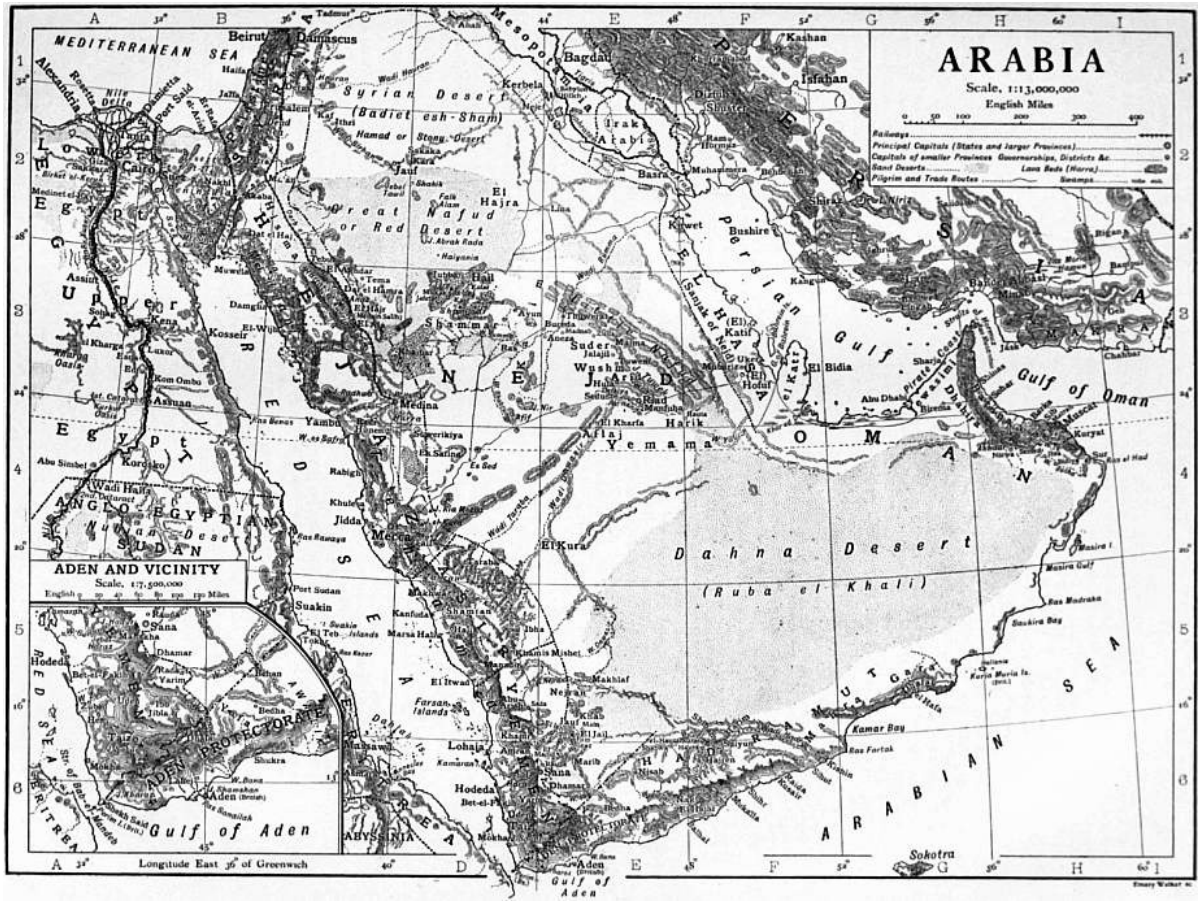
north and conquered them in the 9th century. Other scholars think, with D.H. Müller, partly on palaeographical grounds (cf. M. Lidzbarski's *Ephemeris*, vol. i. pp. 109 seq., Giessen, 1902), that none of the inscriptions are earlier than about 800 B.C. and that the Minaean kingdom existed side by side with the Sabaean. It is curious that the Sabaean inscriptions contain no mention of the Minaeans, though this may be due to the fact that very few of the inscriptions are historical in content.

About 115 B.C. the power over south Arabia passed from the Sabaeans to the Himyarites, a people from the extreme south-west of Arabia; and about this time the kingdom of Katabania came to an end. The title taken by the new rulers was "king of Saba and Raidan." Twenty-six kings of this period are known from the inscriptions, some of which are dated. In this period the Romans made their one attempt at direct interference in the affairs of Arabia. The invasion under Aelius Gallus was an absolute failure, the expedition being betrayed by the guides and lost in the sands of the desert. During the latter part of this time the Abyssinians, who had earlier migrated from Arabia to the opposite coast of Africa, began to flow back to the south of Arabia, where they seem to have settled gradually and increased in importance until about A.D. 300, when they became strong enough to overturn the Himyarite kings and establish a dynasty of their own. The title assumed by them was "king of Saba, Raidān, Hadramut and Yemen." The Himyarites were, however, still active, and after a struggle succeeded in establishing a Jewish Sabaean kingdom, having previously accepted Judaism as their religion. Their best-known king was Dhu Nuwas. The struggle between them and the Abyssinians now became one of Judaism against Christianity. The persecution of the Christians was very severe (see E. Glaser's *Die Abyssinier in Arabien und Afrika*, Munich, 1895, and F.M.E. Pereira's *Historia dos Martyres de Nagran*, Lisbon, 1899). Apparently for this reason Christian Abyssinia was supported from Byzantium in its attempts to regain power. These attempts were crowned with success in 525. Of the Christian Abyssinian kings in Arabia tradition tells of four, one only of whom is mentioned in inscriptions. The famous expedition of Abraha, the Abyssinian viceroy, against Mecca, took place in 570. Five years later the Persians, who had been called in by the opponents of Christianity, succeeded in taking over the rule and in appointing governors over Yemen. (See further ETHIOPIA: *The Axumite Kingdom*.)

Hira, Ghassān and Kinda.—Before passing to the time of Mahomet it is necessary to take account of three other Arabian powers, those of Hira, Ghassan and Kinda.

Hira.

The kingdom of Hira (Ḥīra) was established in the boundary land between the Euphrates and the Arabian desert, a district renowned for its good air and extraordinary fertility. The chief town was Hira, a few miles south of the site of the later town of Kufa. The inhabitants of this land are said in Tabari's history to have been of three classes:—(1) The Tanukh (Tnuhs), who lived in tents and were made up of Arabs from the Tehama and Nejd, who had united in Bahrein to form a new tribe, and who migrated from there to Hīra, probably at the beginning or middle of the 3rd century A.D., when the Arsacid power was growing weak. The Arabian historians relate their conflict with Zenobia. (2) The ʻIbād or ʻIbādites, who dwelt in the town of Hira in houses and so led a settled life. These were Christians, whose ecclesiastical language was Syriac, though the language of intercourse was Arabic. A Christian bishop of Hira is known to have attended a synod in 410. In the 5th century they became Nestorians. (3) Refugees of various tribes, who came into the land but did not belong to the Tanukh or the ʻIbad. There is no trustworthy information as to the earlier chiefs of this people. The dynasty of the Lakhmids, famed in Arabian history and literature, arose towards the end of the 3rd century and lasted until about 602. The names of twenty kings are given by Hishām al-Kalbī in Ṭabari's history. Although so many of their subjects were Christian, the Lakhmids remained heathen until Nu'mān, the last of the dynasty. The kingdom of Hīra was never really independent, but always stood in a relation of dependence on Persia, probably receiving pay from it and employing Persian soldiers. At the height of its power it was able to render valuable aid to its suzerain. Much of its time was spent in wars with Rome and Ghassān. Its revenues were derived from the Bedouins of the surrounding lands as well as from its own subjects at home. About 602 the Lakhmid dynasty fell, and the Persian Chosroes (Khosrau) II. appointed as governor an Arab of the tribe of Tāi. Shortly after it came into relation with Islam.



(Click to enlarge.)

See G. Rothstein's *Die Dynastie der Lakhmiden in al-Hira* (Berlin, 1899); Th. Nöldeke's *Geschichte der Perser und Araber zur Zeit der Sassaniden* (Leiden, 1879).

In the beginning of the 6th century A.D. a dynasty known as the Jafnids, enter into the history alike of the Roman and Persian empires. They ruled over the tribe of Ghassān in the extreme north-west of Arabia, east of the Jordan, from near Petra in the south to the neighbourhood of Rosafa in the north-east. Of their origin little is known except that they came from the south. A part of the same tribe inhabited Yathrib (Medina) at the time of Mahomet. The first certain prince of the Jafnid house was Harith ibn Jabala, who, according to the chronicle of John Malalas, conquered Mondhir (Mundhir) of Hira in 528. In the following year, according to Procopius, Justinian perceived the value of the Ghassānids as an outpost of the Roman empire, and as opponents of the Persian dependants of Hīra, and recognized Hārith as king of the Arabs and patrician of the Roman empire. He was thus constantly engaged in battles against Hīra. In 541 he fought under Belisarius in Mesopotamia. After his death about 569 or 570 the friendly relations with the West continued, but about 583 there was a breach. The Ghassanid kingdom split into sections each with its own prince. Some passed under the sway of Persia, others preserved their freedom at the expense of their neighbours. At this point their history ceases to be mentioned in the Western chronicles. There are references to the Ghassānid Nu'mān in the poems of Nābigha. Arabian tradition tells of their prince Jabala ibn Aiham who accepted Islam, after fighting against it, but finding it too democratic, returned to Christianity and exile in the Roman empire. As Islam advanced, some of the Ghassānids retreated to Cappadocia, others accepted the new faith.

Ghassān.

See Th. Nöldeke, *Die ghassanischen Fürsten aus dent Hause Gafna's* (Berlin, 1887).

In the last decade of the 5th century a new power arose in central Arabia. This was the tribe of Kinda under the sway of the family of Aqil ul Murār, who came from the south. They seem to have stood in much the same relation to the rulers of Yemen, as the people of Hīra to the Persians and the Ghassanids to Rome. Abraha in his invasion of the Hejaz was accompanied by chiefs of Kinda. Details of their history are not known, but they seem to have gained power at one time even over the Lakhmids of Hīra; and to have ruled over Bahrein as well as Yemama until the battle of Shi`b ul Jabala, when they lost this province to Hira. The poet Amru`ul Qais was a member of the princely family of Kinda.

Kinda.

Outside the territory of the powers mentioned above, Arabia in the 6th century was in a state of political chaos. Bahrein, inhabited chiefly by the Bani`Abd Qais and the Bani Bakr, was largely subject to Persian influence near its coast, and a Persian governor, Sebocht, resided in Hajar, its chief town. In Oman the Arabs, who were chiefly engaged in fishing and seafaring, were Azdites mixed with Persians. The ruling dynasty of Julanda in their capital Suhar lasted on till the Abbasid period. No Persian officials are mentioned in this country; whether Persians exercised authority over it is doubtful. On the west coast of Arabia the influence of the kingdom of Yemen was felt in varying degree according to the strength of the rulers of that land. Apart from this influence the Hejaz was simply a collection of cities each with its own government, while outside the cities the various tribes governed themselves and fought continual battles with one another.

Other parts of Arabia.

Time of Mahomet.—Thus at the time of Mahomet's advent the country was peopled by various tribes, some

more or less settled under the governments of south Arabia, Kinda, Hira and Ghassan, these in turn depending on Abyssinia, Persia and Rome (*i.e.* Byzantium); others as in the Hejaz were ruled in smaller communities by members of leading families, while in various parts of the peninsula were wandering Arabs still maintaining the traditions of old family and tribal rule, forming no state, sometimes passing, as suited them, under the influence and protection of one or another of the greater powers. To these may be added a certain number of Jewish tribes and families deriving their origin partly from migrations from Palestine, partly from converts among the Arabs themselves. Mahomet appealed at once to religion and patriotism, or rather created a feeling for both. For Mahomet as a religious teacher and for the details of his career see Mahomet. It is enough here to outline his actions in so far as he attempted to create a united, and then a conquering, Arabia. Though the external conquests of the Arabs belong more properly to the period of the caliphate, yet they were the natural outcome of the prophet's ideas. His idea of Arabia for the Arabians could only be realized by summoning the great kings of the surrounding nations to recognize Islam; otherwise Abyssinia, Persia and Rome (Byzantium) would continue their former endeavours to influence and control the affairs of the peninsula. Tradition tells that a few years before his death he did actually send letters to the emperor Heraclius, to the negus of Abyssinia, the king of Persia, and Cyrus, patriarch of Alexandria, the "Mukaukis" of Egypt, summoning them to accept Islam and threatening them with punishment in case of refusal. But the task of carrying out these threats fell to the lot of his successors; the work of the prophet was to be the subjugating and uniting of Arabia. This work, scarcely begun in Mecca, was really started after the migration to Medina by the formation of a party of men—the *Muhājirun* (Refugees or Emigrants) and the *Ansār* (Helpers or Defenders)—who accepted Mahomet as their religious leader. As the necessity of overcoming his enemies became urgent, this party became military. A few successes in battle attracted to him men who were interested in fighting and who were willing to accept his religion as a condition of membership of his party, which soon began to assume a national form. Mahomet early found an excuse for attacking the Jews, who were naturally in the way of his schemes. The Bani Nadīr were expelled, the Bani Quraiza slaughtered. By the time he had successfully stormed the rich Jewish town of Khaibar, he had found that it was better to allow industrious Jews to remain in Arabia as payers of tribute than to expel or kill them: this policy he followed afterwards. The capture of Mecca (630) was not only an evidence of his growing power, which induced Arabs throughout the peninsula to join him, but gave him a valuable centre of pilgrimage, in which he was able by a politic adoption of some of the heathen Arabian ceremonies into his own rites to win men over the more easily to his own cause. At his death in 623 Mahomet left Arabia practically unified. It is true that rival prophets were leading rebellions in various parts of Arabia, that the tax-collectors were not always paid, and that the warriors of the land were much distressed for want of work owing to the brotherhood of Arabs proclaimed by Mahomet. The tribes were a seething mass of restlessness, their old feuds ready to break out again. But they had realized that they had common interests. The power of the foreigner in Arabia was broken. Islam promised rich booty for those who fought and won, paradise for those who fell.

Early Caliphs.[1] I. *Conquest.*—One task of the early caliphs was to find an outlet for the restless fighting spirit. Abu Bekr (632-634), the first of these caliphs, was a man of simple life and profound faith. He understood the intention of Mahomet as to foreign nations, and set himself resolutely to carry it out in the face of much difficulty. Hence as soon as he assumed office he sent out the army already chosen to advance against the Romans in the north. The successful reduction of the rebels in Arabia enabled him in his first year to send his great general Khālid with his Arab warriors first against Persians, then against Romans. His early death prevented him from seeing the fruits of his policy. Under the second caliph Omar (634-644) the Persians were defeated at Kadesiya (Kadessia), and Irak was completely subdued and the new cities of Kufa and Basra were founded (635). In the same year Damascus fell into the hands of the Arabs under Abu ʻUbaida. In 636 Jerusalem fell and received a visit from the caliph. Three years later the fateful step was taken of appointing Moawiya (Mu'awīyya) governor of Syria. In 640 ʻAmr-ibn-el-Ass (Amr ibn al-ʻĀs) invaded Egypt and the following year took Alexandria and founded Fostat (which later became Cairo). The victory at Nehavend in 641 over the Persians, the flight of the last Sassanid king and the capture of Rei or Rai (class. Rhagae) in 643 meant the entire subjugation of Persia and crowned the conquests of Omar's caliphate. The reign of the third caliph Othman (644-656) was marked by the beginning of that internal strife which was to ruin Arabia; but the foreign conquests continued. In the north the Moslem arms reached Armenia and Asia Minor; on the west they were successful as far as Carthage on the north coast of Africa. After the murder of Othman, ʻAli (656-661) became caliph, but Moawiya, governor of Syria, soon rebelled on the pretext of avenging the death of Othman. After the battle of Siffin (657) arbitration was resorted to for the settlement of the rival claims. By a trick ʻAli was deposed (658), and the Omayyad dynasty was established with its capital at Damascus.

During these early years the Arabs had not only made conquests by land, but had found an outlet for their energy at sea. In 640 Omar sent a fleet of boats across the Red Sea to protect the Moslems on the Abyssinian coast. The boats were wrecked. Omar was so terrified by this that when Moawiya applied to him for permission to use ships for an attack on the islands of the Levant, he resolutely refused. Othman was less careful, and allowed a fleet from Africa to help in the conquests of the Levant and Asia Minor. In 649 he sanctioned the establishment of a maritime service, on condition that it should be voluntary. Abu Qais, appointed admiral, showed its usefulness by the capture of Cyprus. In 652 Abu Sarh with a fleet from Egypt won a naval battle over the Byzantine fleet near Alexandria.

Institution of navy.

2. *Internal Affairs.*—In the meantime what had become of Arabia and its unification? The first task of Abu Bekr had been to reduce those rebels who threatened to destroy that unity even before it was fully established. This he did by the aid of the great general Khālid. First he swept down on the Bani Hanīfa in Yemāma, who with their rival prophet Mosailama (Mosailima) and 40,000 men were in arms. The battle of Yemama (633) was fierce and decisive. Mosailama was slain. The Bani Hanīfa returned to Islam. Bahrein was influenced by this battle, and the rebellion there, which was threatening, was crushed. Oman was reconquered by Huddhaifa, who became its governor. Ikrima settled Māhra. Muhājir, with the help of Ikrima, succeeded with difficulty, but thoroughly, in defeating Amr ibn Ma'dikarib and Qais ibn ʻAbd Yaghūth in Yemen and Ashath ibn Qais in Hadramut. The Hejaz and Tehama were cleared of the plundering nomads by ʻAttāb and Ṭāhir. At the end of the first year of his caliphate Abu Bekr saw Arabia united under Islam. The

new national feeling demanded that all Arabs should be free men, so the caliph ordained that all Arab slaves should be freed on easy terms. The solidarity of Arabia survived the first foreign conquests. It was not intended that Arabs should settle in the conquered lands except as armies of occupation. Thus it was at first forbidden that Arabs should buy or possess land in these countries. Kūfa was to be only a military camp, as was Fostat in Egypt. The taxes with the booty from conquests were to be sent to Arabia for distribution among the Moslems. Omar tried to prevent the advance of conquests lest Arabia should suffer. "I would rather the safety of my people than thousands of spoil and further conquest." But men could not be prevented from pouring out from their homes in search of new conquests and more booty. Many of those who went forth did not return. They acquired property and rank in the new lands. Kūfa attracted chiefly men of south Arabia, Basra those of the north. Both became great cities, each with a population of 150,000 to 200,000 Arabians. Yet so long as the caliphs lived in Medina, the capital of Arabia was the capital of the expanding Arabian empire. To it was brought a large share of the booty. The caliphs were chosen there, and there the rules for the administration were framed. Thence went out the governors to their provinces. Omar was the great organizer of Arabian affairs. He compiled the Koran, instituted the civil list, regulated the military organization. He, too, desired that Mahomet's wish should be carried out and that Arabia should be purely Moslem. To this end he expelled the Christians from Nejrān and gave them lands in Syria and Irak, where they were allowed to live in peace on payment of tribute. The Jews, too, were shortly after expelled from Khaibar. The secondary position that Arabia was beginning to assume in the Arabian empire is clearly marked in the progress of events during the caliphate of Othman. In his appointments to governorships and other offices, as well as in his distribution of spoil, Othman showed a marked preference for the members of his own tribe the Koreish (Quraish) and the members of his own family the Bani Omayya (Umayya). The other Arab tribes became increasingly jealous of the Koreish, while among the Koreish themselves the Hāshimite family came to hate the Omayyad, which now had much power, although it had been among the last to accept Islam and never was very strict in its religious duties. But the quarrels which led to the murder of Othmān were fomented not so much in Arabia as in Kūfa and Baṣra and Fostat. In these cities the rival parties were composed of the most energetic fighting men, who were brought into the most intimate contact with one another, and who kept up their quarrels from the home land. In Kūfa a number of the Koreish had settled, and their arrogance became insupportable. The governors of all these towns were of Othman's own family. After some years of growing dissatisfaction deputies from these places came to Medina, and the result was the murder of the caliph. Syria alone remained loyal to the house of Omayya, and Othmān had been advised to take refuge there, but had refused. Arabia itself counted for little in the strife. Yet its prestige was not altogether lost. After the murder the rebels were unwilling to return home until a new caliph had been chosen in the capital. The Egyptian rebels managed to gain most influence, and, in accordance with their desire, ʻAlī was appointed caliph by the citizens of Medina. But Medina itself was being corrupted by the constant influx of captives, who, employed at first as servants, soon became powerful enough to dictate to their masters. In the struggle that ensued upon the election of ʻAlī, Arabia was involved. Ayesha, Ṭalḥa and Zobair, who were strong in Mecca, succeeded in obtaining possession of Baṣra, but were defeated in 656 at the battle of the Camel (see Ali). In the south of Arabia ʻAlī succeeded in establishing his own governor in Yemen, though the government treasure was carried off to Mecca. But the centre of strife was not to be Arabia. When ʻAlī left Medina to secure Basra, he abandoned it as the capital of the Arabian empire. With the success of Moawiya Damascus became the capital of the caliphate (658) and Arabia became a mere province, though always of importance because of its possession of the two sacred cities Mecca and Medina. Both these cities were secured by Moawiya in 660, and at the same time Yemen was punished for its adherence to ʻAlī. The final blow to any political pretensions of Medina was dealt by the caliph when he had his son Yazīd declared as his successor, thus taking away any claim on the part of the citizens of Medina to elect to the caliphate.

The Omayyads.—The early years of the Omayyads were years of constant strife in Arabia. The Kharijites who had opposed ʻAlī on the ground that he had no right to allow the appeal to arbitration, were defeated at Nahrawān or Nahrwān (658), but those who escaped became fierce propagandists against the Koreish, some claiming that the caliph should be chosen by the Faithful from any tribe of the Arabs, some that there should be no caliph at all, that God alone was their ruler and that the government should be carried on by a council. They broke up into many sects, and were long a disturbing political force in Arabia as elsewhere. On the death of ʻAlī his house was represented by his two sons Ḥasan and Ḥosain (Ḥusain). Ḥasan soon made peace with Moawiya. On the accession of Yazid, Ḥosain refused homage and raised an army, but was slain at Kerbela (680). ʻĀbdallah ibn Zobair (of the house of Hashim) immediately stepped forward in Mecca as the avenger of ʻAlī's family and the champion of religion. The two sacred cities supported him. Medina was besieged and sacked by the troops of Yazīd (682) and Mecca was besieged the following year. The siege was raised in the third month on the news of the death of Yazīd, but not before the Kaʻba had been destroyed. ʻĀbdallah remained in Mecca recognized as caliph in Arabia, and soon after in Egypt and even a part of Syria. He defeated the troops of Merwān I., but could not win the support of the Khārijites. In 691 Abdalmalik (ʻAbdul-Malik) determined to crush his rival and sent his general Ḥajjāj against Mecca. The siege was begun in March 692, and in October the city was taken and ʻĀbdallah slain. Abdalmalik was now supreme in Arabia and throughout the Moslem world. During the remaining years of the Omayyad dynasty (*i.e.* until 750) little is heard of Arabia in history. The conquests of Islam in Spain on the one side and India on the other had little or no effect on it. It was merely a province.

The ʻAbbāsids.—The accession of Abul ʻAbbās (of the house of Hāshim) and the transference of the capital of the caliphate from Damascus to Kūfa, then Anbar and soon after (in 760) to Bagdad meant still further degradation to Arabia and Arabs. From the beginning the ʻAbbāsids depended for help on Persians and Turks, and the chief offices of state were frequently filled with foreigners. In one thing only the Arabs conquered to the end; that was in their language. The study of Arabic was taken up by lexicographers, grammarians and poets (mostly of foreign origin) with a zeal rarely shown elsewhere. The old Arabian war spirit was dying. Although the Arabians, as a rule, were in favour of the Omayyad family, they could not affect the succession of the ʻAbbāsids. They returned more and more to their old inter-tribal disputes. They formed now not only a mere branch of the empire of the caliphate, but a branch deriving little life from and giving less to the main stock. In 762 there was a rebellion in favour of a descendant of ʻAlī, but it was put down with great severity

by the army of the caliph Manṣūr. A more local ʻAlyite revolt in Mecca and Medina was crushed in 785. In the contest between the two sons of Harūn al Rashīd all Arabia sided with Mamūn (812). In 845-846 the lawless raids of Bedouin tribes compelled the caliph Wāthiq to send his Turkish general Bogha, who was more successful in the north than in the centre and south of Arabia in restoring peace.

The Carmathians.—Towards the close of the 9th century Arabia was disturbed by the rise of a new movement which during the next hundred years dominated the peninsula, and at its close left it shattered never to be united again. In the year 880 Yemen was listening to the propaganda of the new sect of the Carmathians (*q.v.*) or followers of Hamdān Qarmaṭ. Four years later these had become a public force. In 900 ʻAbū Saʻid al-Jannābi, who had been sent to Bahrein by Hamdān, had secured a large part of this province and had won the city of Kaṭif (Ketif) which contained many Jews and Persians. The Arabs who lived more inland were mostly Bedouin who found the obligations of Islam irksome, and do not seem to have made a very vigorous opposition to the Carmathians who took Hajar the capital of Bahrein in 903. From this they made successful attacks on Yemāma (Yamama), and attempts only partially successful at first at Oman. In 906 the court at Bagdad learned that these sectaries had gained almost all Yemen and were threatening Mecca and Medina. Abū Saʻīd was assassinated (913) in his palace at Laḥsa (which in 926 was fortified and became the Carmathian capital of Bahrein). His son Saʻīd succeeded him, but proved too weak and was deposed and succeeded by his brother Abu Ṭāhir. His success was constant and the caliphate was brought very low by him. In Arabia he subjugated Oman, and swooping down on the west in 929 he horrified the Moslem world by capturing Mecca and carrying off the sacred black stone to Bahrein. The Fatimite caliph ʻObaidallah (see Fatimites), to whom Abu Tahir professed allegiance, publicly wrote to him to restore the stone, but there is some reason to believe that he secretly encouraged him to retain it. In 939, however, the stone was restored and pilgrimages to the holy cities were allowed to pass unmolested on payment of a tax. So long as Abū Ṭāhir lived the Carmathians controlled Arabia. After his death, however, they quarrelled with the Fatimite rulers of Egypt (969) and began to lose their influence. In 985 they were completely defeated in Irak, and soon after lost control of the pilgrimages. Oman recovered its independence. Three years later Kaṭīf, at that time their chief city, was besieged and taken by a Bedouin sheik, and subsequently their political power in Arabia came to an end. It was significant that their power fell into the hands of Bedouins. Arabia was now completely disorganized, and was only nominally subject to the caliphate. The attempt of Mahomet to unify Arabia had failed. The country was once more split up into small governments, more or less independent, and groups of wandering tribes carrying on their petty feuds. Of the history of these during the next few centuries little is known, except in the case of the Hejaz. Here the presence of the sacred cities led writers to record their annals (cf. F. Wüstenfeld's *Die Chroniken der Stadt Mekka*, 4 vols., Leipzig, 1857-1861). The two cities were governed by Arabian nobles (*sherīfs*), often at feud with one another, recognizing formally the overlordship of the caliph at Bagdad or the caliph of Egypt. Thus in 966 the name of the caliph Moti was banished from the prayers at Mecca, and an ʻAlyite took possession of the government of the city and recognized the Egyptian caliph as his master. About a century later (1075-1094) the ʻAbbāsid caliph was again recognized as spiritual head owing to the success in arms of his protector, the Seljuk Malik-Shah. With the fall of the Bagdad caliphate all attempts at control from that quarter came to an end. After the visit of the Sultaft Bibars (1269) Mecca was governed by an amir dependent on Egypt. Outside the two cities anarchy prevailed, and the pilgrimage was frequently unsafe owing to marauding Bedouins. In 1517 the Osmānlī Turkish sultan Selim conquered Egypt, and having received the right of succession to the caliphate was solemnly presented by the sherīf of Mecca with the keys of the city, and recognized as the spiritual head of Islam and ruler of the Hejaz. At the same time Yemen, which since the 9th century had been in the power of a number of small dynasties ruling in Zubed, Sanʻā, Saʻda and Aden, passed into the hands of the Turk.

For the history of Yemen during this period cf. H.C. Kay, *Omarah's History of Yaman* (London, 1892), and S. Lane-Poole, *The Mahommedan Dynasties*, pp. 87-103 (Westminster, 1894). Little more than a century later (1630), a Yemen noble Khāṣim succeeded in expelling the Turk and establishing a native imāmate, which lasted until 1871. For descriptions of it in the 18th century cf. C. Niebuhr's accounts of his travels in Arabia in 1761.

Oman.—Since the separation from the caliphate (before 1000 A.D.) Oman had remained independent. For more than a century it was governed by five elected imāms, who were chosen from the tribe of al-Azd and generally lived at Nizwa. After them the Bani Nebhān gained the upper hand and established a succession of kings (*māliks*) who governed from 1154 to 1406. During this time the country was twice invaded by Persians. The "kings of Hormūz" claimed authority over the coast land until the beginning of the 16th century. In 1435 the people rose against the tyranny of the Bani Nebhan and restored the imamate of the tribe al-Azd. In 1508 the Portuguese under Albuquerque seized most of the east coast of Oman. In 1624 a new dynasty arose in the interior, when Nāṣir ibn Murshid of the Yariba (Yaʻaruba) tribe (originally from Yemen) was elected imām and established his capital at Rustak. He was able to subdue the petty princes of the country, and the Portuguese were compelled to give up several towns and pay tribute for their residence at Muscat. About 1651 the Portuguese were finally expelled from this city, and about 1698 from the Omanite settlements on the east coast of Africa.

For the history of Oman from 661 to 1856 cf. G.P. Badger, *History of the Imāms and Seyyids of Oman by Salil-ibn-Razik* (London, Hakluyt Society, 1871).

(G. W. T.)

Wahhābi Movement.—Modern Arabian history begins with that of the Wahhabi movement in the middle of the 18th century. Its originator, Mahommed Ibn Abdul Wahhāb, was born (1691) at Ayana in Nejd, and after studying in Basra and Damascus, and making the pilgrimage to Mecca returned to his native country and settled down at Huremala near Deraiya. The abuses and corruptions which had overgrown the practice of orthodox Islam had deeply impressed him, and he set to work to combat them, and to inculcate on all good Moslems a return to the pure simplicity of their original faith. In 1742 Mahommed Ibn Saud, sheik of Deraiya, accepted his doctrines, and enforced them by his sword with such effect that before his death in 1765 the whole of eastern Nejd and El Hasa was converted to the faith of Abdul Wahhab, and accepted the political supremacy of Ibn Saūd. His son and successor, Abdul Aziz, in a rapid series of successful campaigns, extended his dominion and that of the reformed faith far beyond the limits of Nejd. His attacks on the pilgrim

caravans, begun in 1783 and constantly repeated, startled the Mahommedan world,[2] and compelled the attention of the sultan, as the nominal protector of the faithful. In 1798 a Turkish force was sent from Bagdad into El Hasa, but was compelled to retreat without accomplishing anything, and its discomfiture added much to the renown of the Wahhābi power. In 1801 Saud, son of the amir Abdul Aziz, led an expedition to the Euphrates, and on the festival of Bairam, the 20th of April, stormed Kerbela, put the defenders to the sword, destroyed the sacred tomb, scattered the sacred relics and returned laden with the treasures, accumulated during centuries in the sanctuary of the Shiā faith. Mecca itself was taken; plundering was forbidden, but the tombs of the saints and all objects of veneration were ruthlessly destroyed, and all ceremonies which seemed in the eye of the stern puritan conqueror to suggest the taint of idolatry were forbidden.

On the 14th of October 1802 the amir Abdul Aziz, at the age of eighty-two years, was murdered by a Shiā fanatic when at prayers in the mosque of Deraiya, and Saūd, who had for many years led the Wahhābi armies, became the reigning amir. In 1804 Medina was taken and with its fall all resistance ceased. The Wahhabi empire had now attained its zenith, a settled government was established able to enforce law and order in the desert and in the towns, and a spirit of Arabian nationality had grown up which bade fair to extend the Wahhābi dominion over all the Arab race. It already, however, bore within it the germ of decay; the accumulation of treasure in the capital had led to a corruption of the simple manners of the earlier times; the exhaustion of the tribes through the heavy blood tax had roused discontent among them; the plundering of the holy places, the attacks on the pilgrim caravans under the escort of Turkish soldiers, and finally, in 1810, the desecration of the tomb of Mahomet and the removal of its costly treasures, raised a cry of dismay throughout the Mahommedan world, and made it clear even to the Turkish sultan that unless the Wahhābi power were crushed his claims to the caliphate were at an end.

But Turkey was herself fully occupied by affairs in Europe, and to Mehemet Ali, then pasha of Egypt, was deputed the task of bringing the Wahhābis into subjection. In October 1811 an expedition consisting of 10,000 men under Tusun Pasha, the pasha's son, a youth of sixteen, landed in Hejaz without opposition. Saūd with his main forces had started northwards to attack Bagdad, but returning at once he met and defeated Tusun with great loss and compelled him to retire. Medina and subsequently Mecca were eventually taken by the Egyptians, but in spite of continual reinforcements they could do little more than hold their own in Hejaz. In 1813 Mehemet Ali was compelled to take the field himself with fresh troops, but was unable to achieve any decisive success, and in 1814 Tusun was again defeated beyond Taif. In May 1814 Saud died, and his son, Ābdallah, attempted to negotiate, but Mehemet Ali refused all overtures, and in January 1815 advanced into Nejd, defeated the Wahhābi army and occupied Ras, then the chief town in Kasim. Terms of peace were made, but on the retirement of the Egyptians Ābdallah refused to carry out the conditions agreed on, which included the return of the jewels plundered by his father, and another campaign had to be fought before his submission was obtained. Ibrahim Pasha replaced Tusun in command, and on reaching Arabia in September 1816 his first aim was to gain over the great Bedouin tribes holding the roads between Hejaz and his objective in Nejd; having thus secured his line of advance he pushed on boldly and defeated Abdallah at Wiya, where he put to death all prisoners taken; thence rapidly advancing, with contingents of the friendly Harb and Muter tribes in support of his regular troops, he laid siege to Ras; this place, however, held out and after a four months' siege he was compelled to give up the attack. Leaving it on one side he pushed on eastwards, took Aneza after six days' bombardment and occupied Bureda. Here he waited two months for reinforcements, and with his Bedouin contingent, strengthened by the adhesion of the Āteba and Bani Khālid tribes, advanced on Shakra in Wushm, which fell in January 1818 after a regular siege. After destroying Huremala and massacring its inhabitants, he arrived before Deraiya on the 14th of April 1818. For six months the siege went on with varying fortune, but at last the courage and determination of Ibrahim triumphed, and on the 9th of September, after a heroic resistance, Ābdallah, with a remnant of four hundred men, was compelled to surrender. The Wahhābi leader was soon after sent to Constantinople, where, in spite of Mehemet Ali's intercession, he and the companions who had followed him in his captivity were condemned to death, and after being paraded through the city with ignominy for three days were finally beheaded.

Deraiya was razed to the ground and the principal towns of Nejd were compelled to admit Egyptian garrisons; but though the Arabs saw themselves powerless to stand before disciplined troops, the Egyptians, on the other hand, had to confess that without useless sacrifices they could not retain their hold on the interior.

In 1824 Turki, son of the unfortunate Ābdallah, headed a rising which resulted in the re-establishment of the Wahhābi state with Riad as its new capital; and during the next ten years he consolidated his power, paying tribute to and under the nominal suzerainty of Egypt till his murder in 1834. His son, Fesal, succeeded him, but in 1836 on his refusal to pay tribute an Egyptian force was sent to depose him and he was taken prisoner and sent to Cairo, while a rival claimant, Khalid, was established as amir in Riad. Mehemet Ali and his son Ibrahim Pasha were, however, now committed to their conflict with Turkey for Syria and Asia Minor, and had no troops to spare for the thankless task of holding the Arabian deserts; the garrisons were gradually withdrawn, and in 1842 Fēsal, who had escaped from his prison at Cairo reappeared and was everywhere recognized as amir. The few remaining Egyptian troops were ejected from Riad, and with them all semblance of Egyptian or Turkish rule disappeared from central Arabia.

For a time it looked as if the supremacy of the Wahhābi empire was to be renewed; El Hasa, Harik, Kasim and Asir returned to their allegiance, but over Oman and Yemen Fēsal never re-established his dominion, and the Bahrein sheiks with British support kept their independence.

A rival state had, however, arisen, under Ābdallah Ibn Rashid in Jebel Shammar. Driven into exile owing to a feud between his family and the Ibn Āli, the leading family of the Shammar, Ābdallah came to Riad in 1830, and was favourably received by the amir Turki. In 1834 he was with Fēsal on an expedition against El Hasa when news came of the amir's murder by his cousin Mashārah. By Ābdallah's advice the expedition was abandoned; Fēsal hastened back with all his forces to Riad, and invested the citadel where Masharah had taken refuge, but failed to gain possession of it, until Ābdallah with two companions found his way into the palace, killed Mashārah, and placed Fēsal on the throne of his father. As a reward for his services Ābdallah was appointed governor of Jebel Shammar, and had

Ibn Rashid.

already established himself in Hail when the Egyptian expedition of 1836 removed Fēsal temporarily from Nejd. During the exile of the latter he steadily consolidated his power, extending his influence more especially over the desert tribes, till on Fēsal's return in 1842 he had created a state subject only in name to that of which Riad was the capital.

On the death of Ābdallah in 1843, his son Talāl succeeded. He set himself to work to establish law and order throughout the state, to arrange its finances, and to encourage the settlement in Hail of artificers and merchants from abroad; the building of the citadel and palace commenced by Mehemet Ali, and continued by Ābdallah Ibn Rashid, was completed by Talāl. The town walls were strengthened, new wells dug, gardens planted, mosques and schools built. His uncle Obed, to whom equally with Ābdallah is due the foundation of the Ibn Rashid dynasty, laboured to extend the Shammar boundaries. Khaibar, Tema and Jauf became tributary to Hail.

Though tolerant in religion Talāl was careful to avoid the suspicion of lukewarmness towards the Wahhābi formulas. Luxury in clothing and the use of tobacco were prohibited; attendance at the mosque was enforced: any doubt as to his orthodoxy was silenced by the amount and regularity of the tribute sent by him to Riad. Equally guarded was his attitude to the Turkish authorities; it is not improbable that Talal had also entered into relations with the viceroy of Egypt to ensure his position in case of a collision with the Porte. During his twenty years' reign Jebel Shammar became a model state, where justice and security ruled in a manner before unheard of. Fēsal may well have watched with jealous anxiety the growing strength of his neighbour's state as compared with his own, where all progress was arrested by the deadening tyranny of religious fanaticism.

On the 11th of March 1868 Talāl, smitten with an incurable malady, fell by his own hand and was succeeded by his brother Matāb; after a brief reign he was murdered by his nephews, the elder of whom, Bandar, became amir. Mahommed, the third son of the amir Ābdallah, was at the time absent; with a view of getting his uncle into his power, Bandar invited him to return to Hail, and on his arrival went out to meet him accompanied by Hamud, son of Obed, and a small following. Warned by a hurried sign by Hamud that his life was in danger, Mahommed at once attacked Bandar, stabbed him and took possession of the citadel; a general massacre of all members of the house of Ibn Rashid followed, and next day Mahommed appeared with his cousin Hamud in the market-place of Hail, and announced his assumption of the amirship. A strong and capable ruler, he soon established his authority over all northern and western Nejd, and in 1872 the opportunity arrived for his intervention in the east. In that year Abdallah, who had succeeded Fēsal in Riad in 1867, was deposed, but with the assistance of Mahommed was reinstated; two years later, however, he was again deposed and forced to seek refuge at Hail, from which place he appealed for assistance to the Turkish authorities at Bagdad. Midhat Pasha, then governor-general, seized the occasion of asserting Turkish dominion on the Persian Gulf coast, and in 1875, in spite of British protests, occupied El Hasa and established a new province under the title of Nejd, with its headquarters at Hofuf, of which Ābdallah was appointed governor. This was an event of some importance, as it constituted the first Turkish claim to the sovereignty over Nejd abandoned by Egypt thirty-three years earlier. The Turks did not support their client by advancing into Nejd itself, and he and his rivals were left to fight out their battles among themselves. Turkey was indeed too much occupied by the war with Russia to pay much attention to Arab affairs, though a few years later she attempted to occupy Bahrein by a *coup de main*, which was only frustrated by the action of a British gunboat.

The amir Mahommed.

Owing to the dissensions among the ruling family of Riad, the towns of eastern Nejd gradually reverted to their former condition of independence, but menaced in turn by the growing power of Hail, they formed a coalition under the leadership of Zāmil, sheik of Aneza, and in the spring of 1891, Aneza, Bureda, Shakra, Ras and Riad assembled their contingents to contest with Ibn Rashid the supremacy in Nejd. The latter had besides 20,000 of his own south Shammar tribesmen, the whole strength of the Harb Bedouins, some 10,000 men, and an additional support of 1000 mounted men from his kinsmen, the northern Shammar from the Euphrates, while the Muter and Āteba tribes took part with the allies. The total strength of each side amounted to about 30,000 men. Zāmil's forces held a strong position between Aneza and Bureda, and for over a month desultory fighting went on; finally an attack was made against the defenders' centre, covered by 20,000 camel riders; the men of Aneza broke and the whole allied forces fled in disorder; Zamil and his eldest son were killed, as were also two of the Ibn Saud family, while the remainder were taken prisoners. Aneza and Bureda surrendered the same day, and shortly after Ras, Shakra and Riad tendered their submission.

This victory placed the whole of northern and central Arabia under the supremacy of Mahommed Ibn Rashid, which he held undisputed during the rest of his life.

On his death in 1897 his nephew Abdul-Aziz, son of the murdered amir Matab, succeeded; during his reign a new element has been introduced into Nejd politics by the rising importance of Kuwet (Koweit) and the attempts of Turkey to obtain possession of its important harbour. In 1901 a quarrel arose between Sheik Mubārak of Kuwet and the amir of Hail whose cause was supported by Turkey. A force was equipped at Basra under Ahmad Feizi Pasha with the intention of occupying Kuwet; Mubārak thereupon appealed to Great Britain and action was taken which prevented the Turkish designs from being carried out. Kuwet was not formally placed under British protection, but it was officially announced by the government on the 5th of May 1903 "that the establishment of a naval base or fortified port in the Persian Gulf by any other power would be regarded as a very grave menace to British interests which would certainly be resisted with all the means at its disposal."

Recent history.

In the meantime Sheik Mubārak had found useful allies in the Muntafik Arabs from the lower Euphrates, and the Wahhābis of Riad; the latter under the amir Ibn Saūd marched against Ibn Rashid, who at the instigation of the Porte had again threatened Kuwet (Koweit), compelled him to retire to his own territory and took possession of the towns of Bureda and Aneza. Sheik Mubārak and his allies continued their advance, defeated Ibn Rashid in two engagements on the 22nd of July and the 26th of September 1904, and drove him back on his capital, Hail. The Porte now made another effort to assist its protégé; two columns were despatched from Medina and Basra respectively, to relieve Hail, and drive out the Wahhabis. Ahmad Feizi Pasha, in command of the Basra column, 4200 strong, crossed the desert and reached the wells of Lina, 200

m. from Hail, on the 5th of March 1905; here, however, he received orders to halt and negotiate before proceeding farther. The Turkish government realized by this time the strength of the hostile combination, and in view of the serious state of affairs in Yemen, hesitated to undertake another campaign in the deserts of Nejd. Arrangements were accordingly made with the Wahhābis, and on the 10th of April Ahmad Feizi Pasha left Lina, ostensibly with the object of protecting the pilgrim road, and joined the Medina column by the end of the month. Bureda and Aneza were occupied without opposition, the rebellious sheiks amnestied by the sultan and loaded with gifts, and formal peace was made between the rival factions.

History of European influence.

European influence was not felt in Arabia until the arrival of the Portuguese in the eastern seas, following on the discovery of the Cape route. In 1506 Hormuz was taken by Albuquerque, and Muscat and the coast of Oman (*q.v.*) were occupied by the Portuguese till 1650. In 1516 their fleets appeared in the Red Sea and an unsuccessful attempt was made against Jidda; but the effective occupation of Yemen by the Turks in the next few years frustrated any designs the Portuguese may have had in S.W. Arabia. Even in Oman their hold on the country was limited to Muscat and the adjacent ports, while the interior was ruled by the old Yāriba (Ya-ʿaruba) dynasty from their capital at Rustak. The Persian occupation, which followed that of the Portuguese, came to an end in the middle of the 18th century, when Ahmad Ibn Said expelled the invaders and in 1759 established the Ghafari dynasty which still reigns in Oman. He was succeeded by his son, who in 1798 made a treaty with the East India Company with the object of excluding the French from Oman, and the connexion with Great Britain was further strengthened during the long reign of his grandson Sultan Sāid, 1804-1856. During the earlier years of his reign he was constantly at war with the Wahhābi empire, to which Oman became for a time tributary. The piracies committed by the Jawasimi Arabs in the gulf compelled the intervention of England, and in 1810 their strongholds were destroyed by a British-Indian expedition. The overthrow of the Wahhabis in 1817 restored Sultan Said to independence; he equipped and armed on Western models a fleet built in Indian ports, and took possession of Sokotra and Zanzibar, as well as the Persian coast north of the straits of Hormuz as far east as Gwadur, while by his liberal policy at home Sohar, Barka and Muscat became prosperous commercial ports.

British intervention in Oman.

On his death in 1856 the kingdom was divided, Majīd, a younger son, taking Zanzibar, while the two elder sons contested the succession to Oman. The eldest, Thuwēni, with British support, finally obtained the throne, and in 1862 an engagement was entered into by the French and English governments respecting the independence of the sultans of Oman. He was assassinated in 1866, and his successor, Seyyid Turki, reigned till 1888. On his death several claimants disputed the succession; ultimately his son Fēsal was recognized by the British government, and was granted a subsidy from British-Indian revenues, in consideration of which he engaged not to cede any of his territory without the consent of the British government; similar engagements have been entered into by the tribes who occupy the south coast from the borders of Oman westward to the straits of Bab-el-Mandeb.

British sphere of influence.

The opening of the overland route to India again brought the west coast of Arabia into importance. Aden was occupied by the British in 1839. The Hejaz coast and some of the Yemen ports were still held by Mehemet Ali, as viceroy of Egypt, but on his final withdrawal from Arabia in 1845, Hejaz came under direct Turkish rule, and the conquest of Yemen in 1872 placed the whole Red Sea littoral (with the exception of the Midian coast, ceded by Egypt on the accession of Abbas Hilmi Pasha) under Ottoman administration. The island of Perim at the southern entrance of the Red Sea has been a British possession since 1857, while the promontory of Shekh Said on the Arabian side of the strait is in Turkish occupation. In order to define the limits between Turkish territory and that of the independent Arab tribes in political relations with Great Britain, a joint commission of British and Turkish officers in 1902-1905 laid down a boundary line from Shekh Said to a point on the river Bana, 12 m. north-east of the small town of Kataba, from which it is continued in a north-easterly direction up to the great desert. This delimitation places the whole of southern Arabia, east of this line, within the British sphere of influence, which thus includes the district surrounding Aden (*q.v.*), the Hadramut and Oman with its dependencies.

Turkish rule.

The provinces of Hejaz and Yemen are each administered by a Turkish governor-general, with headquarters at Taif and Sana respectively; the country is nominally divided up into divisions and districts under minor officials, but Turkish rule has never been acquiesced in by the inhabitants, and beyond the larger towns, all of which are held by strong garrisons, Turkish authority hardly exists. The powerful Bedouin tribes of Hejaz have always asserted their independence, and are only kept quiet by the large money payments made them by the sultan on the occasion of the annual pilgrimage to the holy cities. A large part of Asir and northern Yemen has never been visited by Turkish troops, and such revenues as are collected, mainly from vexatious customs and transit duties, are quite insufficient to meet the salaries of the officials, while the troops, ill-fed and their pay indefinitely in arrears, live on the country as best they can.

Yemen revolt.

A serious revolt broke out in Yemen in 1892. A Turkish detachment collecting taxes in the Bani Merwan lands north of Hodeda was destroyed by a body of Arabs. This reverse set all Yemen aflame; under the leadership of the imam, who had, since the Turkish occupation, lived in retirement at Sada, 120 m. north of the capital, the powerful tribes between Asir and Sana advanced southwards, occupied the principal towns and besieged the few Turkish fortified posts that still held out. In many cases the garrisons, Arab troops from Syria, went over to the insurgents. Meanwhile, reinforcements under General Ahmad Feizi Pasha reached Hodeda, Manakha was retaken, Sana relieved, and by the end of January 1893 the country with the exception of the northern mountainous districts was reconquered.

A state of intermittent rebellion, however, continued, and in 1904 a general revolt took place with which the normal garrison of Yemen, the 7th army corps, was quite unable to cope. The military posts were everywhere besieged, and Sana, the capital, was cut off from all communication with the coast. During February 1905 reinforcements were sent up which raised the garrison of Sana to a strength of eight battalions, and in March a further reinforcement of about the same strength arrived, and fought its way into the capital with the loss of almost all its guns and train. The position was then desperate, wholesale desertion

and starvation had decimated the garrison, and three weeks later Ali Riza Pasha, the Turkish commander, was compelled to surrender. The fall of Sana made a deep impression at Constantinople, every effort was made to hasten out reinforcements, the veteran Ahmad Feizi Pasha was nominated to the supreme command, and Anatolian troops in place of the unreliable Syrian element were detailed. The scale of the operations may be judged from the fact that the total number of troops mobilized up to the beginning of July 1905 amounted to 126 battalions, 8 squadrons and 15 batteries; the rebel leader Mahommed Yahiya had at this time a following of 50,000.

By the end of June, Ahmad Feizi Pasha was in a position to advance on Manakha, where he organized an efficient transport, rallied the scattered remnants of Ali Riza's army, and with the newly arrived troops had by the middle of July a force of some 40 battalions available for the advance on Sana. He left Manakha on the 17th of July, and after almost daily fighting reached Sana on the 30th of August; on the 31st he entered the city without serious opposition, the insurgents having retreated northward.

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(R. A. W.)

LITERATURE

The literature of Arabia has its origin in the songs, improvisations, recitations and stories of the pre-Mahommedan Arabs. Of written literature in those days there was, so far as we know, none. But where books failed memory was strong and the power of retaining things heard was not confined to a professional class. At every festive meeting many could contribute a poem or a story, many could even improvise the one or the other. When members of different tribes met in peace (as at the fair of ʿUkāẓ) the most skilful reciters strove to maintain the honour of their own people, and a ready improviser was held in high esteem. The smartest epigrams, the fairest similes, the keenest satires, spoken or sung on such occasions, were treasured in the memory of the hearers and carried by them to their homes. But the experience of all peoples in that memory requires to be helped by form. Sentences became balanced and were made clear by some sort of definite ending. The simplest form of this in Arabian literature is the *saj*ʿ or rhymed prose, in which the sentences are usually (though not always) short and end in a rhyme or assonance. Mahomet used this form in many parts of the Koran (*e.g. Sura*, 81). The next step was the introduction of metre into the body of the sentence and the restriction of the passages to a definite length. This in its simplest form gave rise to the *rajaz* verses, where each half-line ends in the same rhyme and consists of three feet of the measure ⏑ – ⏑ –. Other metres were introduced later until sixteen altogether were recognized. In all forms the rhyme is the same throughout the poem, and is confined to the second half of the line except in the first line where the two halves rhyme. While, however, these measures were in early use, they were not systematically analysed or their rules enunciated until the time of Khalīl ibn Ahmad in the 8th century. Two other features of Arabian poetry are probably connected with the necessity for aiding the memory. The first of these is the requirement that each line should have a complete sense in itself; this produces a certain jerkiness, and often led among the Arabs to displacement in the order of the lines in a long poem. The other feature, peculiar to the long poem (*qasīda*, elegy), is that, whatever its real object, whatever its metre, it has a regular scheme in the arrangement of its material. It begins with a description of the old camping-ground, before which the poet calls on his companion to stop, while he bewails the traces of those who have left for other places. Then he tells of his love and how he had suffered from it, how he had journeyed through the desert (this part often contains some of the most famous descriptions and praises of animals) until his beast became thin and worn-out. Then at last comes the real subject of the poem, usually the panegyric of some man of influence or wealth to whom the poet has come in hope of reward and before whom he recites the poem.

Poetry.—The influence of the poet in pre-Mahommedan days was very great. As his name, *ash-Shā*ʿ*ir*, "the knowing man," indicates, he was supposed to have more than natural knowledge and power. Panegyric and satire (*hijā*ʾ) were his chief instruments. The praise of the tribe in well-chosen verses ennobled it throughout the land, a biting satire was enough to destroy its reputation (cf. I. Goldziher's *Abhandlungen zur arabischen Philologie*, i. pp. 1-105). Before Mahomet the ethics of the Arabs were summed up in *muruwwa* (custom). Hospitality, generosity, personal bravery were the subjects of praise; meanness and cowardice those of satire. The existence of poetry among the northern Arabs was known to the Greeks even in the 4th century (cf. St Nilos in Migne's *Patrologia Graeca*, vol. 79, col. 648, and Sozomen's *Ecclesiastical History*, bk. 6, ch. 38). Women as well as men composed and recited poems before the days of the Prophet (cf. L. Cheikho's *Poetesses of the Jāhiliyya*, in Arabic, Beirut, 1897).

The transmission of early Arabic poetry has been very imperfect. Many of the reciters were slain in battle, and it was not till the 8th to the 10th centuries and even later that the earliest collections of these poems were made. Many have to be recovered from grammars, dictionaries, &c., where single lines or groups of

lines are quoted to illustrate the proper use of words, phrases or idioms. Moreover, many a reciter was not content to declaim the genuine verses of ancient poets, but interpolated some of his own composition, and the change of religion introduced by Islam led to the mutilation of many verses to suit the doctrines of the new creed.[3]

The language of the poems, as of all the best Arabian literature, was that of the desert Arabs of central Arabia; and to use it aright was the ambition of poets and scholars even in the Abbasid period. For the man of the towns its vocabulary was too copious to be easily understood, and in the age of linguistic studies many commentaries were written to explain words and idioms.

Of the pre-Mahommedan poets the most famous were the six whose poems were collected by Asmaʿī about the beginning of the 9th century (ed. W. Ahlwardt, *The Diwans of the Six Ancient Arabic Poets*, London, 1870). Single poems of four of these—Amru-ul-Qais, Ṭarafa, Zuhair and ʿAntara—appear in the Mo'allakat (*q.v.*). The other two were Nābigha (*q.v.*) and ʿAlqama (*q.v.*). But besides these there were many others whose names were famous; such as Taʿabbata Sharran, a popular hero who recites his own adventures with great gusto; his companion Shanfarā, whose fame rests on a fine poem which has been translated into French by de Sacy (in his *Chrestomathie Arabe*) and into English by G. Hughes (London, 1896); Aus ibn Hajar of the Bani Tamin, famous for his descriptions of weapons and hunting scenes (ed. R. Geyer, Vienna, 1892); Ḥātim Tā'i, renowned for his open-handed generosity as well as for his poetry (ed. F. Schulthess, Leipzig, 1897, with German translation); and ʿUrwa ibn ul-Ward of the tribe of ʿAbs, rival of Ḥātim in generosity as well as in poetry (ed. Th. Nöldeke, Göttingen, 1863). Among these early poets are found one Jew of repute, Samau'al (Samuel) ibn Adiyā (cf. Th. Nöldeke's *Beiträge*, pp. 52-86; art. *s.v.* "Samuel ibn Adiya" in *Jewish Encyc.* and authorities there quoted), and some Christians such as ʿAdīʿibn Zaid of Hira, who sang alike of the pleasures of drink and of death (ed. by Louis Cheikho in his *Les Poètes arabes chrétiens*, pp. 439-474, Beirut, 1890; in this work many Arabian poets are considered to be Christian without sufficient reason). One poet, a younger contemporary of Mahomet, has attracted much attention because his poems were religious and he was a monotheist. This is Umayya ibn Abi-ṣ-Ṣalt, a Meccan who did not accept Islam and died in 630. His poems are discussed by F. Schulthess in the *Orientalische Studien* dedicated by Th. Nöldeke, Giessen, 1906, and his relation to Mahomet by E. Power (in the *Mélanges de la faculté orientale de l'université Saint-Joseph*, Beirut, 1906). Mahomet's relation to the poets generally was one of antagonism because of their influence over the Arabs and their devotion to the old religion and customs. Kaʿb ibn Zuhair, however, first condemned to death, then pardoned, later won great favour for himself by writing a panegyric of the Prophet (ed. G. Freytag, Halle, 1823). Another poet, Aʿsha (*q.v.*), followed his example. Labīd (*q.v.*) and Hassān ibn Thābit (*q.v.*) were also contemporary. Among the poetesses of the time Khansa (*q.v.*) is supreme. In the scarcity of poets at this time two others deserve mention; Abū Mihjan, who made peace with Islam in 630 but was exiled for his love of wine, which he celebrated in his verse (ed. L. Abel, Leiden, 1887; cf. C. Landberg's *Primeurs arabes*, 1, Leiden, 1886), and Jarwal ibn Aus, known as al-Ḥuṭaiʿa, a wandering poet whose keen satires led to his imprisonment by Omar (Poems, ed. by I. Goldziher in the *Journal of the German Oriental Society*, vols. 46 and 47).

Had the simplicity and religious severity of the first four caliphs continued in their successors, the fate of poetry would have been hard. Probably little but religious poetry would have been allowed. But the Omayyads (with one exception) were not religious men and, while preserving the outward forms of Islam, allowed full liberty to the pre-Islamic customs of the Arabs and the beliefs and practices of Christians. At the same time the circumstances of the poet's life were altered. Poetry depended on patronage, and that was to be had now chiefly in the court of the caliph and the residences of his governors. Hence the centre of attraction was now the city with its interests, not the desert. Yet the old forms of poetry were kept. The *qasīda* still required the long introduction (see above), which was entirely occupied with the affairs of the desert. Thus poetry became more and more artificial, until in the Abbasid period poets arose who felt themselves strong enough to give up the worn-out forms and adopt others more suitable. The names of three great poets adorn the Omayyad period: Akhtal, Farazdaq and Jarīr were contemporaries (see separate articles). The first was a Christian of the tribe of Taghlib, whose Christianity enabled him to write many verses which would have been impossible to a professing Moslem. Protected by the caliph he employed the old weapons of satire to support them against the "Helpers" and to exalt his own tribe against the Qaisites. Farazdaq of the Bani Tamīm, a good Moslem but loose in morals, lived chiefly in Medina and Kufa, and was renowned for his command of language. Jarīr of another branch of the Bani Tamīm lived in Irak and courted the favour of Ḥajjāj, its governor. His satires were so effective that he is said to have crushed forty-three rivals. His great efforts were against Farazdaq, who was supported by Akhtal (cf. *The Naka'id of Jarīr and al-Farazdaq*, ed. A.A. Bevan, Leiden, 1906 foll.). Among many minor poets one woman is conspicuous. Laila ul-Akhyalīyya (d. 706) was married to a stranger. On the death of her lover in battle, she wrote numerous elegies bewailing him, and so became famous and devoted the rest of her life to the writing of verse. Two poets of the Koreish attained celebrity in Arabia itself at this time. Qais ur-Ruqayyāt was the poet of ʿAbdallah ibn uz-Zubair (Abdallah ibn Zobair) and helped him until circumstances went against him, when he made his peace with the caliph. His poems are chiefly panegyrics and love songs (ed. N. Rhodonakis, Vienna, 1902). ʿUmar ibn Abī Rabīʿa (*c.* 643-719) was a wealthy man, who lived a life of ease in his native town of Mecca, and devoted himself to intrigues and writing love songs (ed. P. Schwarz, Leipzig, 1901-1902). His poems were very popular throughout Arabia. As a dweller in the town he was independent of the old forms of poetry, which controlled all others, but his influence among poets was not great enough to perpetuate the new style. One other short-lived movement of the Omayyad period should be mentioned. The *rajaz* poems (see above) had been a subordinate class generally used for improvisations in pre-Mahommedan times. In the 7th and 8th centuries, however, a group of poets employed them more seriously. The most celebrated of these were ʿAjjāj and his son Ru'ba of the Bani Tamīm (editions by W. Ahlwardt, Berlin, 1903; German trans. of Ru'ba's poems by Ahlwardt, Berlin, 1904).

With the establishment of the Abbasid dynasty, a new epoch in Arabian poetry began. The stereotyped beginning of the *qasīda* had been recognized as antiquated and out of place in city life even in the Omayyad period (cf. Goldziher, *Abhandlungen*, i. 144 ff). This form had been ridiculed but now it lost its hold altogether, and was only employed occasionally by way of direct imitation of the antique. The rise of Persian

influence made itself felt in much the same way as the Norman influence in England by bringing a newer refinement into poetry. Tribal feuds are no longer the main incentives to verse. Individual experiences of life and matters of human interest become more usual subjects. Cynicism, often followed by religion in a poet's later life, is common. The tumultuous mixture of interests and passions to be found in a city like Bagdad are the subjects of a poet's verse. One of the earliest of these poets, Muti' ibn Ayās, shows the new depth of personal feeling and refinement of expression. Bashshār ibn Burd (d. 783), a blind poet of Persian descent, shows the ascendancy of Persian influence as he openly rails at the Arabs and makes clear his own leaning to the Persian religion. In the 8th century Abu Nuwās (*q.v.*) is the greatest poet of his time. His language has the purity of the desert, his morals are those of the city, his universalism is that of the man of the world. Abū-l-'Atāhiya (*q.v.*), his contemporary, is fluent, simple and often didactic. Muslim ibn ul-Walīd (ed. de Goeje, Leiden, 1875), also contemporary, is more conservative of old forms and given to panegyric and satire. In the 9th century two of the best-known poets—Abū Tammām (*q.v.*) and Buḥturī (*q.v.*) —were renowned for their knowledge of old poetry (see Hamasa) and were influenced by it in their own verse. On the other hand Ibn ul-Mo'tazz (son of the caliph) was the writer of brilliant occasional verse, free of all imitation. In the 10th century the centre of interest is in the court of Saif ud-Daula (addaula) at Aleppo. Here in Motanabbī (*q.v.*) the claims of modern poetry not only to equal but to excel the ancient were put forward and in part at any rate recognized. Abū Firās (932-968) was a member of the family of Saif ud-Daula, a soldier whose poems have all the charm that comes from the fact that the writer has lived through the events he narrates (ed. by R. Dvořák, Leiden, 1895). Many Arabian writers count Motanabbi the last of the great poets. Yet Abū-l-'Alā ul-Ma'arrī (*q.v.*) was original alike in his use of rhymes and in the philosophical nature of his poems. Ibn Farīd (*q.v.*) is the greatest of the mystic poets, and Busīri (*q.v.*) wrote the most famous poem extant in praise of the Prophet. In the provinces of the caliphate there were many poets, who, however, seldom produced original work. Spain, however, produced Ibn 'Abdūn (d. 1126), famous for the grace and finish of his style (ed. with commentary of Ibn Badrun by R.P.A. Dozy, Leiden, 1846). The Sicilian Ibn Hamdīs (1048-1132) spent the last fifty years of his life in Spain (*Diwān*, ed. Moaçada, Palermo, 1883; *Canzoniere*, ed. Schiaparelli, Rome, 1897). It was also apparently in this country that the strophe form was first used in Arabic poems (cf. M. Hartmann's *Das arabische Strophengedicht*, Weimar, 1897), and Ibn Quzmān (12th century), a wandering singer, here first used the language of everyday life in the form of verse known as *Zajal*.

Anthologies.—As supplemental to the account of poetry may be mentioned here some of the chief collections of ancient verse, sometimes made for the sake of the poems themselves, sometimes to give a *locus classicus* for usages of grammar or lexicography, sometimes to illustrate ancient manners and customs. The earliest of these is the *Mo'allakat* (*q.v.*). In the 8th century Ibn Mofaddal compiled the collection named after him the *Mofaddalīyāt*. From the 9th century we have the Hamasas of Abū Tammām and Buhturī, and a collection of poems of the tribe Hudhail (second half ed. in part by J.G.L. Kosegarten, London, 1854; completed by J. Wellhausen in *Skizzen und Vorarbeiten*, i. Berlin, 1884). The numerous quotations of Ibn Qutaiba (*q.v.*) in the 'Uyūn ul-Akhbār (ed. C. Brockelmann, Strassburg, 1900 ff.) and the *Book of Poetry and Poets* (ed. M.J. de Goeje, Leiden, 1904) bring these works into this class. In the 10th century were compiled the *Jamharat ash'ar al Arab*, containing forty-nine poems (ed. Būlāq, 1890), the work *al-'Iqd ul-Farīd* of Ibn' Abdi-r-Rabbihi (ed. Cairo, various years), and the greatest work of all this class, the *Kītāb ul-Aghāni* ("Book of Songs") (cf. Abu-l Faraj). The 12th century contributes the *Diwān Mukhtarāt ush-Shu'arā'i* with fifty qasīdas. The *Khizānai ul-Adab* of Abdulqādir, written in the 17th century in the form of a commentary on verses cited in a grammar, contains much old verse (ed. 4 vols., Būlāq, 1882).

Belles-Lettres and Romances.—Mahomet in the Koran had made extensive use of *saj'* or rhymed prose (see above). This form then dropped out of use almost entirely for some time. In the 10th century, however, it was revived, occurring almost simultaneously in the *Sermons* of Ibn Nubāta (946-984) and the *Letters* of Abū Bakr ul-Khwārizmī. Both have been published several times in the East. The epistolary style was further cultivated by Hamadhāni (*q.v.*) and carried to perfection by Abū-l'Alā ul-Ma'arrī. Hamadhīni was also the first to write in this rhymed prose a new form of work, the *Maqāma* ("assembly"). The name arose from the fact that scholars were accustomed to assemble for the purpose of rivalling one another in orations showing their knowledge of Arabic language, proverb and verse. In the *Maqāmas* of Hamadhāni a narrator describes how in various places he met a wandering scholar who in these assemblies puts all his rivals to shame by his eloquence. 273
Each oration forms the substance of a *Maqāma*, while the *Maqāmas* themselves are united to one another by the constant meetings of narrator and scholar. Harīrī (*q.v.*) quite eclipsed the fame of his predecessor in this department, and his *Maqāmas* retain their influence over Arabian literature to the present day. As late as the 19th century the sheik Nāṣīf ul Yāzījī (1800-1871) distinguished himself by writing sixty clever *Maqāmas* in the style of Hariri (ed. Beirut, 1856, 1872). While this class of literature had devoted itself chiefly to the finesses of the language, another set of works was given to meeting the requirements of moral education and the training of a gentleman. This, which is known as "Adab literature," is anecdotic in style with much quotation of early poetry and proverb. Thus government, war, friendship, morality, piety, eloquence, are some of the titles under which Ibn Qutaiba groups his stories and verses in the *'Uyūn ul Akhbār*. *Jāhiz* (*q.v.*) in the 9th century and Baihaqī (*The Kitāb al-Maḥāsin val-Masāwi*, ed. F. Schwally, Giessen, 1900-1902) early in the 10th, wrote works of this class. A little later a Spaniard, Ibn 'Abdrabbihi (Abdi-r-Rabbihi), wrote his *'Iqd ul-Farīd* (see section *Anthologies*). The growth of city life in the Abbasid capital led to the desire for a new form of story, differing from the old tales of desert life. This was met in the first place by borrowing. In the 8th century Ibn Muqaffa', a convert from Mazdaism to Islam, translated the Pahlavi version of Bidpai's fables (itself a version of the Indian *Panchatantra*) into Arabic with the title *Kalīla wa Dimna* (ed. Beirūt, various years). Owing to the purity of its language and style it has remained a classic work. The *Book of the 1001 Nights* (*Arabian Nights*) also has its basis in translations from the Indian through the Persian, made as early as the 9th century. To these stories have been added others originating in Bagdad and Egypt and a few others, which were at first in independent circulation. The whole work seems to have taken its present form (with local variations) about the 13th century. Several other romances of considerable length are extant, such as the *Story of 'Antar* (ed. 32 vols., Cairo, 1869, &c., translated in part by Terrick Hamilton, 4 vols., London, 1820), and the *Story of Saif ibn Dhī Yezen* (ed. Cairo, 1892).

(G. W. T.)

Historical Literature.—Arabian historians differ from all others in the unique form of their compositions.

Each event is related in the words of eye-witnesses or contemporaries transmitted to the final narrator through a chain of intermediate reporters (*rāwīs*), each of whom passed on the original report to his successor. Often the same account is given in two or more slightly divergent forms, which have come down through different chains of reporters. Often, too, one event or one important detail is told in several ways on the basis of several contemporary statements transmitted to the final narrator through distinct lines of tradition. The writer, therefore, exercises no independent criticism except as regards the choice of authorities; for he rejects accounts of which the first author or one of the intermediate links seems to him unworthy of credit, and sometimes he states which of several accounts seems to him the best.

A second type of Arabian historiography is that in which an author combines the different traditions about one occurrence into one continuous narrative, but prefixes a statement as to the lines of authorities used and states which of them he mainly follows. In this case the writer recurs to the first method, already described, only when the different traditions are greatly at variance with one another. In yet a third type of history the old method is entirely forsaken and we have a continuous narrative only occasionally interrupted by citation of the authority for some particular point. But the principle still is that what has been well said once need not be told again in other words. The writer, therefore, keeps as close as he can to the letter of his sources, so that quite a late writer often reproduces the very words of the first narrator.

From very early times story-tellers and singers found their subjects in the doughty deeds of the tribe on its forays, and sometimes in contests with foreign powers and in the impression produced by the wealth and might of the sovereigns of Persia and Constantinople. The appearance of the Prophet with the great changes that ensued, the conquests that made the Arabs lords of half the civilized world, supplied a vast store of new matter for relations which men were never weary of hearing and recounting. They wished to know everything about the apostle of God. Every one who had known or seen him was questioned and was eager to answer. Moreover, the word of God in the Koran left many practical points undecided, and therefore it was of the highest importance to know exactly how the Prophet had spoken and acted in various circumstances. Where could this be better learned than at Medina, where he had lived so long and where the majority of his companions continued to live? So at Medina a school was gradually formed, where the chief part of the traditions about Mahomet and his first successors took a form more or less fixed. Soon men began to assist memory by making notes, and pupils sought to take written jottings of what they had heard from their teachers. Thus by the close of the 1st century many *dictata* were already in circulation. For example, Ḥasan of Baṣra (d. 728 A.D.) had a great mass of such notes, and he was accused of sometimes passing off as oral tradition things he had really drawn from books; for oral tradition was still the one recognized authority, and it is related of more than one old scholar, and even of Hasan of Basra himself, that he directed his books to be burned at his death. The books were mere helps. Long after this date, when all scholars drew mainly from books, the old forms were still kept up. Ṭabarī, for example, when he cites a book expresses himself as if he had heard what he quotes from the master with whom he read the passage or from whose copy he transcribed it. He even expresses himself in this wise: "'Omar b. Shabba has *related* to me in his book on the history of Baṣra." No independent book of the 1st century from the Flight (*i.e.* 622-719) has come down to us. It is told, however, that Moawiya summoned an old man named 'Abid ibn Sharya from Yemen to Damascus to tell him all he knew about ancient history and that he induced him to write down his information. This very likely formed the nucleus of a book which bore the name of that sheik and was much read in the 3rd century from the Flight. It seems to be lost now. But in the 2nd century (719-816) real books began to be composed. The materials were supplied in the first place by oral tradition, in the second by the *dictata* of older scholars, and finally by various kinds of documents, such as treaties, letters, collections of poetry and genealogical lists. Genealogical studies had become necessary through Omar's system of assigning state pensions to certain classes of persons according to their kinship with the Prophet, or their deserts during his lifetime. This subject received much attention even in the 1st century, but books about it were first written in the 2nd, the most famous being those of Ibn al-Kalbī (d. 763), of his son Hishām (d. 819), and of Al-Sharqī ibn al-Quṭāmī. Genealogy, which often called for elucidations, led on to history. Baladhuri's excellent *Ansāb al-Ashrāf* (Genealogies of the Nobles) is a history of the Arabs on a genealogical plan.

The oldest extant history is the biography of the Prophet by Ibn Isḥāq (d. 767). This work is generally trustworthy. Mahomet's life before he appeared as a prophet and the story of his ancestors are indeed mixed with many fables illustrated by spurious verses. But in Ibn Isḥāq's day these fables were generally accepted as history—for many of them had been first related by contemporaries of Mahomet—and no one certainly thought it blameworthy to put pious verses in the mouth of the Prophet's forefathers, though, according to the *Fihrist* (p. 92), Ibn Isḥāq was duped by others with regard to the poems he quotes. The original work of Ibn Isḥāq seems to be lost. That which we possess is an edition of it by Ibn Hishām (d. 834) with additions and omissions (text ed. by F. Wüstenfeld, Göttingen, 1858-1860; German translation by Weil, Stuttgart, 1864).

The *Life* of the Prophet by Ibn Oqba (d. 758), based on the statements of two very trustworthy men, 'Urwa ibn az-Zubair (d. 713) and Az-zuhri (d. 742), was still much read in Syria in the 14th century. Fragments of this have been edited by E. Sachau, Berlin, 1904. We fortunately possess the *Book of the Campaigns* of the Prophet by al-Wāqidī (d. 822) and the important *Book of Classes* of his disciple Ibn Sa'd (*q.v.*). Wāqidī had much more copious materials than Ibn Isḥāq, but gives way much more to a popular and sometimes romancing style of treatment. Nevertheless he sometimes helps us to recognize in Ibn Isḥāq's narrative modifications of the genuine tradition made for a purpose, and the additional details he supplies set various events before us in a clearer light. Apart from this his chief merits lie in his studies on the subject of the traditional authorities, the results of which are given by Ibn Sa'd, and in his chronology, which is often excellent. A special study of the traditions about the conquest of Syria made by M.J. de Goeje in 1864 (*Mémoires sur la conquête de la Syrie*, 2nd ed., Leiden, 1900), led to the conclusion that Waqidi's chronology is sound as regards the main events, and that later historians have gone astray by forsaking his guidance. This result has been confirmed by certain contemporary notices found by Th. Nöldeke in 1874 in a Syriac MS. of the British Museum. And that Ibn Isḥāq agrees with Wāqidī in certain main dates is important evidence for the trustworthiness of the former also. For the chronology before the year 10 of the Flight Wāqidī did his best, but here, the material being defective, many of his conclusions are precarious. Wāqidī had already a

great library at his disposal. He is said to have had 600 chests of books, chiefly *dictata* written by or for himself, but in part real books by Abū Mikhnaf (d. 748), Ibn Isḥāq (whom he uses but does not name), ʻAwāna (d. 764), Abū Mashar (d. 791) and other authors. Abū Mikhnaf left a great number of monographs on the chief events from the death of the Prophet to the caliphate of Walid II. These were much used by later writers, and we have many extracts from them, but none of the works themselves except a sort of romance based on his account of the death of Hosain (Ḥusain) of which Wüstenfeld has given a translation. With regard to the history of Irak in particular he was deemed to have the best information, and for this subject he is Tabari's chief source, just as Madāinī, a younger contemporary of Wāqidī, is followed by preference in all that relates to Khorasan. Madāinī's *History of the Caliphs* is the best, if not the oldest, published before Ṭabarī; but this book is known only by the excerpts given by later writers, particularly Balādhuri and Ṭabarī. From these we judge that he had great narrative power, with much clear and exact learning, and must be placed high as a critical historian. His plan was to record the various traditions about an event, choosing them with critical skill; sometimes, however, he fused the several traditions into a continuous narrative. A just estimate of the relative value of the historians can only be reached by careful comparison in detail. This has been essayed by Brünnow in his study on the Khārijites (Leiden, 1884), in which the narrative of Mubarrad in the Kāmil is compared with the excerpts of Madaini given by Balādhuri and those of Abū Mikhnaf given by Ṭabarī. The conclusion reached is that Abū Mikhnaf and Mādainī are both well informed and impartial.

Among the contemporaries of Wāqidī and Mādainī were Ibn Khidāsh (d. 838), the historian of the family Muhallab, whose work was one of Mubarrad's sources for the *History of the Khārijites*; Haitham ibn ʻAdi (d. 822), whose works, though now lost, are often cited; and Saif ibn ʻOmar at-Tamīmī, whose book on the revolt of the tribes under Abu-Bekr and on the Mahommedan conquests was much used by Ṭabarī. His narratives are detailed and often tinged with romance, and he is certainly much inferior to Wāqidī in accuracy. Wellhausen has thoroughly examined the work of Saif in *Skizzen und Vorarbeiten*, vi. Besides these are to be mentioned Abū ʻUbaida (d. 825), who was celebrated as a philologist and wrote several historical monographs that are often cited, and Azraqī, whose excellent *History of Mecca* was published after his death by his grandson (d. 858). With these writers we pass into the 3rd century of Islam. But we have still an important point to notice in the 2nd century; for in it learned Persians began to take part in the creation of Arabic historical literature. Ibn Muqaffaʻ translated the great *Book of Persian Kings*, and others followed his example. Ṭabarī and his contemporaries, senior and junior, such as Ibn Qutaiba, Yaʻqūbī, Dīnawarī, preserve to us a good part of the information about Persian history made known through such translations.[4] But even more important than the knowledge conveyed by these works was their influence on literary style and composition. Half a century later began versions from the Greek either direct or through the Syriac. The pieces translated were mostly philosophical; but the Arabs also learned something, however superficially, of ancient history.

The 3rd century (816-913) was far more productive than the 2nd. Abū ʻUbaida was succeeded by Ibn al-Aʻrābī (d. 846), who in like manner was chiefly famous as a philologist, and who wrote about ancient poems and battles. Much that he wrote is quoted in Tabrīzī's commentary on the *Ḥamāsa*, which is still richer in extracts from the historical elucidations of early poems given by ar-Riyāshī (d. 871). Of special fame as a genealogist was Ibn Ḥabīb (d. 859), of whom we have a booklet on Arabian tribal names (ed. Wüstenfeld, 1850). Azraqi again was followed by Fākihī, who wrote a *History of Mecca* in 885,[5] and ʻOmar b. Shabba (d. 876), who composed an excellent history of Baṣra, known to us only by excerpts. Of the works of Zubair b. Bakkār (d. 870), one of Ṭabarī's teachers, a learned historian and genealogist much consulted by later writers, there is a fragment in the Köprülü library at Constantinople, and another in Göttingen, part of which has been made known by Wüstenfeld (*Die Familie Al-Zobair*, Göttingen, 1878). Yaʻqūbī (Ibn Wāḍiḥ) wrote a short general history of much value (published by Houtsma, Leiden, 1883). About India he knows more than his predecessors and more than his successors down to Berūnī. Ibn Khordādhbeh's historical works are lost. Ibn ʻAbdalḥakam (d. 871) wrote of the conquest of Egypt and the West. Extracts from this book are given by M'G. de Slane in his *Histoire des Berbères*, from which we gather that it was a medley of true tradition and romance, and must be reckoned, with the book of his slightly senior contemporary, the Spaniard Ibn Ḥābīb, in the class of historical romances. A high place must be assigned to the historian Ibn Qutaiba or Kotaiba (d. 889), who wrote a very useful *Handbook of History* (ed. Wüstenfeld, Göttingen, 1850). Much more eminent is Balādhurī (d. 893), whose book on the Arab conquest (ed. M.J. de Goeje, Leiden, 1865-1866) merits the special praise given to it by Masʻūdī, and who also wrote a large work, the *Ansāb al-Ashrāf*. A contemporary, Ibn abi Tāhir Taifūr (d. 894), wrote on the Abbasid caliphs and was drawn on by Ṭabarī. The sixth part of his work is in the British Museum. The universal history of Dinawari (d. 896), entitled *The Long Narratives*, has been edited by Girgas (1887).

All these histories are more or less thrown into the shade by the great work of Ṭabarī (*q.v.*), whose fame has never faded from his own day to ours. The *Annals* (ed. M. de Goeje, Leiden, 1879-1901) are a general history from the creation to 302 A.H. (= A.D. 915). As a literary composition they do not rank very high, which may be due partly to the author's years, partly to the inequality of his sources, sometimes superabundant, sometimes defective, partly perhaps to the somewhat hasty condensation of his original draft. Nevertheless the value of the book is very great: the author's selection of traditions is usually happy, and the episodes of most importance are treated with most fulness of detail, so that it deserves the high reputation it has enjoyed from the first. This reputation rose steadily; there were twenty copies (one of them written by Tabari's own hand) in the library of the Fatimite caliph ʻAziz (latter half of the 4th century), whereas, when Saladin became lord of Egypt, the princely library contained 1200 copies (Maqrīzī, i. 408 seq.).

The *Annals* soon came to be dealt with in various ways. They were published in shorter form with the omission of the names of authorities and of most of the poems cited; some passages quoted by later writers are not found even in the Leiden edition. On the other hand, some interpolations took place, one in the author's lifetime and perhaps by his own hand. Then many supplements were written, *e.g.* by Ferghānī (not extant) and by Hamadhani (partly preserved in Paris). ʻArīb of Cordova made an abridgment, adding the history of the West and continuing the story to about 975.[6] Ibn Mashkawaih wrote a history from the creation to 980, with the purpose of drawing the lessons of the story, following Ṭabarī closely, as far as his book is known, and seldom recurring to other sources before the reign of Moqtadir; what follows is his own

composition and shows him to be a writer of talent.[7] In 963 an abridgment of the *Annals* was translated into Persian by Balʿamī, who, however, interwove many fables.[8] Ibn al-Athīr (d. 1234) abridged the whole work, usually with judgment, but sometimes too hastily. Though he sometimes glided lightly over difficulties, his work is of service in fixing the text of Ṭabarī. He also furnished a continuation to the year 1224. Later writers took Ṭabarī as their main authority, but sometimes consulted other sources, and so add to our knowledge—especially Ibn al-Jauzī (d. 1201), who adds many important details. These later historians had valuable help from the biographies of famous men and special histories of countries and cities, dynasties and princes, on which much labour was spent from the 4th century from the Flight onwards.

The chief historians after Ṭabarī may be briefly mentioned in chronological order. Rāzī (d. A.D. 932) wrote a *History of Spain*; Eutychius (d. 940) wrote *Annals* (ed. L. Cheikho, Paris, 1906), which are very important because he gives the Christian tradition; Suli (d. 946) wrote on the Abbasid caliphs, their viziers and court poets; Masʿudi (*q.v.*) composed various historical and geographical works (d. 956). Of Ṭabarī's contemporary Hamza Ispahānī (*c.* 940) we have the Annals (ed. Gottwaldt, St Petersburg, 1844); Ibn al-Qūṭīya wrote a *History of Spain*; Ibn Zūlāq (d. 997) a *History of Egypt*; ʿOtbi wrote the *History of Mahmud of Ghazna*, at whose court he lived (printed on the margin of the Egyptian edition of Ibn al-Athīr); Thaʿlabī (d. 1036) wrote a well-known *History of the Old Prophets*; Abu Nuʿaim al-Ispahānī (d. 1039) wrote a *History of Ispahan*, chiefly of the scholars of that city; Thaʿālibī (d. c. 1038) wrote, *inter alia*, a well-known *History of the Poets of his Time*, published at Damascus, 1887; Birūnī (*q.v.*) (d. 1048) takes a high place among historians; Kodaʿī (d. 1062) wrote a *Description of Egypt* and also various historical pieces, of which some are extant; Ibn Sāʿid of Cordova (d. 1070) wrote a *View of the History of the Various Nations*. Bagdad and its learned men found an excellent historian in al-Khātib al-Baghdādī (d. 1071), and Spain in Ibn Hayan (d. 1076), and half a century later in Ibn Khaqān (d. 1135) and Ibn Bassam (d. 1147). Samʿani (d. 1167) wrote an excellent book on genealogies; ʿUmāra (d. 1175) wrote a *History of Yemen* (ed. H.C. Kay, London, 1892); Ibn ʿAsaqir (d. 1176) a *History of Damascus and her Scholars*, which is of great value, and exists in whole or in part in several libraries. The *Biographical Dictionary* of the Spaniard Ibn Pascual (d. 1182) and that of Dabbi, a somewhat junior contemporary, are edited in Codera's *Bibliotheca Arab. Hisp.* (1883-1885); Saladin found his historian in the famous ʿImād uddīn (d. 1201) (Arabic text, ed. C. Landberg, Leiden, 1888). Ibn ul-Jauzī, who died in the same year, has been already mentioned. Abdulwahid's *History of the Almohades*, written in 1224, was published by Dozy (2nd ed., 1881). Abdullatif or Abdallatīf (d. 1232) is known by his writings about Egypt (trans. de Sacy, 1810); Ibn al-Athīr (d. 1233) wrote, in addition to the *Chronicle* already mentioned, a *Biographical Dictionary of Contemporaries of the Prophet*. Qifti (d. 1248) is especially known by his *History of Arabic Philologists*. Sibt ibn al-Jauzi (d. 1256), grandson of the Ibn al-Jauzī already mentioned, wrote a great *Chronicle*, of which much the larger part still exists. Codera has edited (Madrid, 1886) Ibn al-ʿAbbar's (d. 1260) *Biographical Lexicon*, already known by Dozy's excerpts from it. Ibn al-ʿAdīm (d. 1262) is famed for his *History of Aleppo*, and Abu Shama (d. 1267) wrote a well-known *History of Saladin and Nureddin*, taking a great deal from ʿImad uddin. Ibn abī Usaibia (d. 1269) wrote a *History of Physicians*, ed. A. Müller. The *History* of Ibn al-ʿAmīd (d. 1276), better known as Elmacin, was printed by Erpenius in 1625. Ibn Saʿīd al-Maghribī (d. 1274 or 1286) is famous for his histories, but still more for his geographical writings. The noted theologian Nawāwī (*q.v.*; d. 1278) wrote a *Biographical Dictionary of the Worthies of the First Ages of Islam*. Preeminent as a biographer is Ibn Khallikān (*q.v.*; d. 1282), whose much-used work was partly edited by de Slane and completely by Wüstenfeld (1835-1840), and translated into English by the former scholar (4 vols., 1843-1871).

Abu ʿl-Faraj, better known as Bar-Hebraeus (d. 1286), wrote, besides his Syriac *Chronicle*, an Arabic *History of Dynasties* (ed. E. Pocock, Oxford, 1663, Beirut, 1890). Ibn ʿAdharī's *History of Africa and Spain* has been published by Dozy (2 vols., Leiden, 1848-1851), and the *Qartas* of Ibn abī Zarʿ by Tornberg (1843). One of the best-known of Arab writers is Abulfeda (d. 1331) (*q.v.*). Not less famous is the great *Encyclopaedia* of his contemporary Nuwairi (d. 1332), but only extracts from it have been printed. Ibn Sayyid an-Nās (d. 1334) wrote a full biography of the Prophet; Mizzī (d. 1341) an extensive work on the men from whom traditions have been derived. We still possess, nearly complete, the great *Chronicle* of Dhahabī (d. 1347), a very learned biographer and historian. The geographical and historical *Masālik al-Absār* of Ibn Fadlallāh (d. 1348) is known at present by extracts given by Quatremère and Amari. Ibn al-Wardi (d. *c.* 1349), best known by his *Cosmography*, wrote a *Chronicle* which has been printed in Egypt. Ṣafadī (d., 1363) got a great name as a biographer. Yafiʿī (d. 1367) wrote a *Chronicle of Islam* and *Lives of Saints*. Subkī (d. 1369) published *Lives of the Theologians of the Shafi'ite School*. Of Ibn Kathīr's *History* the greatest part is extant. For the history of Spain and the Maghrib the writings of Ibn al-Khatīb (d. 1374) are of acknowledged value. Another history, of which we possess the greater part, is the large work of Ibn al-Furāt (d. 1404). Far superior to all these, however, is the famous Ibn Khaldūn (*q.v.*) (d. 1406). Of the historical works of the famous lexicographer Fairūzabādī (*q.v.*) (d. 1414) only a *Life of the Prophet* remains. Maqrizī (d. 1442) is the subject of a separate article; Ibn Hajar (d. 1448) is best known by his *Biographical Dictionary of Contemporaries of the Prophet*, published in the *Bibliotheca Indica*. Ibn ʿArabshāh (d. 1450) is known by his *History of Timur* (Leeuwarden, 1767). ʿAinī (d. 1451) wrote a *General History*, still extant. Abuʿl-Mahāsin ibn Taghrībirdī (d. 1469) wrote at length on the history of Egypt; the first two parts have been published by Juynboll and Matthes, Leiden, 1855-1861. Flügel has published Ibn Kotlubogha's *Biographies of the Hanifite Jurists*. Ibn Shihna (d. 1485) wrote a *History of Aleppo*. Of Sakhawi we possess a bibliographical work on the historians. The polymath Suyūtī (*q.v.*) (d. 1505) contributed a *History of the Caliphs* and many biographical pieces. Samhūdī's *History of Medina* is known through the excerpts of Wüstenfeld (1861). Ibn Iyās (d. 1524) wrote a *History of Egypt*, and Diarbekri (d. 1559) a *Life of Mahomet*. To these names must be added Maqqari (Makkari) (*q.v.*) and Hajji Khalīfa (*q.v.*) (d. 1658). He made use of European sources, and with him Arabic historiography may be said to cease, though he had some unimportant successors.

A word must be said of the historical romances, the beginnings of which go back to the first centuries of Islam. The interest in all that concerned Mahomet and in the allusions of the Koran to old prophets and races led many professional narrators to choose these subjects. The increasing veneration paid to the Prophet and love for the marvellous soon gave rise to fables about his childhood, his visit to heaven, &c., which have found their way even into sober histories, just as many Jewish legends told by the converted Jew Kaʿb al-Aḥbār and by Wahb ibn Monabbih, and many fables about the old princes of Yemen told by ʿAbīd, are taken as genuine

history (see, however, Mas'ūdī, iv. 88 seq.). A fresh field for romantic legend was found in the history of the victories of Islam, the exploits of the first heroes of the faith, the fortunes of 'Alī and his house. Then, too, history was often expressly forged for party ends. The people accepted all this, and so a romantic tradition sprang up side by side with the historical, and had a literature of its own, the beginnings of which must be placed as early as the 2nd century of the Flight. The oldest specimens still extant are the fables about the conquest of Spain ascribed to Ibn Ḥabīb (d. 852), and those about the conquest of Egypt and the West by Ibn 'Abd al-Hakam (d. 871). In these truth and falsehood are mingled. But most of the extant literature of this kind is, in its present form, much more recent; *e.g.* the *Story of the Death of Hosain* by the pseudo-Abū Mikhnaf (translated by Wüstenfeld); the *Conquest of Syria* by Abu Ismā'īl al-Basri (edited by Nassau Lees, Calcutta, 1854, and discussed by de Goeje, 1864); the pseudo-Waqidi (see Hamaker, *De Expugnatione Memphidis et Alexandriae*, Leiden, 1835); the pseudo-Ibn Qutaiba (see Dozy, *Recherches*); the book ascribed to A'ṣam Kūfī, &c. Further inquiry into the origin of these works is called for, but some of them were plainly directed to stirring up fresh zeal against the Christians. In the 6th century of the Flight some of these books had gained so much authority that they were used as sources, and thus many untruths crept into accepted history.

(M. J. DE G.; G. W. T.)

Geography.—The writing of geographical books naturally began with the description of the Moslem world, and that for practical purposes. Ibn Khordādhbeh, in the middle of the 9th century, wrote a *Book of Roads and Provinces* to give an account of the highways, the posting-stations and the revenues of the provinces. In the same century Ya'qūbī wrote his *Book of Countries*, describing specially the great cities of the empire. A similar work describing the provinces in some detail was that of Qudāma or Kodāma (d. 922). Hamdāni (*q.v.*) was led to write his great geography of Arabia by his love for the ancient history of his land. Muqaddasi (Mokaddasi) at the end of the 10th century was one of the early travellers whose works were founded on their own observation. The study of Ptolemy's geography led to a wider outlook, and the writing of works on geography (*q.v.*) in general. A third class of Arabian geographical works were those written to explain the names of places which occur in the older poets. Such books were written by Bakrī (*q.v.*) and Yāqūt (*q.v.*)[9]

Grammar and Lexicography.—Arab tradition ascribes the first grammatical treatment of the language to Abū-l-Aswad ud-Du'alī (latter half of the 7th century), but the certain beginnings of Arabic grammar are found a hundred years later. The Arabs from early times have always been proud of their language, but its systematic study seems to have arisen from contact with Persian and from the respect for the language of the Koran. In Irāk the two towns of Basra and Kufa produced two rival schools of philologists. Bagdad soon had one of its own (cf. G. Flügel's *Die grammatischen Schulen der Araber*, Leipzig, 1862). Khalīl ibn Aḥmad (718-791), an Arab from Omān, of the school of Basra, was the first to enunciate the laws of Arabic metre and the first to write a dictionary. His pupil Sibawaihi (*q.v.*), a Persian, wrote the grammar known simply as *The Book*, which is generally regarded in the East as authoritative and almost above criticism. Other members of the school of Basra were Abu 'Ubaida (*q.v.*), Asma'ī (*q.v.*), Mubarrad (*q.v.*) and Ibn Duraid (*q.v.*). The school of Kufa claimed to pay more attention to the living language (spoken among the Bedouins) than to written laws of grammar. Among its teachers were Kisā'ī, the tutor of Harūn al-Rashīd's sons, Ibn A'rābi, Ibn as-Sikkīt (d. 857) and Ibn ul-Anbāri (885-939). In the fourth century of Islam the two schools of Kūfa and Basra declined in importance before the increasing power of Bagdad, where Ibn Qutaiba, Ibn Jinnī (941-1002) and others carried on the work, but without the former rivalry of the older schools. Persia from the beginning of the 10th century produced some outstanding students of Arabic. Hamadhāni (d. 932) wrote a book of synonyms (ed. L. Cheikho, Beirut, 1885). Jauharī (*q.v.*) wrote his great dictionary the *Sahāh*. Tha'ālibi (*q.v.*) and Jurjānī (*q.v.*) were almost contemporary, and a little later came Zamakhsharī (*q.v.*), whose philological works are almost as famous as his commentary on the Koran. The most important dictionaries of Arabic are late in origin. The immense work, *Lisān ul Arab* (ed. 20 vols, Būlāq, 1883-1889), was compiled by Ibn Manzūr (1232-1311), the *Qāmūs* by Fairūzābādī, the *Taj ul'Arūs* (ed. 10 vols., Būlāq, 1890), founded on the *Qāmūs*, by Murtadā uz-Zabīdī (1732-1790).

Scientific Literature.—The literature of the various sciences is dealt with elsewhere. It is enough here to mention that such existed, and that it was not indigenous. It was in the early Abbasid period that the scientific works of Greece were translated into Arabic, often through the Syriac, and at the same time the influence of Sanskrit works made itself felt. Astronomy seems in this way to have come chiefly from India. The study of mathematics learned from Greece and India was developed by Arabian writers, who in turn became the teachers of Europe in the 16th century. Medical literature was indebted for its origin to the works of Galen and the medical school of Gondesapur. Many of the Arabian philosophers were also physicians and wrote on medicine. Chemistry proper was not understood, but Arabian writings on alchemy led Europe to it later. So also the literature of the animal world (cf. Damīrī) is not zoological but legendary, and the works on minerals are practical and not scientific. See ARABIAN PHILOSOPHY and historical sections of such scientific articles as ASTRONOMY, &c.

(G. W. T.)

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1 For the general history of the succeeding period see CALIPHATE; EGYPT: *History*, § "Mahommedan."

2 For further details of this period, see Egypt: *History*, "Mahommedan Period," § 8.

3 On the subject of transmission cf. Th. Nöldeke's *Beiträge zur Kenntniss der Poesie der alten Araber* (Hanover, 1804); and W. Ahlwardt's *Bemerkungen über die Aechtheit der alten arabischen Gedickte* (Greifswald, 1872).

4 For details see the introduction to Nöldeke's translation of Tabari's *Geschichte der Perser und Araber zur Zeit der Sasaniden* (Leiden, 1879).

5 Published in excerpt by Wüstenfeld along with Azraqi (Leipzig, 1857-1859).

6 Of this work the Gotha Library has a portion containing 290-320 A.H., of which the part about the West has been printed by Dozy in the Bayan, and the rest was published at Leiden in 1897.

7 A fragment (198-251 A.H.) is printed in de Goeje, *Fragm. Hist. Ar.* (vol. ii., Leiden, 1871).

8 The first part was rendered into French by Dubeux in 1836. There is an excellent French translation by Zotenberg (1874).

9 The chief Arabian geographical works have been edited by M.J. de Goeje in his *Bibliotheca Geographorum*

arabicorum (Leiden, 1874 ff.).

ARABIAN PHILOSOPHY. What is known as "Arabian" philosophy owed to Arabia little more than its name and its language. It was a system of Greek thought, expressed in a Semitic tongue, and modified by Oriental influences, called into existence amongst the Moslem people by the patronage of their more liberal princes, and kept alive by the intrepidity and zeal of a small band of thinkers, who stood suspected and disliked in the eyes of their nation. Their chief claim to the notice of the historian of speculation comes from their warm reception of Greek philosophy when it had been banished from its original soil, and whilst western Europe was still too rude and ignorant to be its home (9th to 12th century).

In the course of that exile the traces of Semitic or Mahommedan influence gradually faded away, and the last of the line of Saracenic thinkers was a truer exponent of the one philosophy which they all professed to teach than the first. The whole movement is little else than a chapter in the history of Aristotelianism. That system of thought, after passing through the minds of those who saw it in the hazy light of an orientalized Platonism, and finding many laborious but narrow-purposed cultivators in the monastic schools of heretical Syria, was then brought into contact with the ideas and mental habits of Islam. But those in whom the two currents converged did not belong to the pure Arab race. Of the so-called Arabian philosophers of the East, al-Fārābī, Ibn-Sīnā and al-Ghazālī were natives of Khorasan, Bokhara and the outlying provinces of north-eastern Persia; whilst al-Kindī, the earliest of them, sprang from Basra, on the Persian Gulf, on the debatable ground between the Semite and the Aryan. In Spain, again, where Ibn-Bājja, Ibn-Tufail and Ibn Rushd rivalled or exceeded the fame of the Eastern schools, the Arabians of pure blood were few, and the Moorish ruling class was deeply intersected by Jewish colonies, and even by the natives of Christian Spain. Thus, alike at Bagdad and at Cordova, Arabian philosophy represents the temporary victory of exotic ideas and of subject races over the theological one-sidedness of Islam, and the illiterate simplicity of the early Saracens.

Origin.

Islam had, it is true, a philosophy of its own among its theologians (see MAHOMMEDAN RELIGION). It was with them that the Moslem theology—the science of the word (*Kalām*)—first came into existence. Its professors, the *Mutākallimun* (known in Hebrew as *Medabberim*, and as *Loquentes* in the Latin versions), may be compared with the scholastic doctors of the Catholic Church. Driven in the first instance to speculation in theology by the needs of their natural reason, they came, in after days, when Greek philosophy had been naturalized in the Caliphate, to adapt its methods and doctrines to the support of their views. They employed a quasi-philosophical method, by which, according to Maimonides, they first reflected how things ought to be in order to support, or at least not contradict, their opinions, and then, when their minds were made up with regard to this imaginary system, declared that the world was no otherwise constituted. The dogmas of creation and providence, of divine omnipotence, chiefly exercised them; and they sought to assert for God an immediate action in the making and the keeping of the world. Space they looked upon as pervaded by atoms possessing no quality or extension, and time was similarly divided into innumerable instants. Each change in the constitution of the atoms is a direct act of the Almighty. When the fire burns, or the water moistens, these terms merely express the habitual connexion which our senses perceive between one thing and another. It is not the man that throws a stone who is its real mover: the supreme agent has for the moment created motion. If a living being die, it is because God has created the attribute of death; and the body remains dead, only because that attribute is unceasingly created. Thus, on the one hand, the object called the cause is denied to have any efficient power to produce the so-called effect; and, on the other hand, the regularities or laws of nature are explained to be direct interferences by the Deity. The supposed uniformity and necessity of causation is only an effect of custom, and may be at any moment rescinded. In this way, by a theory which, according to Averroes, involves the negation of science, the Moslem theologians believed that they had exalted God beyond the limits of the metaphysical and scientific conceptions of law, form and matter; whilst they at the same time stood aloof from the vulgar doctrines, attributing a causality to things. Thus they deemed they had left a clear ground for the possibility of miracles.

But at least one point was common to the theological and the philosophical doctrine. Carrying out, it may be, the principles of the Neo-Platonists, they kept the sanctuary of the Deity securely guarded, and interposed between him and his creatures a spiritual order of potent principles, from the Intelligence, which is the first-born image of the great unity, to the Soul and Nature, which come later in the spiritual rank. Of God the philosophers said we could not tell what He is, but only what He is not. The highest point, beyond which strictly philosophical inquirers did not penetrate, was the active intellect,—a sort of soul of the world in Aristotelian garb—the principle which inspires and regulates the development of humanity, and in which lies the goal of perfection for the human spirit. In theological language the active intellect is described as an angel. The inspirations which the prophet receives by angelic messengers are compared with the irradiation of intellectual light, which the philosopher wins by contemplation of truth and increasing purity of life. But while the theologian incessantly postulated the agency of that God whose nature he deemed beyond the pale of science, the philosopher, following a purely human and natural aim, directed his efforts to the gradual elevation of his part of reason from its unformed state, and to its final union with the controlling intellect which moves and draws to itself the spirits of those who prepare themselves for its influences. The philosophers in their way, like the mystics of Persia (the Sufites) in another, tended towards a theory of the communion of man with the spiritual world, which may be considered a protest against the practical and almost prosaic definiteness of the creed of Mahomet.

Arabian philosophy, at the outset of its career in the 9th century, was able without difficulty to take possession of those resources for speculative thought which the Latins had barely achieved at the close of the 12th century by the slow process of rediscovering the Aristotelian logic from the commentaries and verses of Boëtius. What the Latins painfully accomplished, owing to their fragmentary and unintelligent acquaintance

with ancient philosophy, was already done for the Arabians by the scholars of Syria. In the early centuries of the Christian era, both within and without the ranks of the church, the Platonic tone and method were paramount throughout the East. Their influence was felt in the creeds which formulated the orthodox dogmas in regard to the Trinity and the Incarnation. But in its later days the Neo-Platonist school came more and more to find in Aristotle the best exponent and interpreter of the philosopher whom they thought divine. It was in this spirit that Porphyry, Themistius and Joannes Philoponus composed their commentaries on the treatises of the Peripatetic system which, modified often unconsciously by the dominant ideas of its expositors, became in the 6th and 7th centuries the philosophy of the Eastern Church. But the instrument which, in the hands of John of Damascus (Damascenus), was made subservient to theological interests, became in the hands of others a dissolvent of the doctrines which had been reduced to shape under the prevalence of the elder Platonism. Peripatetic studies became the source of heresies; and conversely, the heretical sects prosecuted the study of Aristotle with peculiar zeal. The church of the Nestorians, and that of the Monophysites, in their several schools and monasteries, carried on from the 5th to the 8th century the study of the earlier part of the Organon, with almost the same means, purposes and results as were found among the Latin schoolmen of the earlier centuries. Up to the time when the religious zeal of the emperor Zeno put a stop to the Nestorian school at Edessa, this “Athens of Syria” was active in translating and popularizing the Aristotelian logic. Their banishment from Edessa in 489 drove the Nestorian scholars to Persia, where the Sassanid rulers gave them a welcome; and there they continued their labours on the Organon. A new seminary of logic and theology sprang up at Nisibis, not far from the old locality; and at Gandisapora (or Nishapur), in the east of Persia, there arose a medical school, whence Greek medicine, and in its company Greek science and philosophy, ere long spread over the lands of Iran. Meanwhile the Monophysites had followed in the steps of the Nestorians, multiplying Syriac versions of the logical and medical science of the Greeks. Their school at Resaina is known from the name of Sergius, one of the first of these translators, in the days of Justinian; and from their monasteries at Kinnesrin (Chalcis) issued numerous versions of the introductory treatises of the Aristotelian logic. To the Isagoge of Porphyry, the Categories and the Hermeneutica of Aristotle, the labours of these Syrian schoolmen were confined. These they expounded, translated, epitomized and made the basis of their compilations, and the few who were bold enough to attempt the Analytics seem to have left their task unaccomplished.

The energy of the Monophysites, however, began to sink with the rise of the Moslem empire; and when philosophy revived amongst them in the 13th century, in the person of Gregorius Bat-Hebraeus (Abulfaragius) (1226-1286), the revival was due to the example and influence of the Arabian thinkers. It was otherwise with the Nestorians. Gaining by means of their professional skill as physicians a high rank in the society of the Moslem world, the Nestorian scholars soon made Bagdad familiar with the knowledge of Greek philosophy and science which they possessed. But the narrow limits of the Syrian studies, which added to a scanty knowledge of Aristotle some acquaintance with his Syrian commentators, were soon passed by the curiosity and zeal of the students in the Caliphate. During the 8th and 9th centuries, rough but generally faithful versions of Aristotle’s principal works were made into Syriac, and then from the Syriac into Arabic. The names of some of these translators, such as Johannitius (Hunain ibn-Ishāq), were heard even in the Latin schools. By the labours of Hunain and his family the great body of Greek science, medical, astronomical and mathematical, became accessible to the Arab-speaking races. But for the next three centuries fresh versions, both of the philosopher and of his commentators, continued to succeed each other.

To the Arabians Aristotle represented and summed up Greek philosophy, even as Galen became to them the code of Greek medicine. They adopted the doctrine and system which the progress of human affairs had made the intellectual aliment of their Syrian guides. From first to last Arabian philosophers made no claim to originality; their aim was merely to propagate the truth of Peripateticism as it had been delivered to them. It was with them that the deification of Aristotle began; and from them the belief that in him human intelligence had reached its limit passed to the later schoolmen (see Scholasticism). The progress amongst the Arabians on this side lies in a closer adherence to their text, a nearer approach to the bare exegesis of their author, and an increasing emancipation from control by the tenets of the popular religion.

Under the Caliphate.

Secular philosophy found its first entrance amongst the Saracens in the days of the early caliphs of the Abbasid dynasty, whose ways and thoughts had been moulded by their residence in Persia amid the influences of an older creed, and of ideas which had in the last resort sprung from the Greeks. The seat of empire had been transferred to Bagdad, on the highway of Oriental commerce; and the distant Khorasan became the favourite province of the caliph. Then was inaugurated the period of Persian supremacy, during which Islam was laid open to the full current of alien ideas and culture. The incitement came, however, not from the people, but from the prince: it was in the light of court favour that the colleges of Bagdad and Nishapur first came to attract students from every quarter, from the valleys of Andalusia as well as the upland plains of Transoxiana. Mansūr, the second of the Abbasids, encouraged the appropriation of Greek science; but it was al-Ma’mūn, the son of Harūn al-Rashīd, who deserves in the Mahommedan empire the same position of royal founder and benefactor which is held by Charlemagne in the history of the Latin schools. In his reign (813-833) Aristotle was first translated into Arabic. Orthodox Moslems, however, distrusted the course on which their chief had entered, and his philosophical proclivities became one ground for doubting as to his final salvation.

In the eastern provinces the chief names of Arabian philosophy are those known to the Latin schoolmen as Alkindius, Aliarabius, Avicenna and Algazel, or under forms resembling these. The first of these, Alkindius (*see* Kindi), flourished at the court of Bagdad in the first half of the 9th century. His claims to notice at the present day rest upon a few works on medicine, theology, music and natural science. With him begins that encyclopaedic character—the simultaneous cultivation of the whole field of investigation which is reflected from Aristotle on the Arabian school. In him too is found the union of Platonism and Aristotelianism expressed in Neo-Platonic terms. Towards the close of the 10th century the presentation of an entire scheme of knowledge, beginning with logic and mathematics, and ascending through the various departments of physical inquiry to the region of religious doctrine, was accomplished by a society which had its chief seat at Basra, the native town of al-Kindi. This society—the Brothers of Purity or Sincerity (Ikhwān us Safā’i)—divided into four orders, wrought in the interests of religion no less than of science; and though its attempt to

compile an encyclopaedia of existing knowledge may have been premature, it yet contributed to spread abroad a desire for further information. The proposed reconciliation between science and faith was not accomplished, because the compromise could please neither party. The fifty-one treatises of which this encyclopaedia consists are interspersed with apologues in true Oriental style, and the idea of goodness, of moral perfection, is as prominent an end in every discourse as it was in the alleged dream of al-Maʿmūn. The materials of the work come chiefly from Aristotle, but they are conceived in a Platonizing spirit, which places as the bond of all things a universal soul of the world with its partial or fragmentary souls. Contemporary with this semi-religious and semi-philosophical society lived Alfarabius (see Farābī), who died in 950. His paraphrases of Aristotle formed the basis on which Avicenna constructed his system, and his logical treatises produced a permanent effect on the logic of the Latin scholars. He gave the tone and direction to nearly all subsequent speculations among the Arabians. His order and enumeration of the principles of being, his doctrine of the double aspect of intellect, and of the perfect beatitude which consists in the aggregation of noble minds when they are delivered from the separating barriers of individual bodies, present at least in germ the characteristic theory of Averroes. But al-Farābī was not always consistent in his views; a certain sobriety checked his speculative flights, and although holding that the true perfection of man is reached in this life by the elevation of the intellectual nature, he came towards the close to think the separate existence of intellect no better than a delusion.

Avicenna.

Unquestionably the most illustrious name amongst the Oriental Moslems was Avicenna (980-1037). His rank in the medieval world as a philosopher was far beneath his fame as a physician. Still, the logic of Albertus Magnus and succeeding doctors was largely indebted to him for its formulae. In logic Avicenna starts from distinguishing between the isolated concept and the judgment or assertion; from which two primitive elements of knowledge there is artificially generated a complete and scientific knowledge by the two processes of definition and syllogism. But the chief interest for the history of logic belongs to his doctrine in so far as it bears upon the nature and function of abstract ideas. The question had been suggested alike to East and West by Porphyry, and the Arabians were the first to approach the full statement of the problem. Farābī had pointed out that the universal and individual are not distinguished from each other as understanding from the senses, but that both universal and individual are in one respect intellectual, just as in another connexion they play a part in perception. He had distinguished the universal essence in its abstract nature, from the universal considered in relation to a number of singulars. These suggestions formed the basis of Avicenna's doctrine. The essences or forms—the *intelligibilia* which constitute the world of real knowledge—may be looked at in themselves (metaphysically), or as embodied in the things of sense (physically), or as expressing the processes of thought (logically). The first of these three points of view deals with the form or idea as self-contained in the principles of its own being, apart from those connexions and distinctions which it receives in real (sensuous) science, and through the act of intellect. Secondly, the form may be looked at as the similarity evolved by a process of comparison, as the work of mental reflection, and in that way as essentially expressing a relation. When thus considered as the common features derived by examination from singular instances, it becomes a universal or common term strictly so called. It is intellect which first makes the abstract idea a true universal. *Intellectus in formis agit universalitatem.* In the third place, the form or essence may be looked upon as embodied in outward things (*in singularibus propriis*), and thus it is the type more or less represented by the members of a natural kind. It is the designation of these outward things which forms the "first intention" of names; and it is only at a later stage, when thought comes to observe its own modes, that names, looked upon as predicables and universals, are taken in their "second intention." Logic deals with such second intentions. It does not consider the forms *ante multiplicitatem*, *i.e.* as eternal ideas—nor in *multiplicitate*, *i.e.* as immersed in the matter of the phenomenal world—but *post multiplicitatem*, *i. e.* as they exist in and for the intellect which has examined and compared. Logic does not come in contact with things, except as they are subject to modification by intellectual forms. In other words, universality, individuality and speciality are all equally modes of our comprehension or notion; their meaning consists in their setting forth the relations attaching to any object of our conception. In the mind, *e.g.*, one form may be placed in reference to a multitude of things, and as thus related will be universal. The form animal, *e.g.*, is an abstract intelligible or metaphysical idea. When an act of thought employs it as a schema to unify several species, it acquires its logical aspect (*respectus*) of generality; and the various living beings qualified to have the name animal applied to them constitute the natural class or kind. Avicenna's view of the universal may be compared with that of Abelard, which calls it "that whose nature it is to be predicated of several," as if the generality became explicit only in the act of predication, in the *sermo* or proposition, and not in the abstract, unrelated form or essence. The three modes of the universal before things, in things, and after things, spring from Arabian influence, but depart somewhat from his standpoint.

The place of Avicenna amongst Moslem philosophers is seen in the fact that Shahrastānī takes him as the type of all, and that Ghazālī's attack against philosophy is in reality almost entirely directed against Avicenna. His system is in the main a codification of Aristotle modified by fundamental views of Neo-Platonist origin, and it tends to be a compromise with theology. In order, for example, to maintain the necessity of creation, he taught that all things except God were admissible or possible in their own nature, but that certain of them were rendered necessary by the act of the creative first agent,—in other words, that the possible could be transformed into the necessary. Avicenna's theory of the process of knowledge is an interesting part of his doctrine. Man has a rational soul, one face of which is turned towards the body, and, by the help of the higher aspect, acts as practical understanding; the other face lies open to the reception and acquisition of the intelligible forms, and its aim is to become a reasonable world, reproducing the forms of the universe and their intelligible order. In man there is only the susceptibility to reason, which is sustained and helped by the light of the active intellect. Man may prepare himself for this influx by removing the obstacles which prevent the union of the intellect with the human vessel destined for its reception. The stages of this process to the acquisition of mind are generally enumerated by Avicenna as four; in this part he follows not Aristotle, but the Greek commentator. The first stage is that of the hylic or material intellect, a state of mere potentiality, like that of a child for writing, before he has ever put pen to paper. The second stage is called *in habitu*; it is compared to the case of a child that has learned the elements of writing, when the bare possibility is on the way to be developed, and is seen to be real. In this period of half-trained reason, it appears as happy

conjecture, not yet transformed into art or science proper. When the power of writing has been actualized, we have a parallel to the *intellectus in actu*—the way of science and demonstration is entered. And when writing has been made a permanent accomplishment, or lasting property of the subject, to be taken up at will, it corresponds to the *intellectus adeptus*—the complete mastery of science. The whole process may be compared to the gradual illumination of a body naturally capable of receiving light. There are, however, grades of susceptibility to the active intellect, *i.e.* in theological language, to communication with God and his angels. Sometimes the receptivity is so vigorous in its affinity, that without teaching it rises at one step to the vision of truth, by a certain "holy force" above ordinary measure. (In this way philosophy tried to account for the phenomenon of prophecy, one of the ruling ideas of Islam.) But the active intellect is not merely influential on human souls. It is the universal giver of forms in the world.

In several points Avicenna endeavoured to give a *rationale* of theological dogmas, particularly of prophetic rule, of miracles, divine providence and immortality. The permanence of individual souls he supports by arguments borrowed from those of Plato. The existence of a prophet is shown to be a corollary from a belief in God as a moral governor, and the phenomena of miracles are required to evidence the genuineness of the prophetic mission. Thus Avicenna, like his predecessors, tried to harmonize the abstract forms of philosphy with the religious faith of his nation. But his arguments are generally vitiated by the fallacy of assuming what they profess to prove. His failure is made obvious by the attack of Ghazali on the tendencies and results of speculation.

Ghazālī.

To Ghazālī (*q.v.*) it seemed that the study of secular philosophy had resulted in a general indifference to religion, and that the scepticism which concealed itself under a pretence of piety was destroying the life and purity of the nation. With these views he carried into the fields of philosophy the aims and spirit of the Moslem theologian. His restless life was the reflex of a mental history disturbed by prolonged agitation. Revolting, in the height of his success, against the current creed, he began to examine the foundations of knowledge. The senses are contradicted by one another, and disproved by reason. Reason, indeed, professes to furnish us with necessary truths; but what assurance have we that the verdicts of reason may not be reversed by some higher authority? Ghazālī then interrogated all the sects in succession to learn their criterion of truth. He first applied to the theological schoolmen, who grounded their religion on reason; but their aim was only to preserve the faith from heresy. He turned to the philosophers, and examined the accepted Aristotelianism in a treatise which has come down to us—*The Destruction of the Philosophers*. He assails them on twenty points of their mixed physical and metaphysical peripateticism, from the statement of which, in spite of his pretended scepticism, we can deduce some very positive metaphysical opinions of his own. He claims to have shown that the dogmas of the eternity of matter and the permanence of the world are false; that their description of the Deity as the demiurgos is unspiritual; that they fail to prove the existence, the unity, the simplicity, the incorporeality or the knowledge (both of species and accidents) of God; that their ascription of souls to the celestial spheres is unproved; that their theory of causation, which attributes effects to the very natures of the causes, is false, for that all actions and events are to be ascribed to the Deity; and, finally, that they cannot establish the spirituality of the soul, nor prove its mortality. These criticisms disclose nothing like a sceptical state of mind, but rather a reversion from the metaphysical to the theological stage of thought. He denies the intrinsic tendencies, or souls, by which the Aristotelians explained the motion of the spheres, because he ascribes their motion to God. The sceptic would have denied both. G.H. Lewes censures Renan for asserting of Ghazālī's theory of causation —"*Hume n'a rien dit plus*." It is true that Ghazālī maintains that the natural law according to which effects proceed inevitably from their causes is only custom, and that there is no *necessary* connexion between them. But while Hume absolutely denies the necessity, Ghazālī merely removes it one stage farther back, and plants it in the mind of the Deity. This, of course, is not metaphysics, but theology. Having, as he believed, refuted the opinions of the philosophers, he next investigated the pretensions of the Allegorists, who derived their doctrines from an imam. These Arabian ultramontanes had no word for the doubter. They could not, he says, even understand the problems they sought to resolve by the assumption of infallibility, and he turned again, in his despair, to the instructors of his youth—the Sūfīs. In their mystical intuition of the laws of life, and absorption in the immanent Deity, he at last found peace. This shows the true character of the treatise which, alike in medieval and modern times, has been quoted as containing an exposition of his opinions. The work called *The Tendencies of the Philosophers*, translated in 1506, with the title *Logica et Philosophia Algazelis Arabis*, contains neither the logic nor the philosophy of Ghazālī. It is a mere abstract or statement of the Peripatetic systems, and was made preliminary to that *Destruction* of which we have already spoken.

This indictment against liberal thought from the standpoint of the theological school was afterwards answered in Spain by Averroes; but in Bagdad it heralded the extinction of the light of philosophy. Moderate and compliant with the popular religion as Alfarabius and Avicenna had always been, as compared with their Spanish successor, they had equally failed to conciliate the popular spirit, and were classed in the same category with the heretic or the member of an immoral sect. The 12th century exhibits the decay of liberal intellectual activity in the Caliphate, and the gradual ascendancy of Turkish races animated with all the intolerance of semi-barbarian proselytes to the Mahommedan faith. Philosophy, which had only sprung up when the purely Arabian influences ceased to predominate, came to an end when the sceptre of the Moslem world passed away from the dynasty of Persia. Even in 1150 Bagdad had seen a library of philosophical books burned by command of the caliph Mostanjid; and in 1192 the same place might have witnessed a strange scene, in which the books of a physician were first publicly cursed, and then committed to the flames, while their owner was incarcerated. Thus, while the Latin church showed a marvellous receptivity for ethnic philosophy, and assimilated doctrines which it had at an earlier date declared impious, in Islam the theological system entrenched itself towards the end of the 12th century in the narrow orthodoxy of the Asharites, and reduced the votaries of Greek philosophy to silence.

In Spain.

The same phenomena were repeated in Spain under the Mahommedan rulers of Andalusia and Morocco, with this difference, that the time of philosophical development was shorter, and the heights to which Spanish thinkers soared were greater. The reign of al-Hakam the Second (961-976) inaugurated in Andalusia those scientific and philosophical studies which were simultaneously prosecuted by the Society of Basra. From Cairo, Bagdad, Damascus and

Alexandria, books both old and new were procured at any price for the library of the prince; twenty-seven free schools were opened in Cordova for the education of the poor; and intelligent knowledge was perhaps more widely diffused in Mahommedan Spain than in any other part of Europe at that day. The mosques of the city were filled with crowds who listened to lectures on science and literature, law and religion. But the future glory thus promised was long postponed. The usurping successor of Hakam found it a politic step to request the most notable doctors of the sacred law to examine the royal library; and every book treating of philosophy, astronomy and other forbidden topics was condemned to the flames. But the spirit of research, fostered by the fusion of races and the social and intellectual competition thus engendered, was not crushed by these proceedings; and for the next century and more the higher minds of Spain found in Damascus and Bagdad the intellectual aliment which they desired. At last, towards the close of the 11th century, the long-pent spiritual energies of Mahommedan Spain burst forth in a brief series of illustrious men. Whilst the native Spaniards were narrowing the limits of the Moorish kingdoms, and whilst the generally fanatical dynasty of the Almohades might have been expected to repress speculation, the century preceding the close of Mahommedan sway saw philosophy cultivated by Avempace, Abubacer and Averroes. Even amongst the Almohades there were princes, such as Yusūf (who began his reign in 1163) and Yaqūb Almansūr (who succeeded in 1184), who welcomed the philosopher at their courts and treated him as an intellectual compeer. But about 1195 the old distrust of philosophy revived; the philosophers were banished in disgrace; works on philosophical topics were ordered to be confiscated and burned; and the son of Almansūr condemned a certain Ibn-Habīb to death for the crime of philosophizing.

Arabian speculation in Spain was heralded by Avicebron or Ibn Gabirol (*q.v.*), a Jewish philosopher (1021-1058). About a generation later the rank of Moslem thinkers was introduced by Abū-Bakr Muhammad ibn Yahya, surnamed Ibn-Bājja, and known to the Latin world as Avempace. He was born at Saragossa, and died comparatively young at Fez in 1138. Besides commenting on various physical treatises of Aristotle's, he wrote some philosophical essays, notably one on the *Republic or Régime of the Solitary*, understanding by that the organized system of rules, by obedience to which the individual may rise from the mere life of the senses to the perception of pure intelligible principles and may participate in the divine thought which sustains the world. These rules for the individual are but the image or reflex of the political organization of the perfect or ideal state; and the man who strives to lead this life is called the *solitary*, not because he withdraws from society, but because, while in it, he guides himself by reference to a higher state, an ideal society. Avempace does not develop at any length this curious Platonic idea of the perfect state. His object is to discover the highest end of human life, and with this view he classifies the various activities of the human soul, rejects such as are material or animal, and then analyses the various spiritual forms to which the activities may be directed. He points out the graduated scale of such forms, through which the soul may rise, and shows that none are final or complete in themselves, except the pure intelligible forms, the ideas of ideas. These the intellect can grasp, and in so doing it becomes what he calls *intellectus acquisitus*, and is in a measure divine. This self-consciousness of pure reason is the highest object of human activity, and is to be attained by the speculative method. The intellect has in itself power to know ultimate truth and intelligence, and does not require a mystical illumination as Ghazālī taught. Avempace's principles, it is clear, lead directly to the Averroistic doctrine of the unity of intellect, but the obscurity and incompleteness of the Regime do not permit us to judge how far he anticipated the later thinker. (See Munk, *Mélanges de phil. juive et arabe*, pp. 383-410.)

Avempace.

The same theme was developed by Ibn.-Ṭufail (*q.v.*) in his philosophical romance, called *Hayy ibn-Yakdhān* (the Living, Son of the Waking One), best known by Pococke's Latin version, as the *Philosophus Autodidactus*. It describes the process by which an isolated truth-seeker detaches himself from his lower passions, and raises himself above the material earth and the orbs of heaven to the forms which are the source of their movement, until he arrives at a union with the supreme intellect. The experiences of the religious mystic are paralleled with the ecstatic vision in which the philosophical hermit sees a world of pure intelligences, where birth and decease are unknown. It was this theory which Averroes (1126-1198), the last and most famous of the thinkers of Moslem Spain, carried out to his doctrine of the unity of intellect.

For Aristotle the reverence of Averroes was unbounded, and to expound him was his chosen task. The uncritical receptivity of his age, the defects of the Arabic versions, the emphatic theism of his creed, and the rationalizing mysticism of some Oriental thought, may have sometimes led him astray, and given prominence to the less obvious features of Aristotelianism. But in his conception of the relation between philosophy and religion, Averroes had a light which the Latins were without. The science, falsely so called, of the several theological schools, their groundless distinctions and sophistical demonstrations, he regarded as the great source of heresy and scepticism. The allegorical interpretations and metaphysics which had been imported into religion had taken men's minds away from the plain sense of the Koran. God had declared a truth meet for all men, which needed no intellectual superiority to understand, in a tongue which each human soul could apprehend. Accordingly, the expositors of religious metaphysics, Ghazālī included, are the enemies of true religion, because they make it a mere matter of syllogism. Averroes maintains that a return must be made to the words and teaching of the prophet; that science must not expend itself in dogmatizing on the metaphysical consequences of fragments of doctrine for popular acceptance, but must proceed to reflect upon and examine the existing things of the world. Averroes, at the same time, condemns the attempts of those who tried to give demonstrative science where the mind was not capable of more than rhetoric: they harm religion by their mere negations, destroying an old sensuous creed, but cannot build up a higher and intellectual faith.

Averroes.

In this spirit Averroes does not allow the fancied needs of theological reasoning to interfere with his study of Aristotle, whom he simply interprets as a truth-seeker. The points by which he told on Europe were all implicit in Aristotle, but Averroes set in relief what the original had left obscure, and emphasized things which the Christian theologian passed by or misconceived. Thus Averroes had a double effect. He was the great interpreter of Aristotle to the later Schoolmen. On the other hand, he came to represent those aspects of Peripateticism most alien to the spirit of Christendom; and the deeply religious Moslem gave his name to the anti-sacerdotal party, to the materialists, sceptics and atheists, who defied or undermined the dominant beliefs of the church.

On three points Averroes, like other Moslem thinkers, came specially into relation, real or supposed, with the religious creed, viz. the creation of the world, the divine knowledge of particular things, and the future of the human soul.

The real grandeur of Averroes is seen in his resolute prosecution of the standpoint of science in matters of this world, and in his recognition that religion is not a branch of knowledge to be reduced to propositions and systems of dogma, but a personal and inward power, an individual truth which stands distinct from, but not contradictory to, the universalities of scientific law. In his science he followed the Greeks, and to the Schoolmen he and his compatriots rightly seemed philosophers of the ancient world. He maintained alike the claim of demonstrative science with its generalities for the few who could live in that ethereal world, and the claim of religion for all—the common life of each soul as an individual and personal consciousness. But theology, or the mixture of the two, he regarded as a source of evil to both—fostering the vain belief in a hostility of philosophers to religion, and meanwhile corrupting religion by a pseudo-science.

The latent nominalism of Aristotle only came gradually to be emphasized through the prominence which Christianity gave to the individual life, and, apart from passing notices as in Abelard, first found clear enunciation in the school of Duns Scotus. The Arabians, on the contrary, emphasized the idealist aspect which had been adopted and promoted by the Neo-Platonist commentators. Hence, to Averroes the eternity of the world finds its true expression in the eternity of God. The ceaseless movement of growth and change, which presents matter in form after form as a continual search after a finality which in time and movement is not and cannot be reached, represents only the aspect the world shows to the physicist and to the senses. In the eye of reason the full fruition of this desired finality is already and always attained; the actualization, invisible to the senses, is achieved now and ever, and is thus beyond the element of time. This transcendent or abstract being is that which the world of nature is always seeking. He is thought or intellect, the actuality, of which movement is but the fragmentary attainment in successive instants of time. Such a mind is not in the theological sense a creator, yet the onward movement is not the same as what some modern thinkers seem to mean by development. For the perfect and absolute, the consummation of movement is not generated at any point in the process; it is an ideal end, which guides the operations of nature, and does not wait upon them for its achievement. God is the unchanging essence of the movement, and therefore its eternal cause.

A special application of this relation between the prior perfect, and the imperfect, which it influences, is found in the doctrine of the connexion of the abstract (transcendent) intellect with man. This transcendent mind is sometimes connected with the moon, according to the theory of Aristotle, who assigned an imperishable matter to the sphere beyond the sublunary, and in general looked upon the celestial orbs as living and intelligent. Such an intellect, named active or productive, as being the author of the development of reason in man, is the permanent, eternal thought, which is the truth of the cosmic and physical movement. It is in man that the physical or sensible passes most evidently into the metaphysical and rational. Humanity is the chosen vessel in which the light of the intellect is revealed; and so long as mankind lasts there must always be some individuals destined to receive this light. What seems from the material point of view to be the acquisition of learning, study and a moral life, is from the higher point of view the manifestation of the transcendent intellect in the individual. The preparation of the heart and faculties gives rise to a series of grades between the original predisposition and the full acquisition of actual intellect. These grades in the main resemble those given by Avicenna. But beyond these, Averroes claims as the highest bliss of the soul a union in this life with the actual intellect. The intellect, therefore, is one and continuous in all individuals, who differ only in the degree which their illumination has attained. Such was the Averroist doctrine of the unity of intellect—the eternal and universal nature of true intellectual life. By his interpreters it was transformed into a theory of one soul common to all mankind, and when thus corrupted conflicted not unreasonably with the doctrines of a future life, common to Islam and Christendom.

Opponents of Averoism.

Averroes, rejected by his Moslem countrymen, found a hearing among the Jews, to whom Maimonides had shown the free paths of Greek speculation. In the cities of Languedoc and of Provence to which they had been driven by Spanish fanaticism, the Jews no longer used the learned Arabic, and translations of the works of Averroes became necessary. His writings became the text-book of Levi ben Gerson at Perpignan, and of Moses of Narbonne. Meanwhile, before 1250, Averroes became accessible to the Latin Schoolmen by means of versions, accredited by the names of Michael Scot and others. William of Auvergne is the first Schoolman who criticizes the doctrines of Averroes, not, however, by name. Albertus Magnus and St Thomas devote special treatises to an examination of the Averroist theory of the unity of intellect, which they labour to confute in order to establish the orthodoxy of Aristotle. But as early as Aegidius Romanus (1247-1316). Averroes had been stamped as the patron of indifference to theological dogmas, and credited with the emancipation which was equally due to wider experience and the lessons of the Crusades. There had never been an absence of protest against the hierarchical doctrine. Berengar of Tours (11th century) had struggled in that interest, and with Abelard, in the 12th century, the revolt against authority in belief grew loud. The dialogue between a Christian, a Jew and a philosopher suggested a comparative estimate of religions, and placed the natural religion of the moral law above all positive revelations. Nihilists and naturalists, who deified logic and science at the expense of faith, were not unknown at Paris in the days of John of Salisbury. In such a critical generation the words of Averroism found willing ears, and pupils who outran their teacher. Paris became the centre of a sceptical society, which the decrees of bishops and councils, and the enthusiasm of the orthodox doctors and knights-errant of Catholicism, were powerless to extinguish. At Oxford Averroes told more as the great commentator. In the days of Roger Bacon he had become an authority. Bacon, placing him beside Aristotle and Avicenna, recommends the study of Arabic as the only way of getting the knowledge which bad versions made almost hopeless. In Duns Scotus, Averroes and Aristotle are the unequalled masters of the science of proof; and he pronounces distinctly the separation between Catholic and philosophical truth, which became the watchword of Averroism. By the 14th century Averroism was the common leaven of philosophy; John Baconthorpe is the chief of Averroists, and Walter Burley has similar tendencies.

Meanwhile Averrcism had come to be regarded by the great Dominican school as the arch-enemy of the truth. When the emperor Frederick II. consulted a Moslem free-thinker on the mysteries of the faith, when the phrase or legend of the “Three Impostors” presented in its most offensive form the scientific survey of the

three laws of Moses, Christ and Mahomet, and when the characteristic doctrines of Averroes were misunderstood, it soon followed that his name became the badge of the scoffer and the sceptic. What had begun with the subtle disputes of the universities of Paris, went on to the materialist teachers in the medical schools and the sceptical men of the world in the cities of northern Italy. The patricians of Venice and the lecturers of Padua made Averroism synonymous with doubt and criticism in theology, and with sarcasm against the hierarchy. Petrarch refuses to believe that any good thing can come out of Arabia, and speaks of Averroes as a mad dog barking against the church. In works of contemporary art Averroes is at one time the comrade of Mahomet and Antichrist; at another he lies with Arius and Sabellius, vanquished by the lance of St Thomas.

It was in the universities of north Italy that Averroism finally settled, and there for three centuries it continued as a stronghold of Scholasticism to resist the efforts of revived antiquity and of advancing science.

The school of Padua.

Padua became the seat of Averroist Aristotelianism; and, when Padua was conquered by Venice in 1405, the printers of the republic spread abroad the teaching of the professors in the university. As early as 1300, at Padua, Petrus Aponensis, a notable expositor of medical theories, had betrayed a heterodoxy in faith; and John of Jandun, one of the pamphleteers on the side of Louis of Bavaria, was a keen follower of Averroes, whom he styles a "perfect and most glorious physicist." Urbanus of Bologna, Paul of Venice (d. 1428), and Cajetanus de Thienis (1387-1465), established by their lectures and their discussions the authority of Averroes; and a long list of manuscripts rests in the libraries of Lombardy to witness the diligence of these writers and their successors. Even a lady of Venice, Cassandra Fedele, in 1480, gained her laurels in defence of Averroist theses.

With Pietro Pomponazzi (*q.v.*) in 1495, a brilliant epoch began for the school of Padua. Questions of permanent and present interest took the place of outworn scholastic problems. The disputants ranged themselves under the rival commentators, Alexander and Averroes; and the immortality of the soul became the battle-ground of the two parties. Pomponazzi defended the Alexandrist doctrine of the utter mortality of the soul, whilst Agostino Nifo (*q.v.*), the Averroist, was entrusted by Leo X. with the task of defending the Catholic doctrine. The parties seemed to have changed when Averroism thus took the side of the church; but the change was probably due to compulsion. Nifo had edited the works of Averroes (1495-1497); but his expressions gave offence to the dominant theologians, and he had to save himself by distinguishing his personal faith from his editorial capacity. Alessandro Achillini, the persistent philosophical adversary of Pomponazzi, both at Padua and subsequently at Bologna, attempted, along with other moderate but not brilliant Averroists, to accommodate their philosophical theory with the requirements of Catholicism. It was this comparatively mild Averroism, reduced to the merely explanatory activity of a commentator, which continued to be the official dogma at Padua during the 16th century. Its typical representative is Marc-Antonio Zimara (d. 1552), the author of a reconciliation between the tenets of Averroes and those of Aristotle.

Meanwhile, in 1497, Aristotle was for the first time expounded in Greek at Padua. Plato had long been the favourite study at Florence; and Humanists, like Erasmus, Ludovicus Vives and Nizolius, enamoured of the

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popular philosophy of Cicero and Quintilian, poured out the vials of their contempt on scholastic barbarism with its "impious and thrice-accursed Averroes." The editors of Averroes complain that the popular taste had forsaken them for the Greek. Nevertheless, while Fallopius, Vesalius and Galileo were claiming attention to their discoveries, G. Zabarella, Francesco Piccolomini (1520-1604) and Cesare Cremonini (1550-1631) continued the traditions of Averroism, not without changes and additions. Cremonini, the last of them, died in 1631, after lecturing twelve years at Ferrara, and forty at Padua. The great educational value of Arabian philosophy for the later schoolmen consisted in its making them acquainted with an entire Aristotle. At the moment when it seemed as if everything had been made that could be made out of the fragments of Aristotle, and the compilations of Capella, Cassiodorus and others, and when mysticism and scepticism seemed the only resources left for the mind, the horizon of knowledge was suddenly widened by the acquisition of a complete Aristotle. Thus the mistakes inevitable in the isolated study of an imperfect *Organon* could not henceforth be made. The real bearing of old questions, and the meaninglessness of many disputes, were seen in the new conception of Aristotelianism given by the *Metaphysics* and other treatises. The former Realism and Nominalism were lifted into a higher phase by the principle of the universalizing action of intellect—*Intellectus in formis agit universalitatem*. The commentaries of the Arabians in this respect supplied nutriment more readily assimilated by the pupils than the pure text would have been.

Arabian philosophy, whilst it promoted the exegesis of Aristotle and increased his authority, was not less notable as the source of the separation between theology and philosophy. Speculation fell on irreligious paths. In many cases the heretical movement was due less to foreign example than to the indwelling tendencies of the dominant school of realism. But it is not less certain that the very considerable freedom of the Arabians from theological bias prepared the time when philosophy shook off its ecclesiastical vestments. In the hurry of first terror, the church struck Aristotle with the anathema launched against innovations in philosophy. The provincial council of Paris in 1209, which condemned Amalricus and his followers, as well as David of Dinant's works, forbade the study of Aristotle's *Natural Philosophy* and the *Commentaries*. In 1215 the same prohibition was repeated, specifying the *Metaphysics* and *Physics*, and the *Commentaries* by the Spaniard Mauritius (*i.e.* probably Averroes). Meanwhile Albertus Magnus and Thomas Aquinas, accepting the exegetical services of the Arabians, did their best to controvert the obnoxious doctrine of the Intellect, and to defend the orthodoxy of Aristotle against the unholy glosses of infidels. But it is doubtful whether even they kept as pure from the infection of illegitimate doctrine as they supposed. The tide meanwhile flowed in stronger and stronger. In 1270 Étienne Tempier, bishop of Paris, supported by an assembly of theologians, anathematized thirteen propositions bearing the stamp of Arabian authorship; but in 1277 the same views and others more directly offensive to Christians and theologians had to be censured again. Raymond Lully, in a dialogue with an infidel thinker, broke a lance in support of the orthodox doctrine, and carried on a crusade against the Arabians in every university; and a disciple of Thomas Aquinas drew up a list (*De erroribus philosophorum*) of the several delusions and errors of each of the thinkers from Kindi to Averroes. Strong in their conviction of the truth of Aristotelianism, the Arabians carried out their logical results in the theological field, and made the distinction of necessary and possible, of form and matter, the basis of conclusions in the

most momentous questions. They refused to accept the doctrine of creation because it conflicted with the explanation of forms as the necessary evolution of matter. They denied the particular providence of God, because knowledge in the divine sphere did not descend to singulars. They excluded the Deity from all direct action upon the world, and substituted for a cosmic principle the active intellect,—thus holding a form of Pantheism. But all did not go the same length in their divergence from the popular creed.

The half-legendary accounts which attribute the introduction of Arabian science to Gerbert, afterwards Pope Sylvester II., to Constantinus Africanus and to Adelard of Bath, if they have any value, refer mainly to medical science and mathematics. It was not till about the middle of the 12th century that under the patronage of Raymond, archbishop of Toledo, a society of translators, with the archdeacon Dominicus Gundisalvi at their head, produced Latin versions of the *Commentaries* of Avicenna, and Ghazali, of the *Fons Vitae* of Avicebron, and of several Aristotelian treatises. The working translators were converted Jews, the best-known among them being Joannes Avendeath. With this effort began the chief translating epoch for Arabic works. Avicenna's *Canon of Medicine* was first translated into Latin by Gerard of Cremona (d. 1187), to whom versions of other medical and astronomical works are due. The movement towards introducing Arabian science and philosophy into Europe, however, culminated under the patronage of the emperor Frederick II. (1212-1250). Partly from superiority to the narrowness of his age, and partly in the interest of his struggle with the Papacy, this *Malleus ecclesiae Romanae* drew to his court those savants whose pursuits were discouraged by the church, and especially students in the forbidden lore of the Arabians. He is said to have pensioned Jews for purposes of translation. One of the scholars to whom Frederick gave a welcome was Michael Scot, the first translator of Averroes. Scot had sojourned at Toledo about 1217, and had accomplished the versions of several astronomical and physical treatises, mainly, if we believe Roger Bacon, by the labours of a Jew named Andrew. But Bacon is apparently hypercritical in his estimate of the translators from the Arabic. Another protégé of Frederick's was Hermann the German (Alemannus), who, between the years 1243 and 1256, translated amongst other things a paraphrase of al-Fārābī on the *Rhetoric*, and of Averroes on the *Poetics* and *Ethics* of Aristotle. Jewish scholars held an honourable place in transmitting the Arabian commentators to the schoolmen. It was amongst them, especially in Maimonides, that Aristotelianism found refuge after the light of philosophy was extinguished in Islam; and the Jewish family of the Ben-Tibbon were mainly instrumental in making Averroes known to southern France.

See S. Munk, *Mélanges de philosophie juive et arabe* (Paris, 1859); E. Renan, *De Philosophia Peripatetica apud Syros* (1852), and *Averroës et l'Averroisme* (Paris, 3rd ed., 1867); Am. Jourdain, *Recherches critiques sur l'âge et l'origine des traductions latines d'Aristote* (Paris, 2me ed., 1843); B. Hauréau, *Philosophie scolastique* (Paris, 1850), tome i. p. 359; E. Vacherot, *École d'Alexandrie* (1846-1851), tome iii. p. 85; Schmolders, *Documenta philosophiae Arabum* (Bonn, 1836), and *Essai sur les écoles philosophiques chez les Arabes* (Paris, 1842); Shahrastani, *History of Religious and Philosophical Sects*, in German translation by Haarbrücker (Halle, 1850-1851); Dieterici, *Streit zwischen Mensch und Thier* (Berlin, 1858), and his other translations of the *Encyclopaedia of the Brothers of Sincerity* (1861 to 1872); T.J. de Boer, *The History of Philosophy in Islam* (London, 1903); K. Prantl, *Geschichte der Logik* (Leipzig, 1861); and the Histories of Philosophy; also the literature under the biographies of philosophers mentioned.

(W. W.; G. W. T.)

ARABIAN SEA (anc. *Mare Erythraeum*), the name applied to the portion of the Indian Ocean bounded E. by India, N. by Baluchistan and part of the southern Persian littoral, W. by Arabia, and S., approximately, by a line between Cape Guardafui, the north-east point of Somaliland, and Cape Comorin in India. It has two important branches—at the south-west the Gulf of Aden, connecting with the Red Sea through the strait of Bab-el-Mandeb; and at the north-west the Gulf of Oman, connecting with the Persian Gulf. Besides these larger ramifications, there are the Gulfs of Cambay and Kach on the Indian coast. An interest and importance belong to this sea as forming part of the chief highway between Europe and India. Its islands are few and insignificant, the chief being Sokotra, off the African, and the Laccadives, off the Indian coast.

ARABICI, a religious sect originating about the beginning of the 3rd century, which is mentioned by Augustine (*De Haeres*. c. lxxxiii.), and called also θνητοψυχίται ("mortal-souled") by John of Damascus (*De Haeres*. c. xc.) The name is given to the Arabians mentioned by Eusebius (*Hist. Eccl*. vi. 37), whose distinctive doctrine was a form of Christian materialism, showing itself in the belief that the soul perished and was restored to life along with the body. We may compare Tatian's view of the soul as a subtler variety of matter. According to Eusebius, they were convinced of their error by Origen, and renounced it at a council held about A.D. 246.

ARABI PASHA (*c.* 1839-), more correctly Aḥmad ʿArābī, to which in later years he added the epithet *al-Misrī*, "the Egyptian," Egyptian soldier and revolutionary leader, was born in Lower Egypt in 1839 or 1840 of a fellah family. Having entered the army as a conscript he was made an officer by Said Pasha in 1862, and was employed in the transport department in the Abyssinian campaign of 1875 under Ismail Pasha. A charge

of peculation, unproved, was made against him in connexion with this expedition and he was placed on half-pay. During this time he joined a secret society formed by Ali Rubi with the object of getting rid of Turkish officers from the Egyptian army. Arabi also attended lectures at the mosque El Azhar and acquired a reputation as an orator. In 1878 he was employed by Ismail in fomenting a disturbance against the ministry of Nubar, Rivers Wilson and de Blignières, and received in payment a wife from Ismail's harem and the command of a regiment. This increased his influence with the secret society, which, under the feeble government of Tewfik Pasha and the Dual Control, began to agitate against Europeans. In all that followed Arabi was put forward as the leader of the discontented Egyptians; he was in reality little more than the mouthpiece and puppet of abler men such as Ali Rubi and Mahmud Sami. On the 1st of February 1881 Arabi and two other Egyptian colonels, summoned before a court-martial for acts of disobedience, were rescued by their soldiers, and the khedive was forced to dismiss his then minister of war in favour of Mahmud Sami. A military demonstration on the 8th of September 1881, led by Arabi, forced the khedive to increase the numbers and pay of the army, to substitute Sherif Pasha for Riaz Pasha as prime minister, and to convene an assembly of notables. Arabi became under-secretary for war at the beginning of 1882, but continued his intrigues. The assembly of notables claimed the right of voting the budget, and thus came into conflict with the foreign controllers who had been appointed to guard the interests of the bondholders in the management of the Egyptian finances. Sherif fell in February, Mahmud Sami became prime minister, and Arabi (created a pasha) minister of war. Arabi, after a brief fall from office, acquired a dictatorial power that alarmed the British government. British and French warships went to Alexandria at the beginning of June; on the 11th of that month rioting in that city led to the sacrifice of many European lives. Order could only be restored through the intervention of Arabi, who now adopted a more distinctly anti-European attitude. His arming of the forts at Alexandria was held to constitute a menace to the British fleet. On the refusal of France to co-operate, the British fleet bombarded the forts (11th July), and a British force, under Sir Garnet Wolseley, defeated Arabi on the 13th of September at Tel-el-Kebir. Arabi fled to Cairo where he surrendered, and was tried (3rd of December) for rebellion. In accordance with an understanding made with the British representative, Lord Dufferin, Arabi pleaded guilty, and sentence of death was immediately commuted to one of banishment for life to Ceylon. The same sentence was passed on Mahmud Sami and others. After Arabi's exile had lasted for nearly twenty years, however, the khedive Abbas II. exercised his prerogative of mercy, and in May 1901 Arabi was permitted to return to Egypt. Arabi, as has been said, was rather the figurehead than the inspirer of the movement of 1881-1882; and was probably more honest, as he was certainly less intelligent, than those whose tool, in a large measure, he was. The movement which he represented in the eye of Europe, whatever the motives of its leaders, "was in its essence a genuine revolt against misgovernment,"[1] and it was a dim recognition of this fact which led Arabi to style himself "the Egyptian."

See EGYPT: *History*; also the accounts of Arabi in *Khedives and Pashas*, by C.F. Moberly Bell (1884); and in Lord Cromer's *Modern Egypt* (1908).

1 Lord Cromer in *Egypt*, No. 1, 1905, p. 2.

ARABISTAN (formerly KHUZISTAN), a province of Persia, bounded on the S. by the Persian Gulf, on the W. by Turkish territory, on the N. by Luristan and on the E. by the Bakhtiari district and Fars. It has its modern name, signifying "land of the Arabs," from the Arabs who form the bulk of the population, and is subdivided into the districts of Muhamrah, Fellahiyeh (the old Dorak), Ram Hormuz (popularly known as Ramiz), Havizeh, Shushter and Dizful. It has a population of about 200,000 and pays a yearly revenue of about £30,000. The soil is very fertile, but since the dam over the Karun at Ahvaz was swept away and the numerous canals which diverted the waters of the river for irrigation became useless, a great part of the province is uncultivated, and most of the crops and produce depend for water on rainfall and wells. The climate is hot, and in the low-lying, swampy districts very unhealthy; the prevailing winds are north-west and south-east, the former hot and dry from the arid districts west of Mesopotamia, the latter bearing much moisture from the Persian Gulf and the Indian Ocean. The principal Arab tribes are the Kab (generally known as Chaab) and Beni Lam, the former mostly settled in towns and villages and by religion Shi'ites, the latter nomads and Sunnites. The staples of food are dates and fish in the south, elsewhere the produce of the herds and flocks and rice, wheat and barley. Other products are maize, cotton, silk and indigo, and the manufactures include carpets without pile, coarse woollens, cottons and silk nettings. Dyeing is extensively carried on in Dizful where most of the indigo is grown.

Khuzistan (meaning "the land of the Khuz") was a part of the Biblical Elam, the classical Susiana, and appears in the great inscription of Darius as Uvaja.

ARABS, the name given to that branch of the Semitic race which from the earliest historic times inhabited the south-western portion of the Arabian peninsula. The name, to-day the collective term for the overwhelming majority of the surviving Semitic peoples, was originally restricted to the nomad tribes who ranged the north of the peninsula east of Palestine and the Syro-Arabian desert. In this narrow sense "Arab" is used in the Assyrian inscriptions, in the Old Testament and in the Minaean inscriptions. Before the Christian era it had come to include all the inhabitants of the peninsula. This, it is suggested, may have been due to the fact that the "Arabs" were the chief people near the Greek and Roman colonies in Syria and Mesopotamia. Classical writers use the term both in its local and general sense. The Arabs to-day occupy,

besides Arabia, a part of Mesopotamia, the western shores of the Red Sea, the eastern coast of the Persian Gulf and the north of Africa. The finest type of the race is found in south Arabia among the Ariba Arabs, among the mountaineers of Hadramut and Yemen and among the Bedouin tribes roaming over the interior of central and northern Arabia. The Arabs of the coasts and those of Mesopotamia are hybrids, showing Turkish, Negroid and Hamitic crossings. The people of Syria and Palestine are hybrids of Arab, Phoenician and Jewish descent. The theory that early Arab settlements were made on the east coast of Africa as far as Sofala south of the Zambezi, is without foundation; the earliest Arab settlement on the east coast of Africa that can be proved is Magadoxo (Mukdishu) in the 10th century, and the ruined cities of Mashonaland, once supposed to be the remains of Arab settlements, are now known to be of medieval African origin. On the East African coast-lands Arab influence is still considerable. Traces of the Arab type are met with in Asia Minor, the Caucasus, western Persia and India, while the influence of the Arab language and civilization is found in Europe (Malta and Spain), China and Central Asia.

Ethnology.

The Arabs are at once the most ancient as they in many ways are the purest surviving type of the true Semite. Certainly the inhabitants of Yemen are not, and in historic times never were, pure Semites. Somali and other elements, generally described under the collective racial name of Hamitic, are clearly traceable; but the inland Arabs still present the nearest approach to the primitive Semitic type. The origin of the Arab race can only be a matter of conjecture. From the remotest historic times it has been divided into two branches, which from their geographical position it is simplest to call the North Arabians and the South Arabians. Arabic and Jewish tradition trace the descent of the latter from Joktan (Arabic *Kahtan*) son of Heber, of the former from Ishmael. The South Arabians—the older branch—were settled in the south-western part of the peninsula centuries before the uprise of the Ishmaelites. These latter include not only Ishmael's direct descendants through the twelve princes (Gen. xxv. 16), but the Edomites, Moabites, Ammonites, Midianites and other tribes. This ancient and undoubted division of the Arab race —roughly represented to-day by the universally adopted classification into Arabs proper and Bedouin Arabs (see BEDOUINS)-has caused much dispute among ethnologists. All authorities agree in declaring the race to be Semitic in the broadest ethnological signification of that term, but some thought they saw in this division of the race an indication of a dual origin. They asserted that the purer branch of the Arab family was represented by the sedentary Arabs who were of Hamitic (Biblical Cushite), *i.e.* African ancestry, and that the nomad Arabs were Arabs only by adoption, and were nearer akin to the true Semite as sons of Ishmael. Many arguments were adduced in support of this theory, (1) The unquestioned division in remote historic times of the Arab race, and the immemorial hostility between the two branches. (2) The concurrence of pre-Islamitic literature and records in representing the first settlement of the "pure" Arab as made in the extreme south-western part of the peninsula, near Aden. (3) The use of Himyar, "dusky" or "red" (suggesting African affinities), as the name sometimes for the ruling class, sometimes for the entire people. (4) The African affinities of the Himyaritic language. (5) The resemblance of the grammar of the Arabic now spoken by the "pure" Arabs, where it differs from that of the North, to the Abyssinian grammar. (6) The marked resemblance of the pre-Islamitic institutions of Yemen and its allied provinces-its monarchies, courts, armies and serfs—to the historical Africo-Egyptian type and even to modern Abyssinia. (7) The physique of the "pure" Arab, the shape and size of the head, the slenderness of the lower limbs, all suggesting an African rather than an Asiatic origin. (8) The habits of the people, viz. their sedentary rather than nomad occupations, their fondness for village life, for dancing, music and society, their cultivation of the soil, having more in common with African life than with that of the western Asiatic continent. (9) The extreme facility of marriage which exists in all classes of the southern Arabs with the African races, the fecundity of such unions and the slightness or even total absence of any caste feeling between the dusky "pure" Arab and the still darker African, pointing to a community of origin. And further arguments were found in the characteristics of the Bedouins, their pastoral and nomad tendencies; the peculiarities of their idiom allied to the Hebrew; their strong clan feeling, their continued resistance to anything like regal power or centralized organization.

Such, briefly, were the more important arguments; but latterly ethnologists are inclined to agree that there is little really to be said for the African ancestry theory and that the Arab race had its beginning in the deserts of south Arabia, that in short the true Arabs are aborigines.

Mahommedans call the centuries before the Prophet's birth waqt-el jahilīya, "the time of ignorance," but the fact is that the Arab world has in some respects never since reached so high a level as it had in those days which it suits Moslems to paint in dreary colours. Writing was a fine art and poetry flourished. Eloquence was an accomplishment all strove to acquire, and each year there were assemblies, lasting sometimes a month, which were devoted to contests of skill among the orators and poets, to listen to whose friendly rivalry tribesmen journeyed long distances. Last, that surest index of a people's civilization—the treatment of women —contrasted very favourably with their position under the Koran. Women had rights and were respected. The veil and the harem system were unknown before Mahomet. According to Nöldeke the Nabataean inscriptions and coins show that women held a high social position in northern Arabia, owning large estates and trading independently. Polyandry and polygamy, it is true, were practised, but the right of divorce belonged to the woman as well as the man. Two kinds of marriage were celebrated. One was a purely personal contract, with no witnesses, the wife not leaving her home or passing under marital authority. The other was a formal marriage, the woman becoming subject to her husband by purchase or capture. Even captive women were not kept in slavery. Arabic wealth and culture had indeed thus early reached a stage which justified Professor Robertson Smith in writing, "In this period the name of Arab was associated to Western writers with ideas of effeminate indolence and peaceful opulence ... the golden age of Yemen." But long before Mahomet's time this early Arab predominance was at an end, possibly due in great measure to the loss of the caravan trade through the increase of shipping. The abandonment of great cities and the ruin of many tribes contributed to the apparent nationalization of the Arab peoples. Though the traditional jealousy and hostility of the two branches, the Yemenites and Maadites or Ishmaelites, remained, the Arab world had attained by the levelling process of common misfortune the superficial unity it presents to-day. The nation thus formed, never a nation in the strict sense of the word, was distinctively and thoroughly Semitic in character and language, and has remained unchanged to the present day. The sporadic brilliancy of the ancient Arab kingdoms gave place to a social and political lethargy, the continuation of which for many centuries made the uprise of Saracenic empires seem a miracle to a world ignorant of the Arab past. The Arab race up to Mahomet's day had been in

the main pagan. Monotheism, if it ever prevailed, early gave place to sun and star worship, or simple idolatry. Professor Robertson Smith suggests that totemism was the earliest form of Arabian idolatry, and that each tribe had its sacred animal. This he supports by the fact that some tribal names were derived from those of animals, and that animal-worship was not unknown in Arabia. What seems certain is that Arab religion was of a complex hybrid nature, not much to be wondered at when one remembers that Arabia was the asylum of many religious refugees, Zoroastrians, Jews, Christians. In the later pre-Islamitic times spirits, or jinns, as they were called, of which each tribe or family had its own, were worshipped, and there was but a vague idea of a Supreme Being. Images of the jinns to the number of 360, one for each day of the lunar year, were collected in the temple at Mecca, the chief seat of their worship. That worship was of a sanguinary nature. Human sacrifice was fairly frequent. Under the guise of religion female infanticide was a common practice. At Mecca the great object of worship was a plain black stone, and to it pilgrimages were made from every part of Arabia. This stone was so sacred to the Arabs that even Mahomet dared not dispense with it, and it remains the central object of sanctity in the Ka'ba to-day. The temples of the Sabaeans and the Minaeans were built east of their cities, a fact suggesting sun-worship, yet this is not believed to have been the cult of the Minaeans. Common to both was the worship of Attar, the male Ashtoreth.

With the appearance of Mahomet the Arabs took anew a place in the world's history.

Physique.

Physically the Arabs are one of the strongest and noblest races of the world. Baron de Larrey, surgeon-general to Napoleon on his expedition to Egypt and Syria, writes: "Their physical structure is in all respects more perfect than that of Europeans; their organs of sense exquisitely acute, their size above the average of men in general, their figure robust and elegant, their colour brown; their intelligence proportionate to their physical perfection and without doubt superior, other things being equal, to that of other nations." The typical Arab face is of an oval form, lean-featured; the eyes a brilliant black, deep-set under bushy eyebrows; nose aquiline, forehead straight but not high. In body the Arab is muscular and long-limbed, but lean. Deformed individuals or dwarfs are rare among Arabs; nor, except leprosy, which is common, does any disease seem to be hereditary among them. They often suffer from ophthalmia, though not in the virulent Egyptian form. They are scrupulously clean in their persons, and take special care of their teeth, which are generally white and even. Simple and abstemious in their habits, they often reach an extreme yet healthy old age; nor is it common among them for the faculties of the mind to give way sooner than those of the body.

Character.

Thus, physically, they yield to few races, if any, of mankind; mentally, they surpass most, and are only kept back in the march of progress by the remarkable defect of organizing power and incapacity for combined action. Lax and imperfect as are their forms of government, it is with impatience that even these are borne; of the four caliphs who alone reigned—if reign theirs could be called—in Arabia proper, three died a violent death; and of the Wahhabi princes, the most genuine representatives in later times of pure Arab rule, almost all have met the same fate. The Arab face, which is not unkindly, but never smiling, expresses that dignity and gravity which are typical of the race. While the Arab is always polite, good-natured, manly and brave, he is also revengeful, cruel, untruthful and superstitious. Of the Arab nature Burckhardt (other authorities, *e.g.* Barth and Rohlfs, are far less complimentary) wrote: "The Arab displays his manly character when he defends his guest at the peril of his own life, and submits to the reverses of fortune, to disappointment and distress, with the most patient resignation. He is distinguished from a Turk by the virtues of pity and gratitude. The Turk is cruel, the Arab of a more kind temper; he pities and supports the wretched, and never forgets the generosity shown to him even by an enemy." The Arab will lie and cheat and swear false oaths, but once his word is pledged he may be trusted to the last. There are some oaths such as *Wallah* (by Allah) which mean nothing, but such an oath as the threefold one with *wa, bi* and *ta* as particles of swearing the meanest thief will not break. In temper, or at least in the manifestation of it, the Arab is studiously calm; and he rarely so much as raises his voice in a dispute. But this outward tranquillity covers feelings alike keen and permanent; and the remembrance of a rash jest or injurious word, uttered years before, leads only too often to that blood-revenge which is a sacred duty everywhere in Arabia.

There exist, however, marked tribal or almost semi-national diversities of character among the Arabs. Thus, the inhabitants of Hejaz are noted for courtesy and blamed for fickleness; those of Nejd are distinguished by their stern tenacity and dignity of deportment; the nations of Yemen are gentle and pliant, but revengeful; those of Hasa and Oman cheerful and fond of sport, though at the same time turbulent and unsteady. Anything approaching to a game is rare in Nejd, and in the Hejaz religion and the yearly occurrence of the pilgrim ceremonies almost exclude all public diversions; but in Yemen the well-known game of the "jerid," or palm-stick, with dances and music is not rare. In Oman such amusements are still more frequent. Again in Yemen and Oman, coffee-houses, where people resort for conversation, and where public recitals, songs and other amusements are indulged in, stand open all day; while nothing of the sort is tolerated in Nejd. So too the ceremonies of circumcision or marriage are occasions of gaiety and pastime on the coast, but not in the central provinces.

Manners and customs.

An Arab town, or even village, except it be the merest hamlet, is invariably walled round; but seldom is a stronger material than dried earth used; the walls are occasionally flanked by towers of like construction. A dry ditch often surrounds the whole. The streets are irregular and seldom parallel. The Arab, indeed, lacks an eye for the straight. The Arab carpenter cannot form a right angle; an Arab servant cannot place a cloth square on a table. The Ka'ba at Mecca has none of its sides or angles equal. The houses are of one or two storeys, rarely of three, with flat mud roofs, little windows and no external ornament. If the town be large, the expansion of one or two streets becomes a market-place, where are ranged a few shops of eatables, drugs, coffee, cottons or other goods. Many of these shops are kept by women. The chief mosque is always near the market-place; so is also the governor's residence, which, except in size and in being more or less fortified Arab fashion, does not differ from a private house. Drainage is unthought of; but the extreme dryness of the air obviates the inconvenience and disease that under other skies could not fail to ensue, and which in the damper climates of the coast make themselves seriously felt. But the streets are roughly swept every day, each householder taking care of the roadway that lies before his own door. Whitewash and colour are occasionally used in Yemen, Hejaz and Oman; elsewhere

a light ochre tint, the colour of the sun-dried bricks, predominates, and gives an Arab town the appearance at a distance of a large dust-heap in the centre of the bright green ring of gardens and palm-groves. Baked bricks are unknown in Arabia, and stone buildings are rare, especially in Nejd. Palm branches and the like, woven in wattles, form the dwellings, of the poorer classes in the southern districts. Many Arab towns possess watch-towers, like huge round factory chimneys in appearance, built of sun-dried bricks, and varying in height from 50 to 100 ft. or even more. Indeed, two of these constructions at the town of Birkat-el-Mauj, in Oman, are said to be each of 170 ft. in height, and that of Nezwah, in the same province, is reckoned at 140; but these are of stone.

The principal feature in the interior of an Arab house is the “kahwah” or coffee-room. It is a large apartment spread with mats, and sometimes furnished with carpets and a few cushions. At one end is a small furnace or fireplace for preparing coffee. In this room the men congregate; here guests are received, and even lodged; women rarely enter it, except at times when strangers are unlikely to be present. Some of these apartments are very spacious and supported by pillars; one wall is usually built transversely to the compass direction of the Ka’ba; it serves to facilitate the performance of prayer by those who may happen to be in the kahwah at the appointed times. The other rooms are ordinarily small.

The Arabs are proverbially hospitable. A stranger’s arrival is often the occasion of an amicable dispute among the wealthier inhabitants as to who shall have the privilege of receiving him. Arab cookery is of the simplest. Roughly-ground wheat cooked with butter; bread in thin cakes, prepared on a heated iron plate or against the walls of an open oven; a few vegetables, generally of the leguminous kinds; boiled mutton or camel’s flesh, among the wealthy; dates and fruits—this is the *menu* of an ordinary meal. Rice is eaten by the rich and fish is common on the coasts. Tea, introduced only a few decades back, is now largely drunk. A food of which the Arabs are fond is locusts boiled in salt and water and then dried in the sun. They taste like stale shrimps, but there is a great sale for them. Spices are freely employed; butter much too largely for a European taste.

After eating, the hands are always washed, soap or the ashes of an alkaline plant being used. A covered censer with burning incense is then passed round, and each guest perfumes his hands, face, and sometimes his clothes; this censer serves also on first receptions and whenever special honour is intended. In Yemen and Oman scented water often does duty for it. Coffee, without milk or sugar, but flavoured with an aromatic seed brought from India, is served to all. This, too, is done on the occasion of a first welcome, when the cups often make two or three successive rounds; but, in fact, coffee is made and drunk at any time, as frequently as the desire for it may suggest itself; and each time fresh grains are sifted, roasted, pounded and boiled—a very laborious process, and one that requires in the better sort of establishments a special servant or slave for the work. Arabs generally make but one solid meal a day—that of supper, soon after sunset. Even then they do not eat much, gluttony being rare among them, and even daintiness esteemed disgraceful. Wine, like other fermented drinks, is prohibited by the Koran, and is, in fact, very rarely taken, though the inhabitants of the mountains of Oman are said to indulge in it. On the coast spirits of the worst quality are sometimes procured; opium and hashish are sparingly indulged in. On the other hand, wherever Wahhābiism has left freedom of action, tobacco-smoking prevails; short pipes of clay, long pipes with large open bowls, or most frequently the water-pipe or “nar-ghileh,” being used. The tobacco smoked is generally strong and is either brought from the neighbourhood of Bagdad or grown in the country itself. The strongest quality is that of Oman; the leaf is broad and coarse, and retains its green colour even when dried; a few whiffs have been known to produce absolute stupor. The aversion of the Wahhābis to tobacco is well known; they entitle it “mukhzi” or “the shameful,” and its use is punished with blows, as the public use of wine would be elsewhere.

Dress.

In dress much variety prevails. The loose cotton drawers girded at the waist, which in hot climates do duty for trousers, are not often worn, even by the upper classes, in Nejd or Yemama, where a kind of silk dressing-gown is thrown over the long shirt; frequently, too, a brown or black cloak distinguishes the wealthier citizen; his head-dress is a handkerchief fastened round the head by a band. But in Hejaz, Yemen and Oman, turbans are by no means uncommon; the ordinary colour is white; they are worn over one or more skullcaps. Trousers also form part of the dress in the two former of these districts; and a voluminous sash, in which a dagger or an inkstand is stuck, is wrapped round the waist. The poorer folk, however, and the villagers often content themselves with a broad piece of cloth round the loins, and another across the shoulders. In Oman trousers are rare, but over the shirt a long gown, of peculiar and somewhat close-fitting cut, dyed yellow, is often worn. The women in these provinces commonly put on loose drawers and some add veils to their head-dresses; they are over-fond of ornaments (gold and silver); their hair is generally arranged in a long plait hanging down behind. All men allow their beards and moustaches full growth, though this is usually scanty. Most Arabs shave their heads, and indeed all, strictly speaking, ought by Mahommedan custom to do so. An Arab seldom or never dyes his hair. Sandals are worn more often than shoes; none but the very poorest go barefoot.

Slavery.

Slavery is still, as of old times, a recognized institution throughout Arabia; and an illicit traffic in blacks is carried on along the coasts of the Persian Gulf and the Red Sea. The slaves themselves were obtained chiefly from the east African coast districts down as far as Zanzibar, but this source of supply was practically closed by the end of the 19th century. Slaves are usually employed in Arabia as herdsmen or as domestic servants, rarely in agricultural work; they also form a considerable portion of the bodyguards with which Eastern greatness loves to surround itself. Like their countrymen elsewhere, they readily embrace the religion of their masters and become zealous Mahommedans. Arab custom enfranchises a slave who has accepted Islam at the end of seven years of bondage, and when that period has arrived, the master, instead of exacting from his slave the price of freedom, generally, on giving him his liberty, adds the requisite means for supporting himself and a family in comfort. Further, on every important occasion, such as a birth, circumcision, a marriage or a death, one or more of the household slaves are sure of acquiring their freedom. Hence Arabia has a considerable free black population; and these again, by inter-marriage with the whites around, have filled the land with a mulatto breed of every shade, till, in the eastern and southern provinces especially, a white skin is almost an exception. In Arabia no prejudice exists against negro alliances; no social or political line separates the African from the Arab. A negro may become a sheik, a kadi, an amir, or whatever his industry and his talents may render him capable of being. This is

particularly so in Nejd, Yemen and Hadramut; in the Hejaz and the north a faint line of demarcation may be observed between the races.

The Arabs are good soldiers but poor generals. Personal courage, wonderful endurance of privation, fixity of purpose, and a contempt of death are qualities common to almost every race, tribe and clan that compose the Arab nation. In skirmishing and harassing they have few equals, while at close quarters they have often shown themselves capable of maintaining, armed with swords and spears alone, a desperate struggle against guns and bayonets, neither giving nor receiving quarter. Nor are they wholly ignorant of tactics, their armies, when engaged in regular war, being divided into centre and wings, with skirmishers in front and a reserve behind, often screened at the outset of the engagement by the camels of the expedition. These animals, kneeling and ranged in long parallel rows, form a sort of entrenchment, from behind which the soldiers of the main body fire their matchlocks, while the front divisions, opening out, act on either flank of the enemy. This arrangement of troops may be traced in Arab records as far back as the 5th century, and was often exemplified during the Wahhābi wars.

Military qualities.

Arab women are scarcely less distinguished for their bravery than the men. Records of armed heroines occur frequently in the chronicles or myths of the pre-Islamitic time; and in authentic history the Battle of the Camel, 656 A.D., where Ayesha, the wife of Mahomet, headed the charge, is only the first of a number of instances in which Arab amazons have taken, sword in hand, no inconsiderable share in the wars and victories of Islam. Even now it is the custom for an Arab force to be always accompanied by some courageous maiden, who, mounted on a blackened camel, leads the onslaught, singing verses of encouragement for her own, of insult for the opposing tribe. Round her litter the fiercest of the battle rages, and her capture or death is the signal of utter rout; it is hers also to head the triumph after the victory of her clan.

There is little education, in the European sense of the word, in Arabia. Among the Bedouins there are no schools, and few, even of the most elementary character, in the towns or villages. Where they exist, little beyond the mechanical reading of the Koran, and the equally mechanical learning of it by rote, is taught. On the other hand, Arab male-children, brought up from early years among the grown-up men of the house or tent, learn more from their own parents and at home than is common in other countries; reading and writing are in most instances thus acquired, or rather transmitted; besides such general principles of grammar and eloquence, often of poetry and history, as the elders themselves may be able to impart. To this family schooling too are due the good manners, politeness, and self-restraint that early distinguish Arab children. In the very few instances where a public school of a higher class exists, writing, grammar and rhetoric sum up its teachings. Law and theology, in the narrow sense that both these words have in the Islamitic system, are explained in afternoon lectures given in most mosques; and some verses of the Koran, with one of the accepted commentaries, that of Baidawi for example, form the basis of the instruction. Great attention is paid to accuracy of grammar and purity of diction throughout Arabia; yet something of a dialectic difference may be observed in the various districts. The purest Arabic, that which is as nearly as possible identical in the choice of words and in its inflections with the language of the Koran, is spoken in Nejd, and the best again of that in the province of Suder. Next in purity comes the Arabic of Shammar. Throughout the Hejaz in general, the language, though extremely elegant, is not equally correct; in el-Hasa, Bahrein and Oman it is decidedly influenced by the foreign element called Nabataean. In Yemen, as in other southern districts of the peninsula, Arabic merges insensibly into the Himyaritic or African dialect of Hadramut and Mahra. (See Semitic Languages.)

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ARACAJÚ, a city and seaport of Brazil, capital of the state of Sergipe, 170 m. N.N.E. of Bahia, on the river Cotinguiba, or Cotindiba, 6 m. from the coast. The municipality, of which it forms a part, had a population in 1890 of 16,336, about two-thirds of whom lived in the city itself. Aracajú is a badly built town on the right bank of the river at the base of a ridge of low sand-hills and has the usual features of an unprogressive provincial capital. Good limestone is quarried in its vicinity, and the country tributary to this port produces large quantities of sugar. Cotton is also grown, and the back country sends down hides and skins for shipment. The anchorage is good, but a dangerous bar at the mouth of the river prevents the entrance of vessels drawing more than 12 ft. The port is visited, therefore, only by the smaller steamers of the coastwise lines. The river is navigable as far as the town of Maroim, about 10 m. beyond Aracajú. The city was founded in 1855.

ARACATY, or Aracatí, a city and port of Brazil, in the state of Ceará, 75 m. S.E. of Fortaleza, on the river

Jaguaribe, 8 m. from the sea. Pop. of the municipality (1890) 20,182, of whom about 12,000 belonged to the city. A dangerous bar at the mouth of the river permits the entrance only of the smaller coasting steamers, but the port is an important commercial centre, and exports considerable quantities of cotton, hides, maniçoba, rubber, fruit, and palm wax.

ARACHNE, in Greek mythology, the daughter of Idmon of Colophon in Lydia, a dyer in purple. She had acquired such skill in the art of weaving that she ventured to challenge Athena. While the goddess took as subjects her quarrel with Poseidon as to the naming and possession of Attica, and the warning examples of those who ventured to pit themselves against the immortals, Arachne depicted the metamorphoses of the gods and their amorous adventures. Her work was so perfect that Athena, enraged at being unable to find any blemish in it, tore it to pieces. Arachne hanged herself in despair; but the goddess out of pity loosened the rope, which became a cobweb, while Arachne herself was changed into a spider (Ovid, *Metam.* vi. 5-145). The story probably indicates the superiority of Asia over Greece in the textile arts.

ARACHNIDA, the zoological name given in 1815 by Lamarck (Gr. ἀράχνη, a spider) to a class which he instituted for the reception of the spiders, scorpions and mites, previously classified by Linnaeus in the order Aptera of his great group Insecta. Lamarck at the same time founded the class Crustacea for the lobsters, crabs and water-fleas, also until then included in the order Aptera of Linnaeus. Lamarck included the Thysanura and the Myriapoda in his class Arachnida. The Insecta of Linnaeus was a group exactly equivalent to the Arthropoda founded a hundred years later by Siebold and Stannius. It was thus reduced by Lamarck in area, and made to comprise only the six-legged, wing-bearing "Insecta." For these Lamarck proposed the name Hexapoda; but that name has been little used, and they have retained to this day the title of the much larger Linnaean group, viz. Insecta. The position of the Arachnida in the great sub-phylum Arthropoda, according to recent anatomical and embryological researches, is explained in the article Arthropoda. The Arachnida form a distinct class or line of descent in the grade Euarthropoda, diverging (perhaps in common at the start with the Crustacea) from primitive Euarthropods, which gave rise also to the separate lines of descent known as the classes Diplopoda, Crustacea, Chilopoda and Hexapoda.

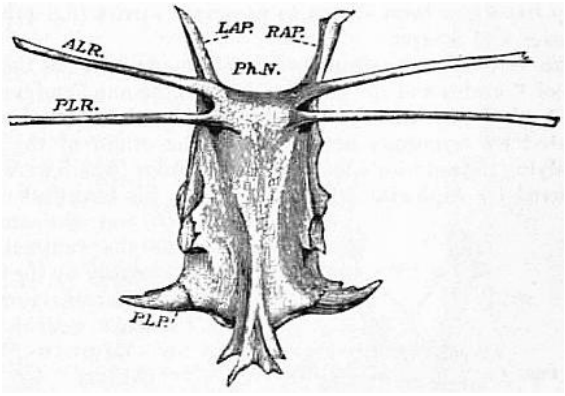


Fig. 1.—Entosternum, entosternite or plastron of *Limulus polyphemus*, Latr. Dorsal surface.

LAP, Left anterior process.
RAP, Right anterior process.
PhN, Pharyngeal notch.
ALR, Anterior lateial rod or tendon.
PLR, Posterior lateral rod or tendon.
PLP, Posterior lateral process.
Natural size.

(From Lankester, *Q. J. Mic. Sci.*, N S vol. xxiv, 1884.)

Limulus an Arachnid.—Modern views as to the classification and affinities of the Arachnida have been determined by the demonstration that *Limulus* and the extinct Eurypterines (*Pterygotus*, &c.) are Arachnida; that is to say, are identical in the structure and relation of so many important parts with *Scorpio*, whilst differing in those respects from other Arthropoda, that it is impossible to suppose that the identity is due to homoplasy or convergence, and the conclusion must be accepted that the resemblances arise from close genetic relationship. The view that Limulus, the king-crab, is an Arachnid was maintained as long ago as 1829 by Strauss-Dürckheim (**1**), on the ground of its possession of an internal cartilaginous sternum—also possessed by the Arachnida (see figs. 1, 2, 3, 4, 5 and 6)—and of the similarity of the disposition of the six leg-like appendages around the mouth in the two cases (see figs. 45 and 63). The evidence of the exact equivalence of the segmentation and appendages of Limulus and Scorpio, and of a number of remarkable points of agreement in structure, was furnished by Ray Lankester in an article published in 1881 ("Limulus an Arachnid," *Quart. Journ. Micr. Sci.* vol. xxi. N.S.), and in a series of subsequent memoirs, in which the structure of the entosternum, of the coxal glands, of the eyes, of the veno-pericardiac muscles, of the respiratory lamellae, and of other parts, was for the first time described, and in which the new facts

discovered were shown uniformly to support the hypothesis that Limulus is an Arachnid. A list of these memoirs is given at the close of this article (**2, 3, 4, 5** and **13**). The Eurypterines (Gigantostraca) were included in the identification, although at that time they were supposed to possess only five pairs of anterior or prosomatic appendages. They have now been shown to possess six pairs (fig. 47), as do Limulus and Scorpio.

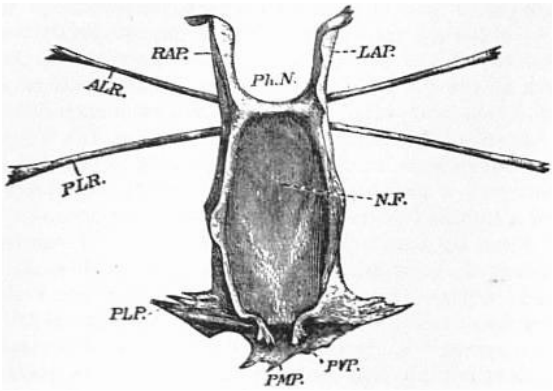


FIG. 2.—Ventral surface of the entosternum of *Limulus polyphemus*, Latr. Letters as in fig. 1 with the addition of NF, neural fossa protecting the aggregated ganglia of the central nervous system; PVP, left posterior ventral process; PMP, posterior median process. Natural size.

(From Lankester.)

The various comparisons previously made between the structure of Limulus and the Eurypterines on the one hand, and that of a typical Arachnid, such as Scorpio, on the other, had been vitiated by erroneous notions as to the origin of the nerves supplying the anterior appendages of Limulus (which were finally removed by Alphonse Milne-Edwards in his beautiful memoir (**6**) on the structure of that animal), and secondly by the erroneous identification of the double sternal plates of Limulus, called "chilaria," by Owen, with a pair of appendages (**7**). Once the identity of the chilaria with the pentagonal sternal plate of the scorpion is recognized—an identification first insisted on by Lankester—the whole series of segments and appendages in the two animals, Limulus and Scorpio, are seen to correspond most closely, segment for segment, with one another (see figs. 7 and 8). The structure of the prosomatic appendages or legs is also seen to present many significant points of agreement (see figures), but a curious discrepancy existed in the six-jointed structure of the limb in Limulus, which differed from the seven-jointed limb of Scorpio by the defect of one joint. R.I. Pocock of the British Museum has observed that in Limulus a marking exists on the fourth joint, which apparently indicates a previous division of this segment into two, and thus establishes the agreement of Limulus and Scorpio in this small feature of the number of segments in the legs (see fig. 11).

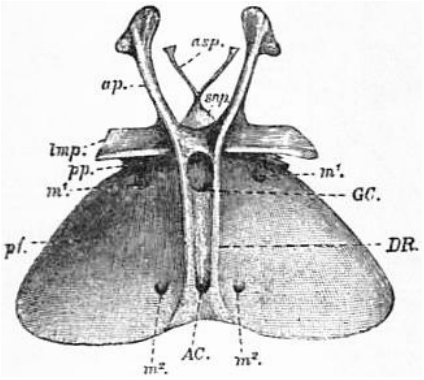


FIG. 3.—Entosternum of scorpion (*Palamnaeus Indus*, de Geer); dorsal surface.

asp, Paired anterior process of the sub-neural arch.
snp, Sub-neural arch.
ap, Anterior lateral process (same as RAP and LAP in fig. 1).
lmp, Lateral median process (same as ALR and PLR of fig. 1).
pp, Posterior process (same as PLP in fig. 1).
pf, Posterior flap or diaphragm of Newport.
m^1 and m^2, Perforations of the diaphragm for the passage of muscles.
DR, The paired dorsal ridges.
GC, Gastric canal or foramen.
AC, Arterial canal or foramen.

(After Lankester, *loc. cit.*)

It is not desirable to occupy the limited space of this article by a full description of the limbs and segments of Limulus and Scorpio. The reader is referred to the complete series of figures here given, with their explanatory legends (figs 12, 13, 14, 15). Certain matters, however, require comment and explanation to render the comparison intelligible. The tergites, or chitinized dorsal halves of the body rings, are fused to form a "prosomatic carapace," or carapace of the prosoma, in both Limulus and Scorpio (see figs. 7 and 8). This region corresponds in both cases to six somites, as indicated by the presence of six pairs of limbs. On the surface of the carapace there are in both animals a pair of central eyes with simple lens and a pair of lateral eye-tracts, which in Limulus consist of closely-aggregated simple eyes, forming a "compound" eye, whilst in Scorpio they present several separate small eyes. The microscopic structure of the central and the lateral eyes has been shown by Lankester and A.G. Bourne (**5**) to differ; but the lateral eyes of Scorpio were shown by them to be similar in structure to the lateral eyes of Limulus, and the central eyes of Scorpio to be identical in structure with the central eyes of Limulus (see below).

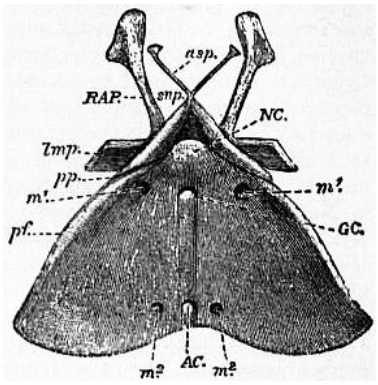


FIG. 4.—Ventral surface of the same entosternum as that drawn in fig. 3. Letters as in fig. 3 with the addition of NC, neural canal or foramen.

(After Lankester, *loc. cit.*)

Following the prosoma is a region consisting of six segments (figs. 14 and 15), each carrying a pair of plate-like appendages in both Limulus and Scorpio. This region is called the mesosoma. The tergites of this region and those of the following region, the metasoma, are fused to form a second or posterior carapace in Limulus, whilst remaining free in Scorpio. The first pair of foliaceous appendages in each animal is the genital operculum; beneath it are found the openings of the genital ducts. The second pair of mesosomatic appendages in Scorpio are known as the "pectens." Each consists of an axis, bearing numerous blunt tooth-like processes arranged in a series. This is represented in Limulus by the first gill-bearing appendage. The leaves (some 150 in number) of the gill-book (see figure) correspond to the tooth-like processes of the pectens of Scorpio. The next four pairs of appendages (completing the mesosomatic series of six) consist, in both Scorpio and Limulus, of a base carrying each 130 to 150 blood-holding, leaf-like plates, lying on one another like the leaves of a book. Their minute structure is closely similar in the two cases; the leaf-like plates receive blood from the great sternal sinus, and serve as respiratory organs. The difference between the gill-books of Limulus and the lung-books of Scorpio depends on the fact that the latter are adapted to aerial respiration, while the former serve for aquatic respiration. The appendage carrying the gill-book stands out on the surface of the body in Limulus, and has other portions developed besides the gill-book and its base; it is fused with its fellow of the opposite side. On the other hand, in Scorpio, the gill-book-bearing appendage has sunk below the surface, forming a recess or chamber for itself, which communicates with the exterior by an oval or circular "stigma" (fig. 10, *stg*). That this in-sinking has taken place, and that the lung-books or in-sunken gill-books of Scorpio really represent appendages (that is to say, limbs or parapodia) is proved by their developmental history (see figs. 17 and 18). They appear at first as outstanding processes on the surface of the body.

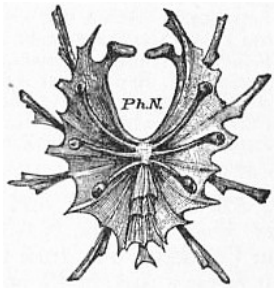


FIG. 5.—Entosternum of one of the mygalomorphous spiders; ventral surface. Ph.N., pharyngeal notch. The posterior median process with its repetition of triangular segments closely resembles the same process in Limulus.

(From Lankester, *loc. cit.*)

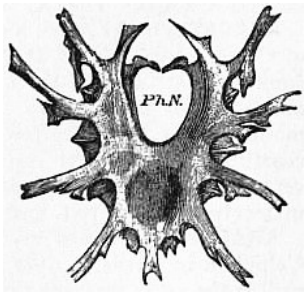


FIG. 6.—Dorsal surface of the same entosternum as that drawn in fig. 5. Ph.N., pharyngeal notch.

After Lankester, *loc. cit.*

The exact mode in which the in-sinking of superficial outstanding limbs, carrying gill-lamellae, has historically taken place has been a matter of much speculation. It was to be hoped that the specimen of the Silurian scorpion (*Palaeophonus*) from Scotland, showing the ventral surface of the mesosoma (fig. 49), would throw light on this matter; but the specimen recently carefully studied by the writer and Pocock reveals neither gill-bearing limbs nor stigmata. The probability appears to be against an actual introversion of the appendage and its lamellae, as was at one time suggested by Lankester. It is probable that such an in-sinking as is shown in the accompanying diagram has taken place (fig. 15); but we are yet in need of evidence as to the exact equivalence of margins, axis, &c., obtaining between the lung-book of Scorpio and the gill-book of Limulus. Zoologists are familiar with many instances (fishes, crustaceans) in which the protective walls of a water-breathing organ or gill-apparatus become converted into an air-breathing organ or lung, but there is no other case known of the conversion of gill processes themselves into air-breathing plates.

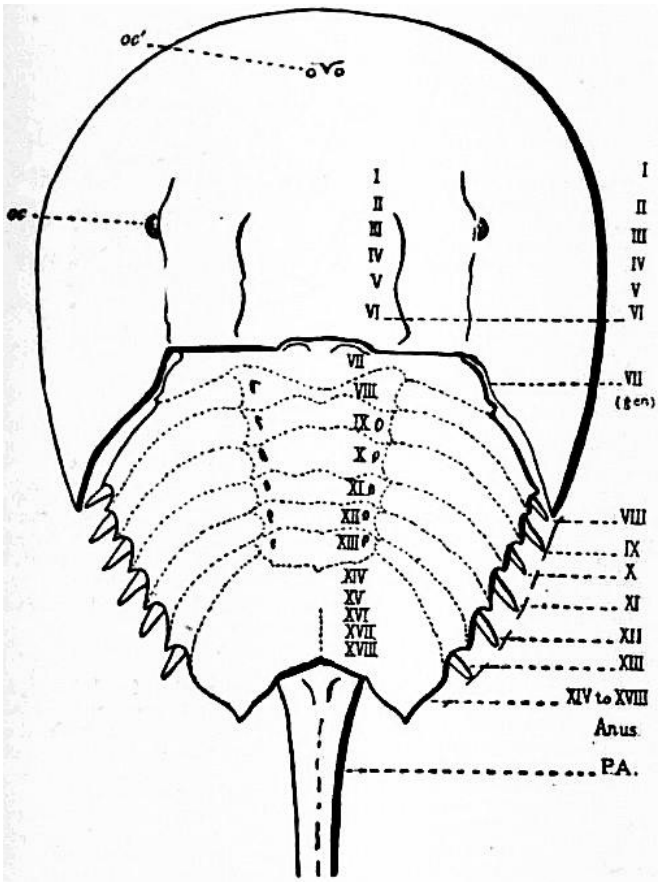


FIG. 7.—Diagram of the dorsal surface of *Limulus polyphemus*.

oc, Lateral compound eyes.
oc', Central monomeniscous eyes.
PA, Post-anal spine.
I to VI, The six appendage-bearing somites of the prosoma.
VII, Usually considered to be the tergum of the genital somite, but suggested by Pocock to be that of the otherwise suppressed praegenital somite.
VIII to XIII, The six somites of the mesosoma, each with a movable pleural spine and a pair of dorsal entopophysis or muscle-attaching ingrowths.
XIV to XVIII, The confluent or unexpressed six somites of the metasoma.

[According to the system of numbering explained in the text, if VII is the tergum of the praegenital somite (as is probable) it should be labelled *Prg* without any number, and the somites VIII to XIII should be lettered 1 to 6, indicating that they are the six normal somites of the mesosoma; whilst XV to XVIII should be replaced by the numbers 7 to 12 —an additional suppressed segment (making up the typical six) being reckoned to the metasomatic fusion.]

(From Lankester, *Q.J. Micr Set.* vol. xxi., 1881.)

The identification of the lung-books of Scorpio with the gill-books of Limulus is practically settled by the existence of the pectens in Scorpio (fig. 14, VIII) on the second mesosomatic somite. There is no doubt that *these* are parapodial or limb appendages, carrying numerous imbricated secondary processes, and therefore comparable in essential structure to the leaf-bearing plates of the second mesosomatic somite of Limulus. They have remained unenclosed and projecting on the surface of the body, as once were the appendages of the four following somites. But they have lost their respiratory function. In non-aquatic life such an unprotected organ cannot subserve respiration. The “pectens” have become more firmly chitinized and probably somewhat altered in shape as compared with their condition in the aquatic ancestral scorpions. Their present function in scorpions is not ascertained. They are not specially sensitive under ordinary conditions, and may be touched or even pinched without causing any discomfort to the scorpion. It is probable that they acquire special sensibility at the breeding season and serve as “guides” in copulation. The shape of the legs and the absence of paired terminal claws in the Silurian *Palaeophonus* (see figs. 48 and 49) as compared with living scorpions (see fig. 10) show that the early scorpions were aquatic, and we may hope some day in better-preserved specimens than the two as yet discovered, to find the respiratory organs of those creatures in the condition of projecting appendages serving aquatic respiration somewhat as in Limulus, though not necessarily repeating the exact form of the broad plates of Limulus.

It is important to note that the series of lamellae of the lung-book and the gill-book correspond *exactly* in structure, the narrow, flat blood-space in the lamellae being interrupted by pillar-like junctions of the two surfaces in both

cases (see Lankester (**4**)), and the free surfaces of the adjacent lamellae being covered with a very delicate chitinous cuticle which is drawn out into delicate hairs and processes. The elongated axis which opens at the stigma in Scorpio and which can be cleared of soft, surrounding tissues and coagulated blood so as to present the appearance of a limb axis carrying the book-like leaves of the lung is not really, as it would seem to be at first sight, the limb axis. That is necessarily a blood-holding structure and is obliterated and fused with soft tissues of the sternal region so that the lamellae cannot be detached and presented as standing out from it. The apparent axis or basal support of the scorpion's lung-books shown in the figures, is a false or secondary axis and merely a part of the infolded surface which forms the air-chamber. The maceration of the soft parts of a scorpion preserved in weak spirit and the cleaning of the chitinized in-grown cuticle give rise to the false appearance of a limb axis carrying the lamellae. The margins of the lamellae of the scorpion's lung-book, which are *lowermost* in the figures (fig. 15) and appear to be free, are really those which are attached to the blood-holding axis. The true free ends are those nearest the stigma.

Passing on now from the mesosoma we come in Scorpio to the metasoma of six segments, the first of which is broad whilst the rest are cylindrical. The last is perforated by the anus and carries the post-anal spine or sting. The somites of the metasoma carry no parapodia. In Limulus the metasoma is practically suppressed. In the allied extinct Eurypterines it is well developed, and resembles that of Scorpio. In the embryo Limulus (fig. 42) the six somites of the mesosoma are not fused to form a carapace at an early stage, and they are followed by three separately marked metasomatic somites; the other three somites of the metasoma have disappeared in Limulus, but are represented by the unsegmented prae-anal region. It is probable that we have in the metasoma of Limulus a case of the disappearance of once clearly demarcated somites. It would be possible to suppose, on the other hand, that new somites are only beginning to make their appearance here. The balance of various considerations is against the latter hypothesis. Following the metasoma in Limulus, we have as in Scorpio the post-anal spine—in this case not a sting, but a powerful and important organ of locomotion, serving to turn the animal over when it has fallen upon its back. The nature of the post-anal spine has been strangely misinterpreted by some writers. Owen (**7**) maintained that it represented a number of coalesced somites, regardless of its post-anal position and mode of development. The agreement of the grouping of the somites, of the form of the parapodia (appendages, limbs) in each region, of the position of the genital aperture and operculum, of the position and character of the eyes, and of the powerful post-anal spines not seen in other Arthropods, is very convincing as to the affinity of Limulus and Scorpio. Perhaps the most important general agreement of Scorpio compared with Limulus and the Eurypterines is the division of the body into the three regions (or tagmata)—prosoma, mesosoma and metasoma—each consisting of six segments, the prosoma having leg-like appendages, the mesosoma having foliaceous appendages, and the metasoma being destitute of appendages.

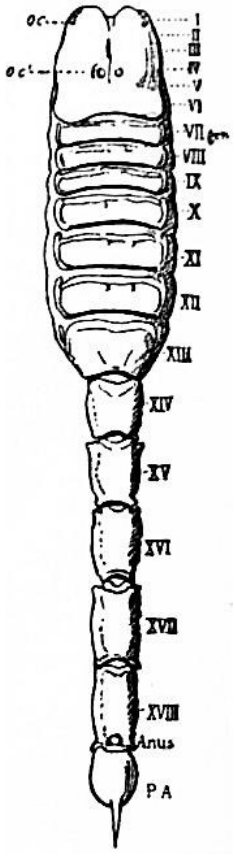


FIG. 8.—Diagram of the dorsal surface of a scorpion to compare with fig. 7. Letters and Roman numerals as in fig. 7, excepting that VII is here certainly the tergum of the first somite of the mesosoma —the genital somite— and is *not* a survival of the embryonic praegenital somite. The anus (not seen) is on the sternal surface.

(From Lankester, *loc. cit.*)

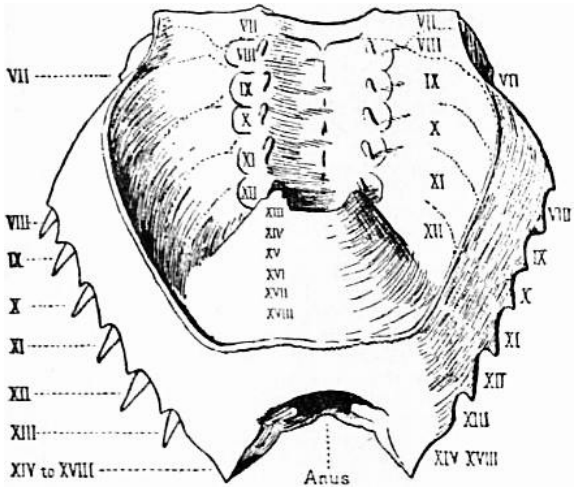


FIG. 9.—Ventral view of the posterior carapace or meso-metasomatic (opisthospmatic) fusion of *Limulus polyphemus*. The soft integument and limbs of the mesosoma have been removed as well as all the viscera and muscles, so that the inner surface of the terga of these somites with their entopophyses are seen. The unsegmented dense chitinous sternal plate of the metasoma (XIII to XVIII) is not removed. Letters as in fig. 7.

After Lankester, *loc. cit.*)

In 1893, some years after the identification of the somites of Limulus with those of Scorpio, thus indicated, had been published, zoologists were startled by the discovery by a Japanese zoologist, Kishinouye (**8**), of a seventh prosomatic somite in the embryo of Limulus longispina. This was seen in longitudinal sections, as shown in fig. 19. The simple identification of somite with somite in Limulus and Scorpio seemed to be threatened by this discovery. But in 1896 Dr

August Brauer of Marburg (**9**) discovered in the embryo of Scorpio a seventh prosomatic somite (see VII PrG, figs. 17 and 18), or, if we please so to term it, a *praegenital* somite, hitherto unrecognized. In the case of Scorpio this segment is indicated in the embryo by the presence of a pair of rudimentary appendages, carried by a well-marked somite. As in Limulus, so in Scorpio, this unexpected somite and its appendages disappear in the course of development. In fact, more or less complete "excalation" of the somite takes place. Owing to its position it is convenient to term the somite which is excalated in Limulus and Scorpio "the praegenital somite." It appears not improbable that the sternal plates wedged in between the last pair of legs in both Scorpio and Limulus, viz. the pentagonal sternite of Scorpio (fig. 10) and the chilaria of Limulus (see figs. 13 and 20), may in part represent in the adult the sternum of the excalated praegenital somite. This has not been demonstrated by an actual following out of the development, but the position of these pieces and the fact that they are (in Limulus) supplied by an independent segmental nerve, favours the view that they may comprise the sternal area of the vanished praegenital somite. This interpretation, however, of the "metasternites" of Limulus and Scorpio is opposed by the coexistence in Thelyphonus (figs. 55, 57 and 58) of a similar metasternite with a complete praegenital somite. H.J. Hansen (**10**) has recognized that the "praegenital somite" persists in a rudimentary condition, forming a "waist" to the series of somites in the Pedipalpi and Araneae. The present writer is of opinion that it will be found most convenient to treat this evanescent somite as something special, and not to attempt to reckon it to either the prosoma or the mesosoma. These will then remain as typically composed each of six appendage-bearing somites-the prosoma comprising in addition the ocular prosthomere.[1] When the praegenital somite or traces of it are present it should not be called "the seventh prosomatic" or the "first mesosomatic," but simply the "praegenital somite." The first segment of the mesosoma of Scorpio and Limulus thus remains the first segment, and can be identified as such throughout the Eu-arachnida, carrying as it always does the genital apertures. But it is necessary to remember, in the light of recent discoveries, that the sixth prosomatic pair of appendages is carried on the seventh somite of the whole series, there being two prosthomeres or somites in front of the mouth, the first carrying the eyes, the second the chelicerae; also that the first mesosomatic or genital somite is not the seventh or even the eighth of the whole senes of somites which have been historically present, but is the ninth, owing to the presence or to the excalation of a praegenital somite. It seems that confusion and trouble will be best avoided by abstaining from the introduction of the non-evident somites, the ocular and the praegenital, into the numerical nomenclature of the component somites of the three great body regions. We shall, therefore, ignoring the ocular somite, speak of the first, second, third, fourth, fifth and sixth leg-bearing somites of the prosoma, and indicate the appendages by the Roman numerals, I, II, III, IV, V, VI, and whilst ignoring the praegenital somite we shall speak of the first, second, third, &c., somite of the mesosoma or opisthosoma (united mesosoma and metasoma) and indicate them by the Arabic numerals.

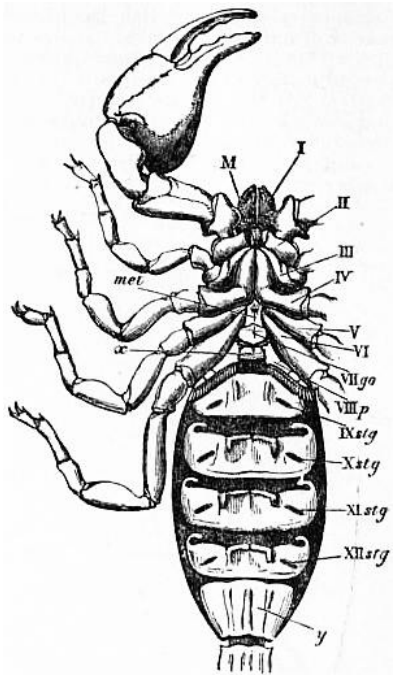


FIG. 10.—Ventral view of a scorpion, *Palamnaeus indus*, de Geer, to show the arrangement of the coxae of the limbs, the sternal elements, genital plate and pectens.

M, Mouth behind the oval median camerostome.
I, The chelicerae.
II, The chelae.
III to VI, the four pairs of walking legs.
VII*go*, The genital somite or first somite of the mesosoma with the genital operculum (a fused pair of limbs).
VIII*p*, The pectiniferous somite.
IX*stg* to XII*stg*, the four pulmonary somites.
met, The pentagonal metasternite of the prosoma behind all the coxae.
x, The sternum of the pectiniferous somite.
y, The broad first somite of the metasoma.

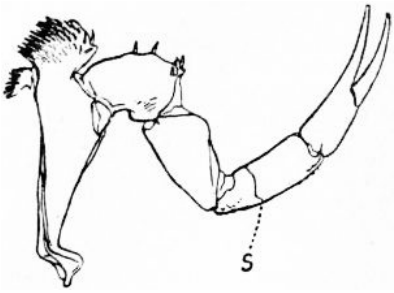


FIG. 11.—Third leg of *Limulus polyphemus*, showing the division of the fourth segment of the leg by a groove S into two, thus giving seven segments to the leg as in scorpion.

(From a drawing by Pocock.)

There are a number of other important points of structure besides those referring to the somites and appendages in which Limulus agrees with Scorpio or other Arachnida and differs from other Arthropoda. The chief of these are as follows:—

1. *The Composition of the Head* (that is to say, of the anterior part of the prosoma) *with especial Reference to the Region in Front of the Mouth.*—It appears (see ARTHROPODA) that there is embryological evidence of the existence of two somites in Arachnida which were originally post-oral, but have become prae-oral by adaptational shifting of the oral aperture. These forwardly-slipped somites are called "prosthomeres." The first of these has, in Arachnids as in other Arthropods, its pair of appendages represented by the eyes. The second has for its pair of appendages the small pair of limbs which in all living Arachnids is either chelate or retrovert (as in spiders), and is known as the chelicerae. It is possible, as maintained by some writers (Patten and others), that the lobes of the cerebral nervous mass in Arachnids indicate a larger number of prosthomeres as having fused in this region, but there is no *embryological* evidence at present which justifies us in assuming the existence in Arachnids of more than two prosthomeres. The position of the chelicerae of Limulus and of the ganglionic nerve-masses from which they receive their nerve-supply, is closely similar to that of the same structures in Scorpio. The cerebral mass is in Limulus more easily separated by dissection as a median lobe distinct from the laterally-placed ganglia of the chelceral somite than is the case in Scorpio, but the relations are practically the same in the two forms. Formerly it was supposed that in Limulus both the

chelicerae and the next following pair of appendages were prosthomerous, as in Crustacea, but the dissections of Alphonse Milne-Edwards (**6**) demonstrated the true limitations of the cerebrum, whilst embryological researches have done as much for Scorpio. Limulus thus agrees with Scorpio and differs from the Crustacea, in which there are three prosthomeres—one ocular and two carrying palpiform appendages. It is true that in the lower Crustacea (Apus, &c.) we have evidence of the gradual movement forward of the nerve-ganglia belonging to these palpiform appendages. But although in such lower Crustacea the nerve-ganglia of the third prosthomere have not fused with the anterior nerve-mass, there is no question as to the prae-oral position of two appendage-bearing somites in addition to the ocular prosthomere. The Crustacea have, in fact, three prosthomeres in the head and the Arachnida only two, and Limulus agrees with the Arachnida in this respect and differs from the Crustacea. The central nervous systems of Limulus and of Scorpio present closer agreement in structure than can be found when a Crustacean is compared with either. The wide divarication of the lateral cords in the prosoma and their connexion by transverse commissures, together with the “attraction” of ganglia to the prosomatic ganglion group which properly belong to hinder segments, are very nearly identical in the two animals. The form and disposition of the ganglion cells are also peculiar and closely similar in the two. (See Patten (**42**) for important observations on the neuromeres, &c., of Limulus and Scorpio.)

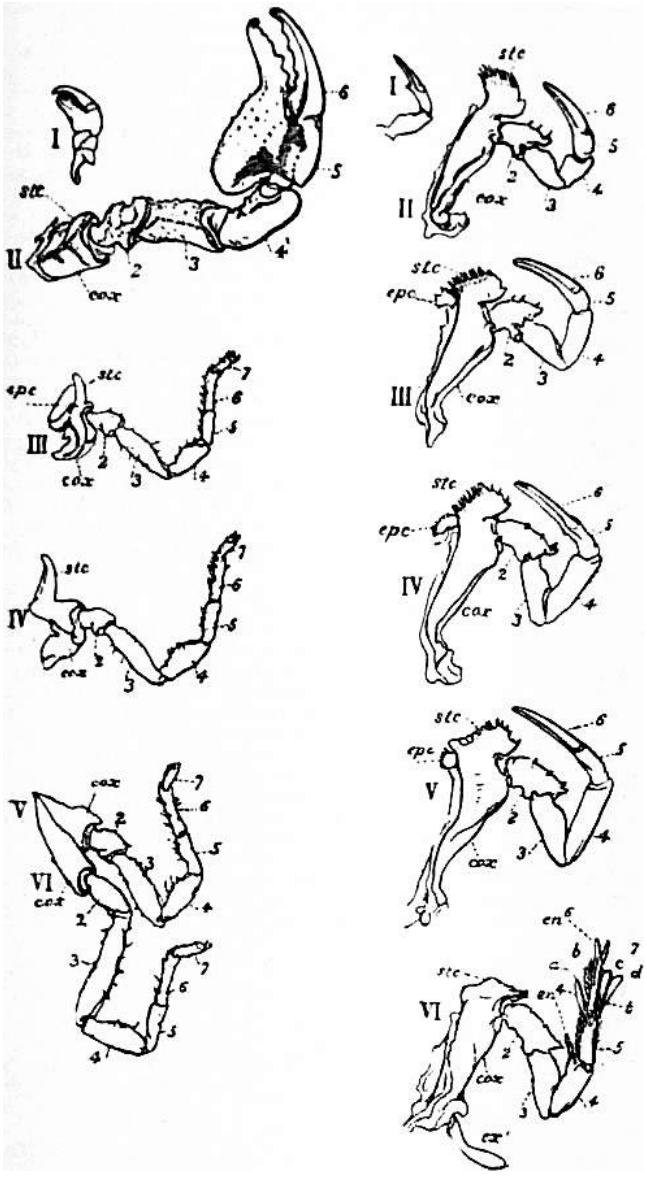


FIG. 12.—The prosomatic appendages of *Limulus polyphemus* (right) and Scorpio (left), *Palamnaeus indus* compared. The corresponding appendages are marked with the same Roman numeral. The Arabic numerals indicate the segments of the legs.

cox, Coxa or basal segment of the leg.
stc, The sterno-coxal process or jaw-like up-growth of the coxa.
epc, The articulated movable outgrowth of the coxa, called the epi-coxite (present only in III of the scorpion and III, IV and V of Limulus).
ex[1], The exopodite of the sixth limb of Limulus.
a, b, c, d, Movable processes on the same leg (see for some suggestions on the morphology of this leg, Pocock in *Quart. Journ. Micr. Sci.* March 1901; see also fig. 50 below and explanation).

(From Lankester, *loc. cit.*)

2. *The Minute Structure of the Central Eyes and of the Lateral Eyes.*—Limulus agrees with Scorpio not only in having a pair of central eyes and also lateral

eyes, but in the microscopic structure of those organs, which differs in the central and lateral eyes respectively. The central eyes are “simple eyes,” that is to say, have a single lens, and are hence called “monomeniscous.” The lateral eyes are in Limulus “compound eyes,” that is to say, consist of many lenses placed close together; beneath each lens is a complex of protoplasmic cells, in which the optic nerve terminates. Each such unit is termed an “ommatidium.” The lateral eyes of Scorpio consist of groups of separate small lenses each with its ommatidium, but they do not form a continuous compound eye as in Limulus. The ommatidium (soft structure beneath the lens-unit of a compound eye) is very simple in both Scorpio and Limulus. It consists of a single layer of cells, continuous with those which secrete the general chitinous covering of the prosoma. The cells of the ommatidium are a good deal larger than the neighbouring common cells of the epidermis. They secrete the knob-like lens (fig. 22). But they also receive the nerve fibres of the optic nerve. They are at the same time both optic nerve-end cells, that is to say, retina cells, and corneagen cells or secretors of the chitinous lens-like cornea. In Limulus (fig. 23) each ommatidium has a peculiar ganglion cell developed in a central position, whilst the ommatidium of the lateral eyelets of Scorpio shows small intermediate cells between the larger nerve-end cells. The structure of the lateral eye of Limulus was first described by Grenacher, and further and more accurately by Lankester and Bourne (**5**) and by Watase; that of Scorpio by Lankester and Bourne, who showed that the statements of von Graber were erroneous, and that the lateral eyes of Scorpio have a single cell-layered or “monostichous” ommatidium like that of Limulus. Watase has shown, in a very convincing way, how by deepening the pit-like set of cells beneath a simple lens the more complex ommatidia of the compound eyes of Crustacea and Hexapoda may be derived from such a condition as that presented in the lateral eyes of Limulus and Scorpio. (For details the reader is referred to Watase (**11**) and to Lankester and Bourne (**5**).) The structure of the central eyes of Scorpio and spiders and also of Limulus differs essentially from that of the lateral eyes in having two layers of cells (hence called diplostichous) beneath the lens, separated from one another by a membrane (figs. 24 and 25). The upper layer is the corneagen and secretes the lens, the lower is the retinal layer. The mass of soft cell-structures beneath a large lens of a central eye is called an “ommatoeum.” It shows in Scorpio and Limulus a tendency to segregate into minor groups or “ommatidia.” It is found that in embryological growth the retinal layer of the central eyes forms as a separate pouch, which is pushed in laterally beneath the corneagen layer from the epidermic cell layer. Hence it is in origin double, and consists of a true retinal layer and a post-retinal layer (fig. 24, B), though these are not separated by a membrane. Accordingly the diplostichous ommatoeum or soft tissue of the Arachnid’s central eye should strictly be called “triplostichous,” since the deep layer is itself doubled or folded. The retinal cells of both the lateral and central eyes of Limulus and Scorpio produce cuticular structures on their sides; each such piece is a rhabdomere and a number (five or ten) uniting form a rhabdom (fig. 26). In the specialized ommatidia of the compound eyes of Crustacea and Hexapods the rhabdom is an important structure.[2] It is a very significant fact that the lateral and central eyes of Limulus and Scorpio not only agree each with each in regard to their monostichous and diplostichous structure, but also in the formation in both classes of eyes of rhabdomeres and rhabdoms in which the component pieces are five or a multiple of five (fig. 26). Whilst each unit of the lateral eye of Limulus has a rhabdom of ten[3] pieces forming a star-like chitinous centre in section, each lateral eye of Scorpio has several rhabdoms of five or less rhabdomeres, indicating that the Limulus lateral eye-unit is more specialized than the detached lateral eyelet of Scorpio, so as to present a coincidence of one lens with one rhabdom. Numerous rhabdomeres (grouped as rhabdoms in Limulus) are found in the retinal layer of the central eyes also.

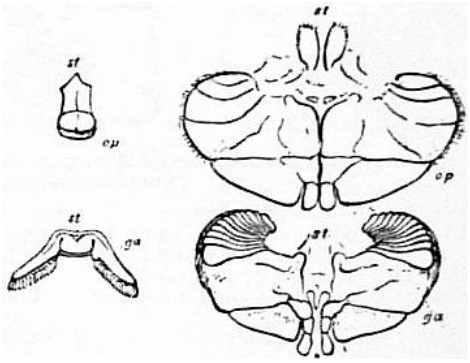


FIG. 13.—Diagrams of the metasternite *st*, with genital operculum *op*, and the first lamelligerous pair of appendages *ga*, with uniting sternal element *st* of Scorpio (left) and Limulus (right).

(From Lankester, *loc. cit.*)

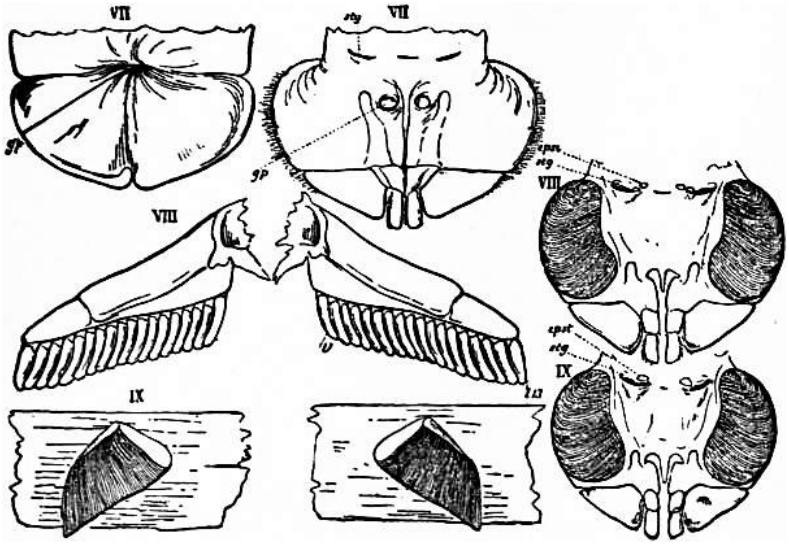


FIG. 14.—The first three pairs of mesosomatic appendages of Scorpio and Limulus compared.

VII, The genital operculum.
VIII, The pectens of Scorpio and the first branchial plate of Limulus.
IX, The first pair of lung-books of
gp, Genital pore.
epst, Epistigmatic sclerite.
stg, Stigma or orifice of the hollow tendons of the branchial plates of

Scorpio and the second branchial plate of Limulus. Limulus.

(After Lankester, *loc. cit.*)

Whilst Limulus agrees thus closely with Scorpio in regard to the eyes, it is to be noted that no Crustacean has structures corresponding to the peculiar diplostichous central eyes, though these occur again (with differences in detail) in *Hexapoda*. Possibly, however, an investigation of the development of the median eyes of some Crustacea (Apus, Palaemon) may prove them to be diplostichous in origin.

3. *The so-called "Coxal Glands."*—In 1882 (*Proc. Roy. Soc*. No. 221) Lankester described under the name "coxal glands" a pair of brilliantly white oviform bodies lying in the Scorpion's prosoma immediately above the coxae of the fifth and sixth pairs of legs (fig. 27). These bodies had been erroneously supposed by Newport (**12**) and other observers to be glandular outgrowths of the alimentary canal. They are really excretory glands, and communicate with the exterior by a very minute aperture on the posterior face of the coxa of the fifth limb on each side. When examined with the microscope, by means of the usual section method, they are seen to consist of a labyrinthine tube lined with peculiar cells, each cell having a deep vertically striated border on the surface farthest from the lumen, as is seen in the cells of some renal organs. The coils and branches of the tube are packed by connective tissue and blood spaces. A similar pair of coxal glands, lobate instead of ovoid in shape, was described by Lankester in Mygale, and it was also shown by him that the structures in Limulus called "brick-red glands" by Packard have the same structure and position as the coxal glands of Scorpio and Mygale. In Limulus these organs consist each of four horizontal lobes lying on the coxal margin of the second, third, fourth, and fifth prosomatic limbs, the four lobes being connected to one another by a transverse piece or stem (fig. 28). Microscopically their structure is the same in essentials as that of the coxal glands of Scorpio (**13**). Coxal glands have since been recognized and described in other Arachnida. In 1900 it was shown that the coxal gland of Limulus is provided with a very delicate thin-walled coiled duct which opens, even in the adult condition, by a minute pore on the coxa of the fifth leg (Patten and Hazen, **13A**). Previously to this, Lankester's pupil Gulland had shown (1885) that in the embryo the coxal gland is a comparatively simple tube, which opens to the exterior in this position and by its other extremity into a coelomic space. Similar observations were made by Laurie (**17**) in Lankester's laboratory (1890) with regard to the early condition of the coxal gland of Scorpio, and by Bertkau (**41**) as to that of the spider Atypus. H.M. Bernard (**13B**) showed that the opening remains in the adult scorpion. In all the embryonic or permanent opening is on the coxa of the fifth pair of prosomatic limbs. Thus an organ newly discovered in Scorpio was found to have its counterpart in Limulus.

The name "coxal gland" needs to be carefully distinguished from "crural gland," with which it is apt to be confused. The crural glands, which occur in many terrestrial Arthropods, are epidermal in origin and totally distinct from the coxal glands. The coxal glands of the Arachnida are structures of the same nature as the green glands of the higher Crustacea and the so-called "shell glands" of the Entomostraca. The latter open at the base of the fifth pair of limbs of the Crustacean, just as the coxal glands open on the coxal joint of the fifth pair of limbs of the Arachnid. Both belong to the category of "coelomoducts," namely, tubular or funnel-like portions of the coelom opening to the exterior in pairs in each somite (potentially,) and usually persisting in only a few somites as either "urocoels" (renal organs) or "gonocoets" (genital tubes). In Peripatus they occur in every somite of the body. They have till recently been very generally identified with the nephridia of Chaetopod worms, but there is good reason for considering the true nephridia (typified by the nephridia of the earthworm) as a distinct class of organs (see Lankester in vol. ii. chap. in. of *A Treatise on Zoology*, 1900). The genital ducts of Arthropoda are, like the green glands, shell glands and coxal glands, to be regarded as coelomoducts (gonocoels). The coxal glands do not establish any special connexion between Limulus and Scorpio, since they also occur in the same somite in the lower Crustacea, but it is to be noted that the coxal glands of Limulus are in minute structure and probably in function more like those of Arachnids than those of Crustacea.

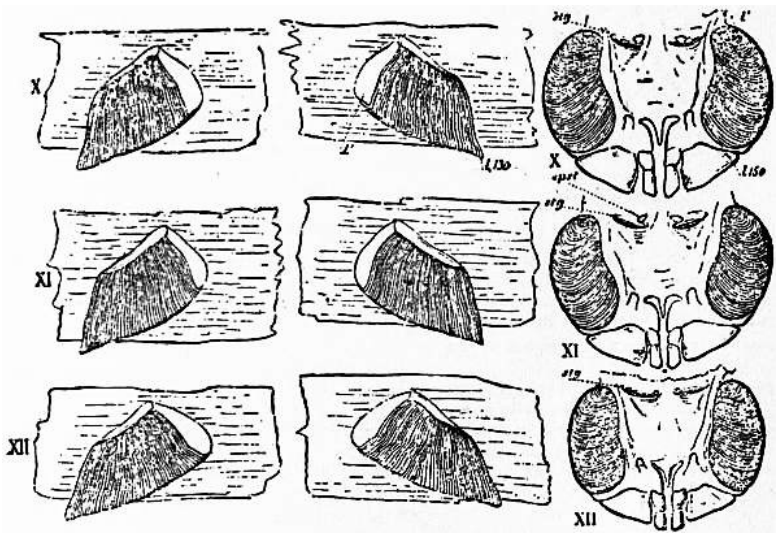


FIG. 15.—The remaining three pairs of mesosomatic appendages of Scorpio and Limulus. Letters as in fig. 14. *l*130 indicates that there are 130 lamellae in the scorpion's lung-book, whilst *l*150 indicates that 150 similar lamellae are counted in the gill of Limulus.

(After Lankester, *loc. cit.*)

4. *The Entosternites and their Minute Structure.*—Strauss-Dürckheim (**1**) was the first to insist on the affinity between Limulus and the Arachnids, indicated by the presence of a free suspended entosternum or plastron or entosternite in both. We have figured here (figs. 1 to 6) the entosternites of Limulus, Scorpio and Mygale. Lankester some years ago made a special study of the histology (**3**) of these entosternites for the

purpose of comparison, and also ascertained the relations of the very numerous muscles which are inserted into them (**4**). The entosternites are cartilaginous in texture, but they have neither the chemical character nor the microscopic structure of the hyaline cartilage of Vertebrates. They yield chitin in place of chondrin or gelatin—as does also the cartilage of the Cephalopod's endoskeleton. In microscopic structure they all present the closest agreement with one another. We find a firm, homogeneous or sparsely fibrillated matrix in which are embedded nucleated cells (corpuscles of protoplasm) arranged in rows of three, six or eight, parallel with the adjacent lines of fibrillation.

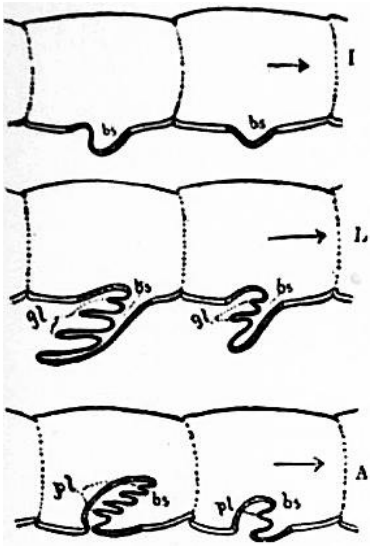


FIG. 16.—Diagram to show the way in which an outgrowing gill-process bearing blood-holding lamellae, may give rise, if the sternal body wall sinks inwards, to a lung-chamber with air-holding lamellae.

I is the embryonic condition.
bs, Blood sinus.
L is the condition of outgrowth with *gl*, gill lamellae.
A is the condition of in-sinking of the sternal surface and consequent enclosure of the lamelligerous surface of the appendage in a chamber with narrow orifice—the pulmonary air-holding chamber.
pl, Pulmonary lamellae.
bs, Blood sinus.

(After Kingsley.)

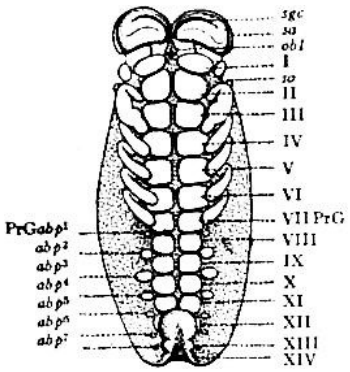


FIG. 17.—Embryo of scorpion, ventral view showing somites and appendages.

sgc, Frontal groove.
sa, Rudiment of lateral eyes.
obl, Camerostome (upper lip).
so, Sense-organ of Patten.
PrG*abp*^{1}, Rudiment of the appendage of the praegenital somite which disappears.
abp^2, Rudiment of the right half of the genital operculum.
abp^3, Rudiment of the right pecten.
abp^4 to *abp*^{7}. Rudiments of the four appendages which carry the pulmonary lamellae.
I to VI, Rudiments of the six limbs of the prosoma.
VIIPrG, The evanescent praegenital somite.
VIII, The first mesosomatic somite or genital somite.
IX, The second mesosomatic somite or pectiniferous somite.
X to XIII, The four pulmoniferous somites.
XIV, The first metasomatic somite.

(After Brauer, *Zeitsch. wiss. Zool.*, vol. lix., 1895.)

A minute entosternite having the above-described structure is found in the Crustacean Apus between the bases of the mandibles, and also in the Decapoda in a similar position, but in no Crustacean does it attain to any size or importance. On the other hand, the entosternite of the Arachnida is a very large and important feature in the structure of the prosoma, and must play an important part in the economy of these organisms. In Limulus (figs. 1 and 2) it has as many as twenty-five pairs of muscles attached to it, coming to it from the bases of the surrounding limbs and from the dorsal carapace and from the pharynx. It consists of an oblong plate 2 in. in length and 1 in breadth, with a pair of tendinous outgrowths standing out from it at right angles on each side. It "floats" between the prosomatic nerve centres and the alimentary canal. In each somite of the mesosoma is a small, free entosternite having a similar position, but below or ventral to the nerve cords, and having a smaller number of muscles attached to it. The entosternite was probably in origin part of the fibrous connective tissue lying close to the integument of the sternal surface—giving attachment to muscles corresponding more or less to those at present attached to it. It became isolated and detached, why or with what advantage to the organism it is difficult to say, and at that period of Arachnidan development the great ventral nerve cords occupied a more lateral position than they do at present. We know that such a lateral position of the nerve cords preceded the median position in both Arthropoda and Chaetopoda. Subsequently to the floating off of the entosternite the approximation of the nerve cords took place in the prosoma, and thus they were able to take up a position below the entosternite. In the mesosoma the approximation had occurred before the entosternites were formed.

In the scorpion (figs. 3 and 4) the entosternite has tough membrane-like outgrowths which connect it with the body-wall, both dorsally and ventrally forming an oblique diaphragm, cutting off the cavity of the prosoma from that of the mesosoma. It was described by

Newport as “the diaphragm.” Only the central and horizontal parts of this structure correspond precisely to the entosternite of Limulus: the right and left anterior processes (marked *ap* in figs. 3 and 4, and RAP, LAP, in figs. 1 and 2) correspond in the two animals, and the median lateral process *lmp* of the scorpion represents the tendinous outgrowths ALR, PLR of Limulus. The scorpion’s entosternite gives rise to outgrowths, besides the great posterior flaps, *pf*, which form the diaphragm, unrepresented in Limulus. These are a ventral arch forming a neural canal through which the great nerve cords pass (figs. 3 and 4, *snp*), and further a dorsal gastric canal and arterial canal which transmit the alimentary tract and the dorsal artery respectively (figs. 3 and 4, GC, DR).

In Limulus small entosternites are found in each somite of the appendage-bearing mesosoma, and we find in Scorpio, in the only somite of the mesosoma which has a well-developed pair of appendages, that of the pectens, a small entosternite with ten pairs of muscles inserted into it. The supra-pectinal entosternite lies ventral to the nerve cords.

In Mygale (figs. 5 and 6) the form of the entosternite is more like that of Limulus than is that of Scorpio. The anterior notch Ph.N. is similar to that in Limulus, whilst the imbricate triangular pieces of the posterior median region resemble the similarly-placed structures of Limulus in a striking manner.

It must be confessed that we are singularly ignorant as to the functional significance of these remarkable organs—the entosternites. Their movement in an upward or downward direction in Limulus and Mygale must exert a pumping action on the blood contained in the dorsal arteries and the ventral veins respectively. In Scorpio the completion of the horizontal plate by oblique naps, so as to form an actual diaphragm shutting off the cavity of the prosoma from the rest of the body, possibly gives to the organs contained in the anterior chamber a physiological advantage in respect of the supply of arterial blood and its separation from the venous blood of the mesosoma. Possibly the movement of the diaphragm may determine the passage of air into or out of the lung-sacs. Muscular fibres connected with the suctorial pharynx are in Limulus inserted into the entosternite, and the activity of the two organs may be correlated.

5. *The Blood and the Blood-vascular System.*—The blood fluids of Limulus and Scorpio are very similar. Not only are the blood corpuscles of Limulus more like in form and granulation to those of Scorpio than to those of any Crustacean, but the fluid is in both animals strongly impregnated with the blue-coloured respiratory proteid, haemocyanin. This body occurs also in the blood of Crustacea and of Molluscs, but its abundance in both Limulus and Scorpio is very marked, and gives to the freshly-shed blood a strong indigo-blue tint.

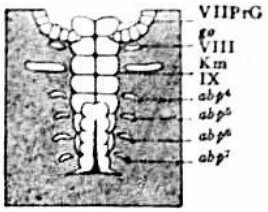


FIG. 18.—Portion of a similar embryo at a later stage of growth. The praegenital somite, VII PrG, is still present, but has lost its rudimentary appendages; *go*, the genital operculum, left half; Km, the left pecten; abp^4 to abp^7, the rudimentary appendages of the lung-sacs.

(After Brauer, *loc. cit.*)

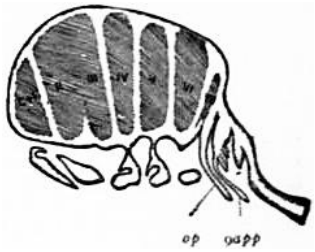


FIG. 19.—Section through an early embryo of *Limulus longispina*, showing seven transverse divisions in the region of the unsegmented anterior carapace. The seventh, VII, is anterior to the genital operculum, *op*, and is the cavity of the praegenital somite which is more or less completely suppressed in subsequent development, possibly indicated by the area marked VII in fig. 7 and by the great entopophyses of the prosomatic carapace.

(After Kishinouye, *Journ. Sci. Coll. Japan*, vol. v., 1892.)

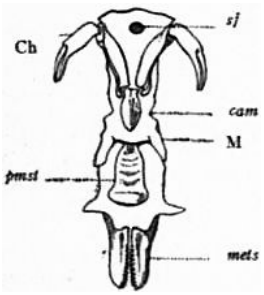


FIG. 20.—View of the ventral surface of the mid-line of the prosomatic region of *Limulus polyphemus*. The coxae of the five pairs of limbs following the chelicerae were arranged in a series on each side between the mouth, M, and the metasternites, *mets*.

sf, The sub-frontal median sclerite.
Ch, The chelicerae.
cam, The camerostome or upper lip.
M, The mouth.
pmst, The promesosternal sclerite of chitinous plate, unpaired.
mets, The right and left metasternites (corresponding to the similarly placed pentagonal sternite of Scorpio). Natural size.

(After Lankester.)

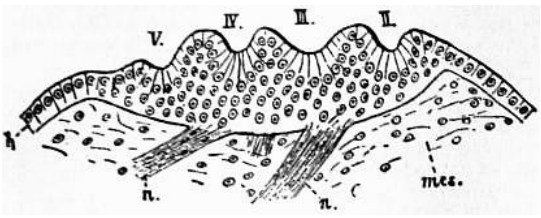
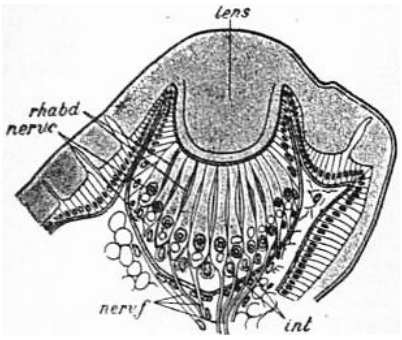


FIG. 2l.—Development of the lateral eyes of a scorpion. *h*, Epidermic cell-layer; *mes*, mesoblastic connective tissue; *n*, nerves; II, III, IV, V, depressions of the epidermis in each of which a cuticular lens will be formed.

(*From Korschelt and Heider, after Laurie.*)

FIG. 22.—Section through the lateral eye of *Euscorpius italicus*.



lens, Cuticular lens.
nerv c, Retinal cells (nerve-end cells).
rhabd, Rhabdomes.
nerv f, Nerve fibres of the optic nerve.
int, Intermediate cells (lying between the bases of the retinal cells).

(After Lankester and Bourne from Parker and Habwell's *Text book of Zoology*, Macmillan & Co.)

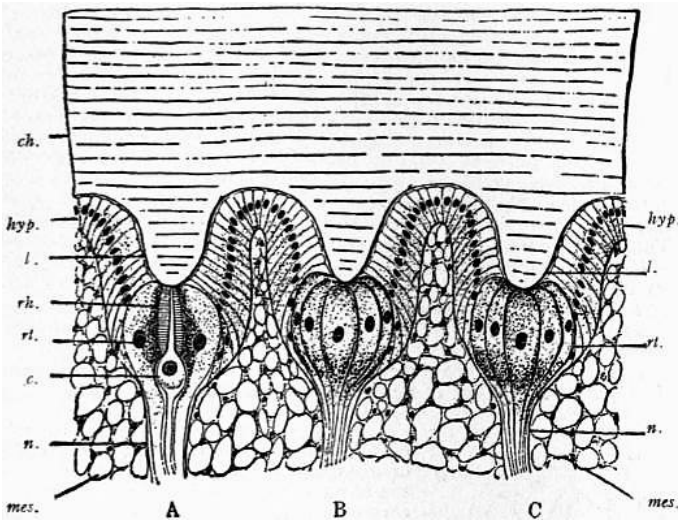


FIG. 23.—Section through a portion of the lateral eye of Limulus, showing three ommatidia—A, B and C. *hyp*, The epidermic cell-layer (so-called hypodermis), the cells of which increase in volume below each lens, *l*, and become nerve-end cells or retinula-cells, *rt*; in A, the letters *rh* point to a rhabdomere secreted by the cell *rt*; *c*, the peculiar central spherical cell; *n*, nerve fibres; *mes*, mesoblastic skeletal tissue; *ch*, chitinous cuticle.
(From Korschelt and Heider after Watase.)

The great dorsal contractile vessel or "heart" of Limulus is closely similar to that of Scorpio; its ostia or incurrent orifices are placed in the same somites as those of Scorpio, but there is one additional posterior pair. The origin of the paired arteries from the heart differs in Limulus from the arrangement obtaining in Scorpio, in that a pair of lateral commissural arteries exist in Limulus (as described by Alphonse Milne-Edwards (**6**)) leading to a suppression of the more primitive direct connexion of the four pairs of posterior lateral arteries and of the great median posterior arteries with the heart itself (fig. 29). The arterial system is very completely developed in both Limulus and Scorpio, branching repeatedly until minute arterioles are formed, not to be distinguished from true capillaries; these open into irregular swollen vessels which are the veins or venous sinuses. A very remarkable feature in Limulus, first described by Owen, is the close accompaniment of the prosomatic nerve centres and nerves by arteries, so close indeed that the great ganglion mass and its out-running nerves are actually sunk in or invested by arteries. The connexion is not so intimate in Scorpio, but is nevertheless a very close one, closer than we find in any other Arthropods in which the arterial system is well developed, *e.g.* the Myriapoda and some of the arthrostracous Crustacea. It seems that there is a primitive tendency in the Arthropoda for the arteries to accompany the nerve cords, and a "supra-spinal" artery—that is to say, an artery in close relation to the ventral nerve cords—has been described in several cases. On the other hand, in many Arthropods, especially those which possess tracheae, the arteries do not have a long course, but soon open into wide blood sinuses. Scorpio certainly comes nearer to Limulus in the high development of its arterial system, and the intimate relation of the anterior aorta and its branches to the nerve centres and great nerves, than does any other Arthropod.

An arrangement of great functional importance in regard to the venous system must now be described, which was shown in 1883 by Lankester to be common to Limulus and Scorpio. This arrangement has not hitherto been detected in any other class than the Arachnida, and if it should ultimately prove to be peculiar to that group, would have considerable weight as a proof of the close genetic affinity of Limulus and Scorpio.

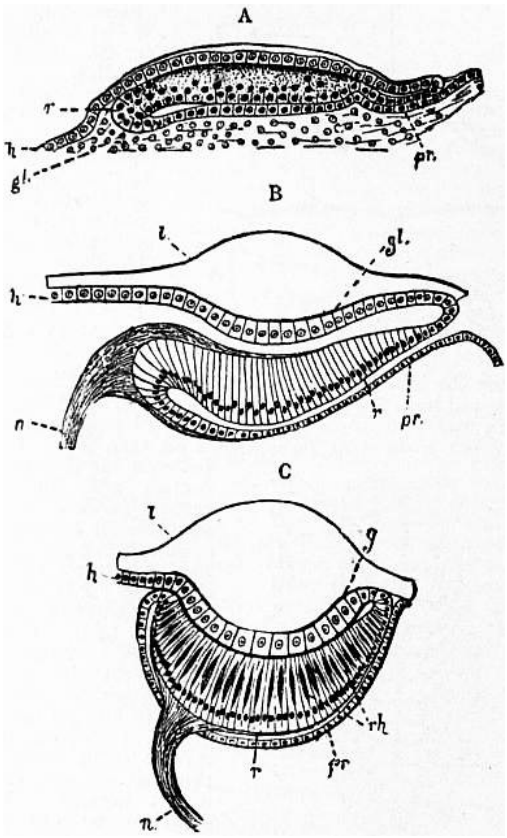


FIG. 24.—Diagrams of the development and adult structure of one of the paired central eyes of a scorpion.

A, Early condition before the lens is deposited, showing the folding of the epidermic cell-layer into three.
B, Diagram showing the nature of this infolding.
C, Section through the fully formed eye.
h, Epidermic cell-layer.
r, The retinal portion of the same which, owing to the infolding, lies between *gl*, the corneagen or lens-forming portion, and *pr*, the post-retinal or capsular portion or fold.
l, Cuticular lens.
g, Line separating lens from the lens-forming or corneagen cells of the epidermis.
n, Nerve fibres.
rh, Rhabdomeres.
[How the inversion of the nerve-end-cells and their connexion with the nerve-fibres is to be reconciled with the condition found in the adult, or with that of the monostichous eye, has not hitherto been explained.]

(From Korschelt and Heider.)

The great pericardial sinus is strongly developed in both animals. Its walls are fibrous and complete, and it holds a considerable volume of blood when the heart itself is contracted. Opening in pairs in each somite, right and left into the pericardial sinus are large veins, which bring the blood respectively from the gill-books and the lung-books to that chamber, whence it passes by the ostia into the heart. The blood is brought to the respiratory organs in both cases by a great venous collecting sinus having a ventral median position. In both animals *the wall of the pericardial sinus is connected by vertical muscular bands to the wall of the ventral venous sinus* (its lateral expansions around the lung-books in Scorpio) in each somite through which the pericardium passes. There are seven pairs of these *veno-pericardiac vertical muscles* in Scorpio, and eight in Limulus (see figs. 30, 31, 32). It is obvious that the contraction of these muscles must cause a depression of the floor of the pericardium and a rising of the roof of the ventral blood sinus, and a consequent increase of volume and flow of blood to each. Whether the pericardium and the ventral sinus are made to expand simultaneously or all the movement is made by one only of the surfaces concerned, must depend on conditions of tension. In any case it is clear that we have in these muscles an apparatus for causing the blood to flow differentially in increased volume into either the pericardium, through the veins leading from the respiratory organs, or from the body generally into the great sinuses which bring the blood to the respiratory organs. These muscles act so as to pump the blood through the respiratory organs.

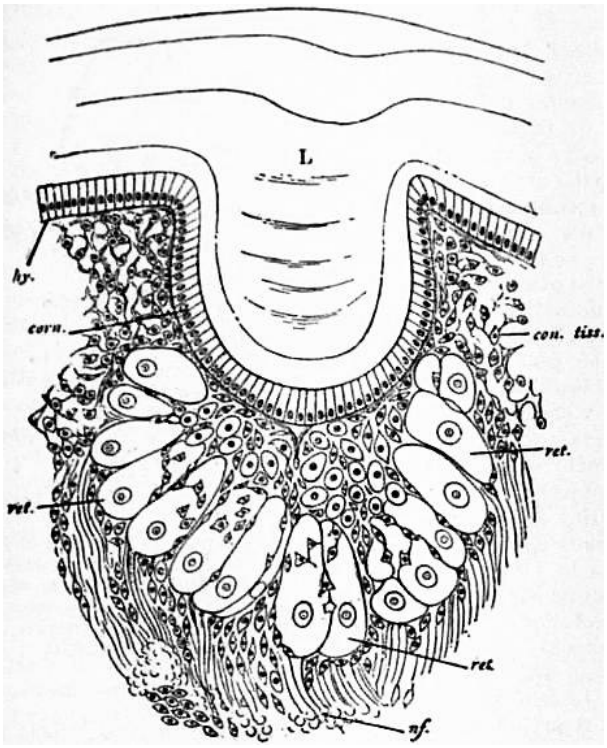


FIG. 25.—Section through one of the central eyes of a young Limulus.

L, Cuticular or corneous lens.
hy, Epidermic cell-layer.
corn, Its corneagen portion immediately underlying the lens.
ret, Retinula cells.
nf, Nerve fibres.
con. tiss, Connective tissue (mesoblastic skeletal tissue).

(After Lankester and Bourne, *Q. J. Mic. Sci.*, 1883.)

It is not surprising that with so highly developed an arterial system Limulus and Scorpio should have a highly developed mechanism for determining the flow of blood to the respiratory organs. That this is, so to speak, a need of animals with localized respiratory organs is seen by the existence of provisions serving a similar purpose in other animals, *e.g.* the branchial hearts of the Cephalopoda.

The veno-pericardiac muscles of Scorpio were seen and figured by Newport but not described by him. Those of Limulus were described and figured by Alphonse Milne-Edwards, but he called them merely "transparent ligaments," and did not discover their muscular structure. They are figured and their importance for the first time recognized in the memoir on the muscular and skeletal systems of Limulus and Scorpio by Lankester, Beck and Bourne (**4**).

6. *Alimentary Canal and Gastric Glands.*—The alimentary canal in Scorpio, as in Limulus, is provided with a powerful suctorial pharynx, in the working of which extrinsic muscles take a part. The mouth is relatively smaller in Scorpio than in Limulus—in fact is minute, as it is in all the terrestrial Arachnida which suck the juices of either animals or plants. In both, the alimentary canal takes a straight course from the pharynx (which bends under it downwards and backwards towards the mouth in Limulus) to the anus, and is a simple, narrow, cylindrical tube (fig. 33). The only point in which the gut of Limulus resembles that of Scorpio rather than that of any of the Crustacea, is in possessing more than a single pair of ducts or lateral outgrowths connected with ramified gastric glands or gastric caeca. Limulus has two pairs of these, Scorpio as many as six pairs. The Crustacea never have more than one pair. The minute microscopic structure of the gastric glands in the two animals is practically identical. The functions of these gastric diverticula have never been carefully investigated. It is very probable that in Scorpio they do not serve merely to secrete a digestive fluid (shown in other Arthropoda to resemble the pancreatic fluid), but that they also become distended by the juices of the prey sucked in by the scorpion—as certainly must occur in the case of the simple unbranched gastric caeca of the spiders.

The most important difference which exists between the structure of Limulus and that of Scorpio is found in the hinder region of the alimentary canal. Scorpio is here provided with a single or double pair of renal excretory tubes, which have been identified by earlier authors with the Malpighian tubes of the Hexapod and Myriapod insects. Limulus is devoid of any such tubes. We shall revert to this subject below.

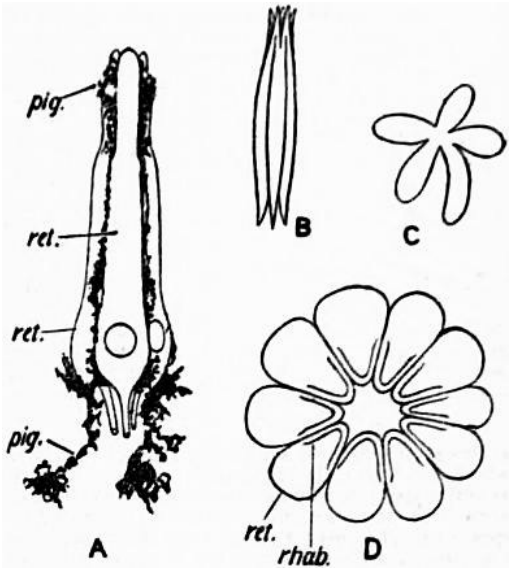


FIG. 26.

A, Diagram of a retinula of the central eye of a scorpion consisting of five retina-cells (*ret*), with adherent branched pigment cells (*pig*).

B, Rhabdom of the same, consisting of five confluent rhabdomeres.

C, Transverse section of the rhabdom of a retinula of the scorpion's central eye, showing its five constituent rhabdomeres as rays of a star.

D, Transverse section of a retinula of the lateral eye of Limulus, showing ten retinula cells (*ret*), each bearing a rhabdomere (*rhab*).

(After Lankester.)

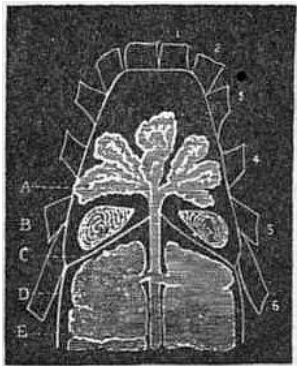


FIG. 27.—Diagram showing the position of the coxal glands of a scorpion, *Buthus australis*, Lin., in relation to the legs, diaphragm (entosternal flap), and the gastric caeca.

1 to 6, The bases of the six prosomatic limbs.
A, prosomatic gastric gland (sometimes called salivary).
B, Coxal gland.
C, Diaphragm of Newport = fibrous flap of the entosternum.
D, Mesosomatic gastric caeca (so-called liver).
E, Alimentary canal.

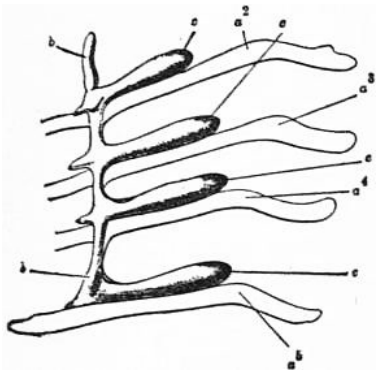
(From Lankester, *Q. J. Mic. Sci.*, vol. xxiv. N.S. p. 152.)

7. *Ovaries and Spermaries: Gonocoels and Gonoducts.*—The scorpion is remarkable for having the specialized portion of coelom from the walls of which egg-cells or sperm-cells are developed according to sex, in the form of a simple but extensive network. It is not a pair of simple tubes, nor of dendriform tubes, but a closed network. The same fact is true of Limulus, as was shown by Owen (**7**) in regard to the ovary, and by Benham (**14**) in regard to the testis. This is a very definite and remarkable agreement, since such a reticular gonocoel is not found in Crustacea (except in the male Apus). Moreover, there is a significant agreement in the character of the spermatozoa of Limulus and Scorpio. The Crustacea are—with the exception of the Cirrhipedia—remarkable for having stiff, motionless spermatozoids. In Limulus Lankester found (**15**) the spermatozoa to possess active flagelliform "tails," and to resemble very closely those of Scorpio which, as are those of most terrestrial Arthropoda, are actively motile. This is a microscopic point of agreement, but is none the less significant.

In regard to the important structures concerned with the fertilization of the egg, Limulus and Scorpio differ entirely from one another. The eggs of Limulus are fertilized in the sea after they have been laid. Scorpio, being a terrestrial animal, fertilizes by copulation. The male possesses elaborate copulatory structures of a chitinous nature, and the eggs are fertilized in the female without even quitting the place where they are formed on the wall of the reticular gonocoel. The female scorpion is viviparous, and the young are produced in a highly developed condition as fully formed scorpions.

FIG. 28.—The right coxal gland of *Limulus polyphemus*, Latr.

a^2 to a^5, Posterior borders of the chitinous bases of the coxae



of the second, third, fourth and fifth prosomatic limbs.
b, Longitudinal lobe or stolon of the coxal gland.
c. Its four transverse lobes or outgrowths corresponding to the four coxae.

(From Lankester, *loc. cit.*, after Packard.)

Differences between Limulus and Scorpio.—We have now passed in review the principal structural features in which Limulus agrees with Scorpio and differs from other Arthropoda. There remains for consideration the one important structural difference between the two animals. Limulus agrees with the majority of the Crustacea in being destitute of renal excretory caeca or tubes opening into the hinder part of the gut. Scorpio, on the other hand, in common with all air-breathing Arthropoda except Peripatus, possesses these tubules, which are often called Malpighian tubes. A great deal has been made of this difference by some writers. It has been considered by them as proving that Limulus, in spite of all its special agreements with Scorpio (which, however, have scarcely been appreciated by the writers in question), really belongs to the Crustacean line of descent, whilst Scorpio, by possessing Malpighian tubes, is declared to be unmistakably tied together with the other Arachnida to the tracheate Arthropods, the Hexapods, Diplopods, and Chilopods, which all possess Malpighian tubes.

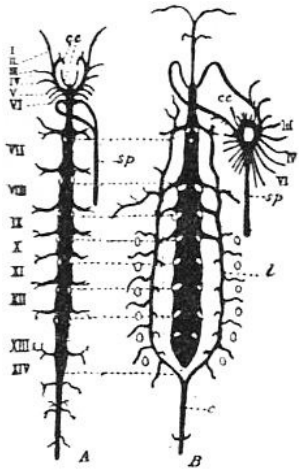


FIG. 29.—Diagram of the arterial system of A, Scorpio, and B, Limulus. The Roman numerals indicate the body somites and the two figures are adjusted for comparison. *ce*, Cerebral arteries; *sp*, supra-spinal or medullary artery; *c*, caudal artery; *l*, lateral anastomotic artery of Limulus. The figure B also shows the peculiar neural investiture formed by the cerebral arteries in Limulus and the derivation from this of the arteries to the limbs, III, IV, VI, whereas in Scorpio the latter have a separate origin from the anterior aorta.

From Lankester, "Limulus an Arachnid."

It must be pointed out that the presence or absence of such renal excretory tubes opening into the intestine appears to be a question of adaptation to the changed physiological conditions of respiration, and not of morphological significance, since a pair of renal excretory tubes of this nature is found in certain Amphipod Crustacea (Talorchestia, &c.) which have abandoned a purely aquatic life. This view has been accepted and supported by Professors Korschelt and Heider (**16**). An important fact in its favour was discovered by Laurie (**17**), who investigated the embryology of two species of Scorpio under Lankester's direction. It appears that the Malpighian tubes of Scorpio are developed from the mesenteron, viz. that portion of the gut which is formed by the hypoblast, whereas in Hexapod insects the similar caecal tubes are developed from the proctodaeum or in-pushed portion of the gut which is formed from epiblast. In fact it is not possible to maintain that the renal excretory tubes of the gut are of one common origin in the Arthropoda. They have appeared independently in connexion with a change in the excretion of nitrogenous waste in Arachnids, Crustacea, and the other classes of Arthropoda when aerial, as opposed to aquatic, respiration has been established—and they have been formed in some cases from the mesenteron, in other cases from the proctodaeum. Their appearance in the air-breathing Arachnids does not separate those forms from the water-breathing Arachnids which are devoid of them, any more than does their appearance in certain Amphipoda separate those Crustaceans from the other members of the class.

Further, it is pointed out by Korschelt and Heider that the hinder portion of the gut frequently acts in Arthropoda as an organ of nitrogenous excretion in the absence of any special excretory tubules, and that the production of such caeca from its surface in separate lines of descent does not involve any elaborate or unlikely process of growth. In other words, the Malpighian tubes of the terrestrial Arachnida are *homoplastic* with those of Hexapoda and Myriapoda, and not *homogenetic* with them. We are compelled to take a similar view of the agreement between the tracheal air-tubes of Arachnida and other tracheate Arthropods. They are homoplasts (see **18**) one of another, and do not owe their existence in the various classes compared to a common inheritance of an ancestral tracheal system.

Conclusions arising from the Close Affinity of Limulus and Scorpio.—When we consider the relationships of the various classes of Arthropoda, having accepted and established the fact of the close genetic affinity of Limulus and Scorpio, we are led to important conclusions. In such a consideration we have to make use not only of the fact just mentioned, but of three important generalizations which serve as it were as implements for the

proper estimation of the relationships of any series of organic forms. First of all there is the generalization that the relationships of the various forms of animals (or of plants) to one another is that of the ultimate twigs of a much-branching genealogical tree. Secondly, identity of structure in two organisms does not necessarily indicate that the identical structure has been inherited from an ancestor common to the two organisms compared (homogeny), but may be due to independent development of a like structure in two different lines of descent (homoplasy). Thirdly, those members of a group which, whilst exhibiting undoubted structural characters indicative of their proper assignment to that group, yet are simpler than and inferior in elaboration of their organization to other members of the group, are not necessarily representatives of the earlier and primitive phases in the development of the group—but are very often examples of retrogressive change or degeneration. The second and third implements of analysis above cited are of the nature of cautions or checks. Agreements are not *necessarily* due to common inheritance; simplicity is not *necessarily* primitive and ancestral.

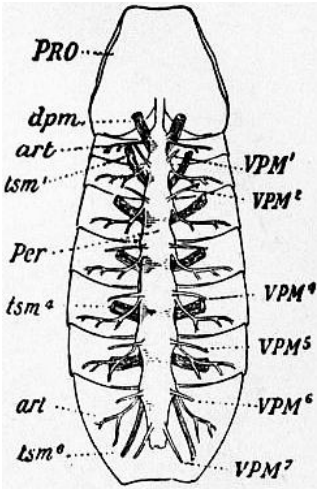


FIG. 30.—View from below of a scorpion (*Buthus occitanus*) opened and dissected so as to show the pericardium with its muscles, the lateral arteries, and the tergo-sternal muscles.

PRO, Prosoma.
dpm, Dorso-plastral muscle.
art, Lateral artery.
tsm[1], Tergo-sternal muscle (labelled *dv* in fig. 31) of the second (pectiniferous) mesosomatic somite; this is the most anterior pair of the series of six, none are present in the genital somite.
tsm[4], Tergo-sternal muscle of the fifth mesosomatic somite.
tsm[6], Tergo-sternal muscle of the enlarged first metasomatic somite.
Per, Pericardium.
VPM[1] to VPM[7], The series of seven pairs of veno-pericardiac muscles (labelled *pv* in fig. 31).

There is some reason to admit the existence of another more anterior pair of these muscles in Scorpio; this would make the number exactly correspond with the number in Limulus.

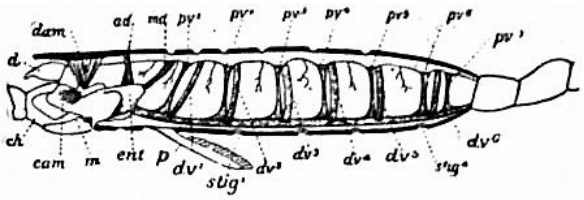
(After Lankester, *Trans. Zool. Soc.* vol. xi, 1883.)

On the other hand, we must not rashly set down agreements as due to "homoplasy" or "convergence of development" if we find two or three or more concurrent agreements. The probability is against agreement being due to homoplasy when the agreement involves a number of really separate (not correlated) coincidences. Whilst the chances are in favour of some *one* homoplastic coincidence or structural agreement occurring between some member or other of a large group *a* and some member or other of a large group *b*, the matter is very different when by such an initial coincidence the two members have been particularized. The chances against these two selected members exhibiting *another* really independent homoplastic agreement are enormous: let us say 10,000 to 1. The chances against yet another coincidence are a hundred million to one, and against yet one more "coincidence" they are the square of a hundred million to one. Homoplasy can only be assumed when the coincidence is of a simple nature, and is such as may be reasonably supposed to have arisen by the action of like selective conditions upon like material in two separate lines of descent.[4]

So, too, degeneration is not to be lightly assumed as the explanation of a simplicity of structure. There is a very definite criterion of the simplicity due to degeneration, which can in most cases be applied. Degenerative simplicity is never uniformly distributed over all the structures of the organism. It affects many or nearly all the structures of the body, but leaves some, it may be only one, at a high level of elaboration and complexity. Ancestral simplicity is more uniform, and does not co-exist with specialization and elaboration of a single organ. Further: degeneration cannot be inferred safely by the examination of an isolated case; usually we obtain a series of forms indicating the steps of a change in structure—and what we have to decide is whether the movement has been from the simple to the more complex, or from the more complex to the simple. The feathers of a peacock afford a convenient example of primitive and degenerative simplicity. The highest point of elaboration in colour, pattern and form is shown by the great eye-painted tail feathers. From these we can pass by gradual transitions in two directions, viz. either to the simple lateral tail feathers with a few rami only, developed only on one side of the shaft and of uniform metallic coloration—or to the simple contour feathers of small size, with the usual symmetrical series of numerous rami right and left of the shaft and no remarkable colouring. The one-sided specialization and the peculiar metallic colouring of the lateral tail feathers mark them as the extreme terms of a degenerative series, whilst the symmetry, likeness of constituent parts *inter se*, and absence of specialized pigment, as well as the fact that they differ little from any average feather of birds in general, mark the contour feather as primitively simple, and as the starting-point from which the highly elaborated eye-painted tail feather has gradually evolved.

Applying these principles to the consideration of the Arachnida, we arrive at the conclusion that the smaller and simpler Arachnids are not the more primitive, but that the Acari or mites are, in fact, a degenerate group. This was maintained by Lankester in 1878 (**19**), again in 1881 (**20**); it was subsequently announced as a novelty by Claus in 1885 (**21**). Though the aquatic members of a class of animals are in some instances derived from terrestrial forms, the usual transition is from an aquatic ancestry to more recent land-living forms. There is no doubt, from a consideration of the facts of structure, that the aquatic water-breathing Arachnids, represented in the past by the Eurypterines and to-day by the sole survivor Limulus, have preceded the terrestrial air-breathing forms of that group. Hence we see at once that the better-known Arachnida form a series, leading from Limulus-like aquatic creatures through scorpions, spiders and harvest-men, to the degenerate Acari or mites. The spiders are specialized and reduced in apparent complexity, as compared with the scorpions, but they cannot be regarded as degenerate since the concentration of structure which occurs in them results in greater efficiency and power than are exhibited by the scorpion. The determination of the relative degree of perfection of organization attained by two animals compared is difficult when we introduce, as seems inevitable, the question of efficiency and power, and do not confine the question to the perfection of morphological development. We have no measure of the degree of power manifested by various animals—though it would be possible to arrive at some conclusions as to how that

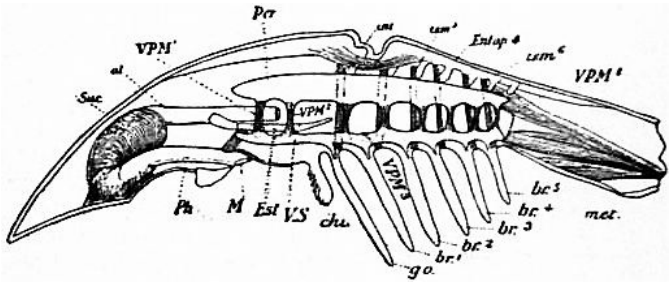
"power" should be estimated. It is not possible here to discuss that matter further. We must be content to point out that it seems that the spiders, the pedipalps, and other large Arachnids have not been derived from the scorpions directly, but have independently developed from aquatic ancestors, and from one of these independent groups—probably through the harvest-men from the spiders—the Acari have finally resulted.



After Beck, *Trans. Zool. Soc.* Vol. xi., 1883.

Fig. 31.—Diagram of a lateral view of a longitudinal section of a scorpion.

d, Chelicera.
ch, Chela.
cam, Camerostome.
m, Mouth.
ent, Entosternum.
p, Pecten.
stig[1], First pulmonary aperture.
stig[4], Fourth pulmonary aperture.
dam, Muscle from carapace to a praeoral entosclerite.
ad, Muscle from carapace to entosternum.
md, Muscle from tergite of genital somite to entosternum (same as *dpm* in fig. 30).
dv[1] to *dv*[6], Dorso-ventral muscles (same as the series labelled *tsm* in fig. 30).
pv[1] to *pv*[7], The seven veno-pericardiac muscles of the right side (labelled VPM in fig. 30).



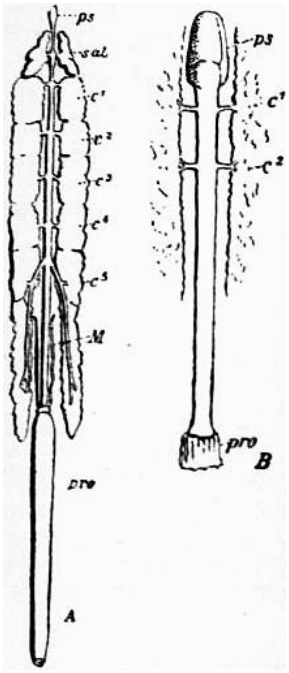
After Benham, *Trans Zool. Soc.* vol. xi, 1883.

Fig. 32.—Diagram of a lateral view of a longitudinal section of Limulus.

Suc, Suctorial pharynx.
al, Alimentary canal.
Ph, Pharynx.
M, Mouth.
Est, Entosternum.
VS, Ventral venous sinus.
chi, Chilaria.
go, Genital operculum.
br[1] to *br*[5], Branchial appendages,
met, Unsegmented metasoma.
Entap[4], Fourth dorsal entapophysis of left side.
tsm, Tergo-sternal muscles, six pairs as in Scorpio (labelled *dv* in fig. 31).
VPM[1] to VPM[8], The eight pairs of veno-pericardiac muscles (labelled *pv* in fig. 31). VPM[1] is probably represented in Scorpio, though not marked in figs. 30 and 31.

Leaving that question for consideration in connexion with the systematic statement of the characters of the various groups of Arachnida which follows on p. 299, it is well now to consider the following question, viz., seeing that Limulus and Scorpio are such highly developed and specialized forms, and that they seem to constitute as it were the first and second steps in the series of recognized Arachnida—what do we know, or what are we led to suppose with regard to the more primitive Arachnida from which the Eurypterines and Limulus and Scorpio have sprung? Do we know in the recent or fossil condition any such primitive Arachnids? Such a question is not only legitimate, but prompted by the analogy of at least one other great class of Arthropods. The great Arthropod class, the Crustacea, presents to the zoologist at the present day an immense range of forms, comprising the primitive phyllopods, the minute copepods, the parasitic cirrhipedes and the

powerful crabs and lobsters, and the highly elaborated sand-hoppers and slaters. It has been insisted, by those who accepted Lankester's original doctrine of the direct or genetic affinity of the Chaetopoda and Arthropoda, that Apus and Branchipus really come very near to the ancestral forms which connected those two great branches of Appendiculate (Parapodiate) animals. On the other hand, the land crabs are at an immense distance from these simple forms. The record of the Crustacean family-tree is, in fact, a fairly complete one—the lower primitive members of the group are still represented by living forms in great abundance. In the case of the Arachnida, if we have to start their genealogical history with Limulus and Scorpio, we are much in the same position as we should be in dealing with the Crustacea, were the whole of the Entomostraca and the whole of the Arthrostraca wiped out of existence and record. There is no possibility of doubt that the series of forms corresponding in the Arachnidan line of descent, to the forms distinguished in the Crustacean line of descent as the lower grade—the Entomostraca—have ceased to exist, and not only so, but have left little evidence in the form of fossils as to their former existence and nature. It must, however, be admitted as probable that we should find some evidence, in ancient rocks or in the deep sea, of the early more primitive Arachnids. And it must be remembered that such forms must be expected to exhibit, when found, differences from Limulus and Scorpio as great as those which separate Apus and Cancer. The existing Arachnida, like the higher Crustacea, are "nomomeristic," that is to say, have a fixed typical number of somites to the body. Further, they are like the higher Crustacea, "somatotagmic," that is to say, they have this limited set of somites grouped in three (or more) "tagmata" or regions of a fixed number of similarly modified somites—each tagma differing in the modification of its fixed number of somites from that characterizing a neighbouring "tagma." The most primitive among the lower Crustacea, on the other hand, for example, the Phyllopoda, have not a fixed number of somites, some genera—even allied species—have more, some less, within wide limits; they are "anomomeristic." They also, as is generally the case with anomomeristic animals, do not exhibit any conformity to a fixed plan of "tagmatism" or division of the somites of the body into regions sharply marked off from one another; the head or prosomatic tagma is followed by a trunk consisting of somites which either graduate in character as we pass along the series or exhibit a large variety in different genera, families and orders, of grouping of the somites. They are anomotagmic, as well as anomomeristic.



From Lankester, "Limulua an Arachnid."

FIG. 33.—The alimentary canal and gastric glands of a scorpion (A) and of Limulus (B).

ps, Muscular suctorial enlargement of the pharynx.
sal, Prosomatic pair of gastric caeca in Scorpio, called salivary glands by some writers.
c^1, and c^2, The anterior two pairs of gastric caeca and ducts of the mesosomatic region.
c^3, c^4 and c^5. Caeca and ducts of Scorpio not represented in Limulus.
M, The Malpighian or renal caecal diverticula of Scorpio.
pro, The proctodaeum or portion of gut leading to anus and formed embryologically by an inversion of the epiblast at that orifice.

When it is admitted—as seems to be reasonable—that the primitive Arachnida would, like the primitive Crustacea, be anomomeristic and anomotagmic, we shall not demand of claimants for the rank of primitive Arachnids agreement with Limulus and Scorpio in respect of the exact number of their somites and the exact grouping of those somites; and when we see how diverse are the modifications of the branches of the appendages both in Arachnida and in other classes of Arthropoda (*q.v.*), we shall not over-estimate a difference in the form of this or that appendage exhibited by the claimant as compared with the higher Arachnids. With those considerations in mind, the claim of the extinct group of the trilobites to be considered as representatives of the lower and more primitive steps in the Arachnidan genealogy must, it seems, receive a favourable judgment. They differ from the Crustacea in that they have only a single pair of prae-oral appendages, the second pair being definitely developed as mandibles. This fact renders their association with the Crustacea impossible, if classification is to be the expression of genetic affinity inferred from structural coincidence. On the contrary, this particular point is one in which they agree with the higher Arachnida. But little is known of the structure of these extinct animals; we are therefore compelled to deal with such special points of resemblance and difference as their remains still exhibit. They had lateral eyes[5] which resemble no known eyes so closely as the lateral eyes of Limulus. The general form and structure of their prosomatic carapace are in many striking features identical with that of Limulus. The trilobation of the head and body—due to the expansion and flattening of the sides or "pleura" of the tegumentary skeleton—is so closely repeated in the young of Limulus that the latter has been called "the trilobite stage" of Limulus (fig. 42 compared with fig. 41). No Crustacean exhibits this trilobite form. But most important of the evidences presented by the trilobites of affinity with Limulus, and therefore with the Arachnida, is the tendency less marked in some, strongly carried out in others, to form a pygidial or telsonic shield—a fusion of the posterior somites of the body, which is precisely identical in character with the metasomatic carapace of Limulus. When to this is added the fact that a post-anal spine is developed to a large size in some trilobites (fig. 38), like that of Limulus and Scorpio, and that lateral spines on the pleura of the somites are frequent as in Limulus, and that neither metasomatic fusion of somites nor post-anal spine, nor lateral pleural spines are found in any Crustacean, nor all three together in any Arthropod besides the trilobites and Limulus—the claim of the trilobites to be considered as representing one order of a lower grade of Arachnida, comparable to the grade Entomostraca of the Crustacea, seems to be established.

The fact that the single pair of prae-oral appendages of trilobites, known only as yet in one genus, is in that particular case a pair of uni-ramose antennae—does not render the association of trilobites and Arachnids improbable. Although the prae-oral pair of appendages in the higher Arachnida is usually chelate, it is not always so; in spiders it is not so; nor in many Acari. The bi-ramose structure of the post-oral limbs, demonstrated by Beecher in the trilobite Triarthrus, is no more inconsistent with its claim to be a primitive

Arachnid than is the foliaceous modification of the limbs in Phyllopods inconsistent with their relationship to the Arthrostracous Crustaceans such as Gammarus and Oniscus.

Thus, then, it seems that we have in the trilobites the representatives of the lower phases of the Arachnidan pedigree. The simple anomomeristic trilobite, with its equi-formal somites and equi-formal appendages, is one term of the series which ends in the even more simple but degenerate Acari. Between the two and at the highest point of the arc, so far as morphological differentiation is concerned, stands the scorpion; near to it in the trilobite's direction (that is, on the ascending side) are Limulus and the Eurypterines—with a long gap, due to obliteration of the record, separating them from the trilobite. On the other side—tending downwards from the scorpion towards the Acari—are the Pedipalpi, the spiders, the book-scorpions, the harvest-men and the water-mites.

The strange nobody-crabs or Pycnogonids occupy a place on the ascending half of the arc below the Eurypterines and Limulus. They are strangely modified and degenerate, but seem to be (as explained in the systematic review) the remnant of an Arachnidan group holding the same relation to the scorpions which the Laemodipoda hold to the Podophthalmate Crustacea.

We have now to offer a classification of the Arachnida and to pass in review the larger groups, with a brief statement of their structural characteristics.

In the bibliography at the close of this article (referred to by leaded arabic numerals in brackets throughout these pages), the titles of works are given which contain detailed information as to the genera and species of each order or sub-order, their geographical distribution and their habits and economy so far as they have been ascertained. The limits of space do not permit of a fuller treatment of those matters here.

Tabular Classification[6] of the Arachnida.

Class. ARACHNIDA.

Grade A. ANOMOMERISTICA.

Sub-Class. TRILOBITAE.

Orders. Not satisfactorily determined.

Grade B. NOMOMERISTICA.

Sub-Class I. PANTOPODA.

Order 1. Nymphonomorpha.

Order 2. Ascorhynchomorpha.

Order 3. Pycnogonomorpha.

Sub-Class II. EU-ARACHNIDA.

Grade *a.* delobranchia, Lankester (*vel* hydropneustea, Pocock).

Order 1. Xiphosura.

Order 2. Gigantostraca.

Grade *b.* embolobranchia, Lankester (*vel* aeropneustea, Pocock).

Section α. Pectinifera.

Order 1. Scorpionidea.

Sub-order *a.* Apoxypoda.

Sub-order *b.* Dionychopoda.

Section β. Epectinata.

Order 2. Pedipalpi.

Sub-order *a.* Uropygi.

Tribe 1. Urotricha.

Tribe 2. Tartarides.

Sub-order *b.* Amblypygi.

Order 3. Araneae.

Sub-order *a.* Mesothelae.

Sub-order *b.* Opisthothelae.

Tribe 1. Mygalomorphae.

Tribe 2. Arachnomorphae.

Order 4. Palpigradi (= Microthelyphonidae).

Order 5. Solifugae (= Mycetophorae).

Order 6. Pseudoscorpiones (= Chelonethi).

Sub-order *a.* Panctenodactyli.

Sub-order *b.* Hemirtenodactyli.

Order 7. Podogona (= Ricinulei).

Order 8. Opiliones.

Sub-order *a.* Laniatores.

Sub-order *b.* Palpatores.

Sub-order *c.* Anepignathi.

Order 9. Rhynchostomi (= Acari).

Sub-order *a.* Notostigmata.

Sub-order *b.* Cryptostigmata.

Sub-order *c.* Metastigmata.

Sub-order *d.* Prostigmata.

Sub-order *e.* Astigmata.

Sub-order *f.* Vermiformia.
Sub-order *g.* Tetrapoda.

CLASS. ARACHNIDA.—Euarthropoda having two prosthomeres (somites which have passed from a post-oral to a prae-oral position), the appendages of the first represented by eyes, of the second by solitary rami which are rarely antenniform, more usually chelate. A tendency is exhibited to the formation of a metasomatic as well as a prosomatic carapace by fusion of the tergal surfaces of the somites. Intermediate somites forming a mesosoma occur, but tend to fuse superficially with the metasomatic carapace or to become co-ordinated with the somites of the metasoma, whether fused or distinct to form one region, the opisthosoma (abdomen of authors). In the most highly developed forms the two anterior divisions (tagmata) of the body, prosoma and mesosoma, each exhibit six pairs of limbs, pediform and plate-like respectively, whilst the metasoma consists of six limbless somites and a post-anal spine. The genital apertures are placed in the first somite following the prosoma, excepting where a praegenital somite, usually suppressed, is retained. Little is known of the form of the appendages in the lowest archaic Arachnida, but the tendency of those of the prosomatic somites has been (as in the Crustacea) to pass from a generalized bi-ramose or multi-ramose form to that of uni-ramose antennae, chelae and walking legs.

The Arachnida are divisible into two grades of structure—according to the fixity or non-fixity of the number of somites building up the body:—

Grade A (*of the Arachnida*). *ANOMOMERISTICA.*—Extinct archaic Arachnida, in which (as in the Entomostracous Crustacea) the number of well-developed somites may be more or less than eighteen and may be grouped only as head (prosoma) and trunk or may be further differentiated. A telsonic tergal shield of greater or less size is always present, which may be imperfectly divided into well-marked but immovable tergites indicating incompletely differentiated somites. The single pair of palpiform appendages in front of the mouth has been found in one instance to be antenniform, whilst the numerous post-oral appendages in the same genus were bi-ramose. The position of the genital apertures is not known. Compound lateral eyes present; median eyes wanting. The body and head have the two pleural regions of each somite flattened and expanded on either side of the true gut-holding body-axis. Hence the name of the sub-class signifying tri-lobed, a condition realized also in the Xiphosurous Arachnids. The members of this group, whilst resembling the lower Crustacea (as all lower groups of a branching genealogical tree must do), differ from them essentially in that the head exhibits only one prosthomere (in addition to the eye-bearing prosthomere) with palpiform appendages (as in all Arachnida) instead of two. The Anomomeristic Arachnida form a single sub-class, of which only imperfect fossil remains are known.

Sub-class (of the Anomomeristica). TRILOBITAE.—The single sub-class Trilobitae constitutes the grade Anomomeristica. It has been variously divided into orders by a number of writers. The greater or less evolution and specialization of the metasomatic carapace appears to be the most important basis for classification—but this has not been made use of in the latest attempts at drawing up a system of the Trilobites. The form of the middle and lateral regions of the prosomatic shield has been used, and an excessive importance attached to the demarcation of certain areas in that structure. Sutures are stated to mark off some of these pieces, but in the proper sense of that term as applied to the skeletal structures of the Vertebrata, no sutures exist in the chitinous cuticle of Arthropoda. That any partial fusion of originally distinct chitinous plates takes place in the cephalic shield of Trilobites, comparable to the partial fusion of bony pieces by suture in Vertebrata, is a suggestion contrary to fact.

The Trilobites are known only as fossils, mostly Silurian and prae-Silurian; a few are found in Carboniferous and Permian strata. As many as two thousand species are known. Genera with small metasomatic carapace, consisting of three to six fused segments distinctly marked though not separated by soft membrane, are *Harpes*, *Paradoxides* and *Triarthrus* (fig. 34). In *Calymene*, *Homalonotus* and *Phacops* (fig. 38) from six to sixteen segments are clearly marked by ridges and grooves in the metasomatic tagma, whilst in *Illaenus* the shield so formed is large but no somites are marked out on its surface. In this genus ten free somites (mesosoma) occur between the prosomatic and metasomatic carapaces. *Asaphus* and *Megalaspis* (fig. 39) are similarly constituted. In *Agnostus* (fig. 40) the anterior and posterior carapaces constitute almost the entire body, the two carapaces being connected by a mid-region of only two free somites. It has been held that the forms with a small number of somites marked in the posterior carapace and numerous free somites between the anterior and posterior carapace, must be considered as anterior to those in which a great number of posterior somites are traceable in the metasomatic carapace, and that those in which the

traces of distinct somites in the posterior or metasomatic carapace are most completely absent must be regarded as derived from those in which somites are well marked in the posterior carapace and similar in appearance to the free somites. The genus *Agnostus*, which belongs to the last category, occurs abundantly in Cambrian strata and is one of the earliest forms known. This would lead to the supposition that the great development of metasomatic carapace is a primitive and not a late character, were it not for the fact that *Paradoxides* and *Atops*, with an inconspicuous telsonic carapace and numerous free somites, are also Cambrian in age, the latter indeed anterior in horizon to *Agnostus*.

On the other hand, it may well be doubted whether the pygidial or posterior carapace is primarily due to a fusion of the tergites of somites which were previously movable and well developed. The posterior carapace of the Trilobites and of *Limulus* is probably enough in origin a telsonic carapace—that is to say, is the tergum of the last segment of the body which carries the anus. From the front of this region new segments are produced in the first instance, and are added during growth to the existing series. This telson may enlarge, it may possibly even become internally and sternally developed as partially separate somites, and the tergum may remain without trace of somite formation, or, as appears to be the case in *Limulus*, the telson gives rise to a few well-marked somites (mesosoma and two others) and then enlarges without further trace of segmentation, whilst the chitinous integument which develops in increasing thickness on the terga as growth advances welds together the unsegmented telson and the somites in front of it, which were previously marked by separate tergal thickenings. It must always be remembered that we are liable (especially in the case of fossilized integuments) to attach an unwarranted interpretation to the mere discontinuity or continuity of the thickened plates of chitinous cuticle on the back of an Arthropod. These plates may fuse, and yet the somites to which they belong may remain distinct, and each have its pair of appendages well developed. On the other hand, an unusually large tergal plate, whether terminal or in the series, is not always due to fusion of the dorsal plates of once-separate somites, but is often a case of growth and enlargement of a single somite without formation of any trace of a new somite. For the literature of Trilobites see (**22***).

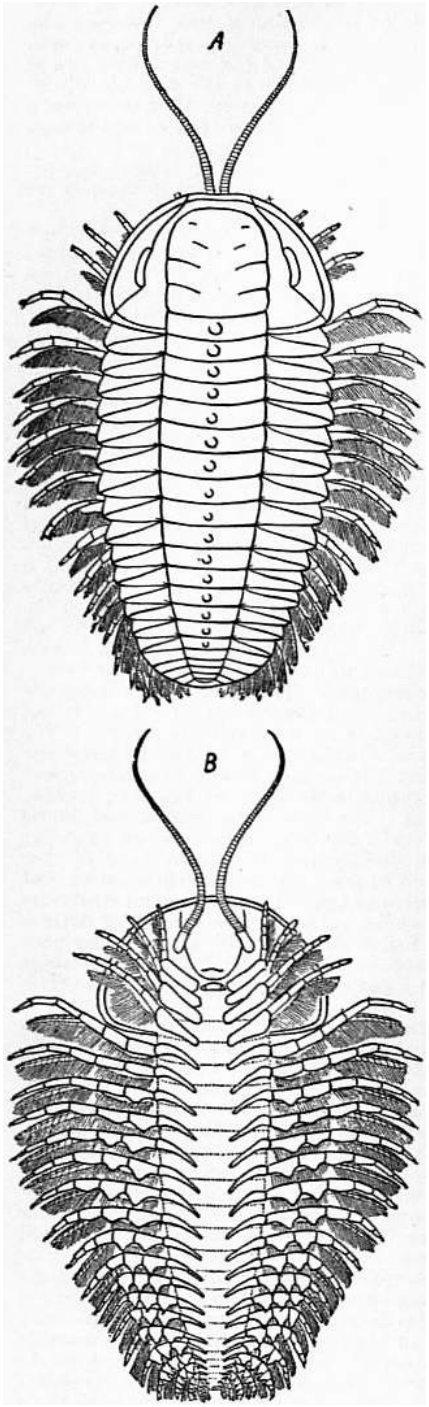


FIG. 34.—Restoration of *Triarthrus Becki*, Green, as determined by Beecher from specimens obtained from the Utica Slates (Ordovician), New York. A, dorsal; B, ventral surface. In the latter the single pair of antennae springing up from each side of the camerostome or hypostome or upper lip-lobe are seen. Four pairs of appendages besides these are seen to belong to the cephalic tergum. All the appendages are pediform and bi-ramose; all have a prominent gnathobase, and in all the exopodite carries a comb-like series of secondary processes.

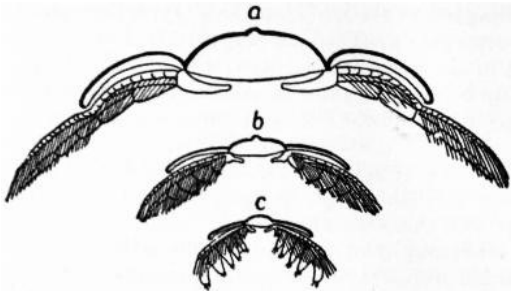


FIG. 35.—*Triarthrus Becki*, Green. *a*, Restored thoracic limbs in transverse section of the animal; *b*, section across a posterior somite; *c*, section across one of the sub-terminal somites.

(After Beecher.)

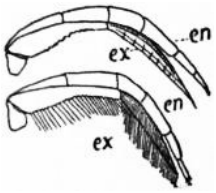


FIG. 36.—*Triarthrus Becki*, Green. Dorsal view of second thoracic leg with and without setae. *en*, Inner ramus; *ex*, Outer ramus.

(After Beecher.)

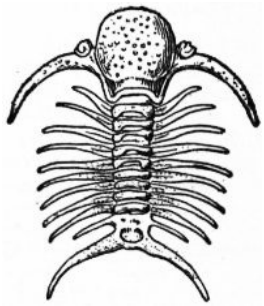


FIG. 37.—*Deiphon Forbesii*, Barr. One of the Cheiruridae. Silurian Bohemia.

(From Zittel's Palaeontology.)

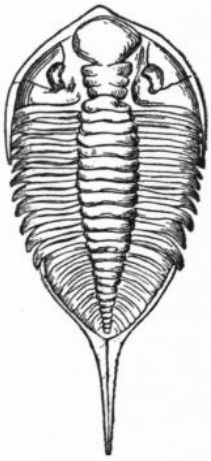


FIG. 38.—*Dalmanites Kmulurus*, Green. One of the *Phacopidae*, from the Silurian, New York.

(From Zittel.)

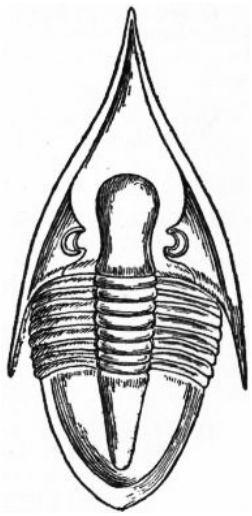


FIG. 39.—*Megalaspis extenuatus*. One of the *Asaphidae* allied to *Illaenus*, from the Ordovician of East Gothland, Sweden.

(From Zittel.)

Grade B (*of the Aracknida*) *NOMOMERISTICA*.—Arachnida in which, excluding from consideration the eye-bearing prosthomere, the somites are primarily (that is to say, in the common ancestor of the grade) grouped in three regions of six—(*a*) the "prosoma" with palpiform appendages, (*b*) the "mesosoma" with plate-like appendages, and (*c*) the "metasoma" with suppressed appendages. A somite placed between the prosoma and mesosoma —the prae-genital somite—appears to have belonged originally to the prosomatic series (which with its ocular prosthomere and palpiform limbs [Pantopoda], would thus consist of eight somites), but to have been gradually reduced. In living Arachnids, excepting the Pantopoda, it is either fused (with loss of its appendages) with the prosoma (*Limulus*,[7] *Scorpio*), after embryonic appearance, or is retained as a rudimentary, separate, detached somite in front of the mesosoma, or disappears altogether (excalation). The atrophy and total disappearance of ancestrally well-marked somites frequently take place (as in all Arthropoda) at the posterior extremity of the body, whilst excalation of somites may occur at the constricted areas which often separate adjacent "regions," though there are very few instances in which it has been recognized. Concentration of the organ-systems by fusion of neighbouring regions (prosoma, mesosoma, metasoma), previously distinct, has frequently occurred, together with obliteration of the muscular and chitinous structures indicative of distinct somites. This concentration and obliteration of somites, often accompanied by dislocation of important segmental structures (such as appendages and nerve-ganglia), may lead to highly developed specialization (individuation, H. Spencer), as in the Araneae and Opiliones, and, on the other hand, may terminate in simplification and degeneration, as in the Acari.

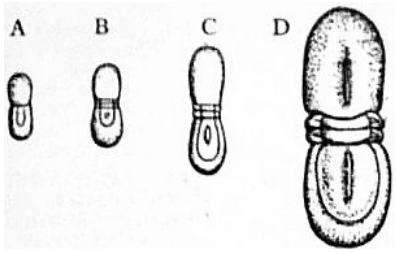
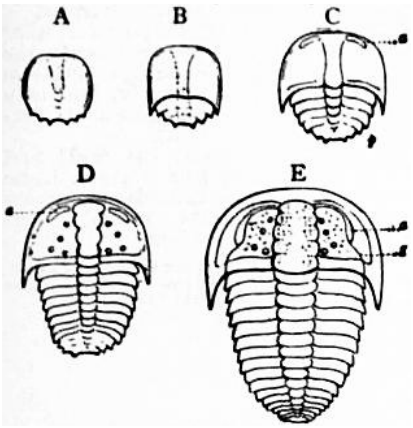


FIG. 40.—Four stages in the development of the trilobite *Agnostus nudus*. A, Youngest stage with no mesosomatic somites; B and C, stages with two mesosomatic somites between the prosomatic and telsonic carapaces; D, adult condition, still with only two free mesosomatic somites.

(From Korschelt and Heider.)

From Korschelt and Heider, after Barrande.

FIG. 41.—Five Stages in the development of the trilobite *Sao hirsuta*.



A, Youngest stage.
B, Older stage with distinct pygidial carapace.
C, Stage with two free mesosomatic somites between the prosomatic and telsonic carapaces.
D, Stace with seven free intermediate somites.
E, Stave with twelve free somites; the telsonic carapace has not increased in size.
a, Lateral eye.
g, So-called facial “suture” (not really a suture).
p, Telsonic carapace.

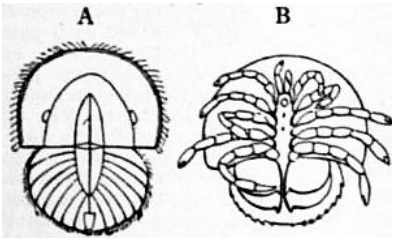
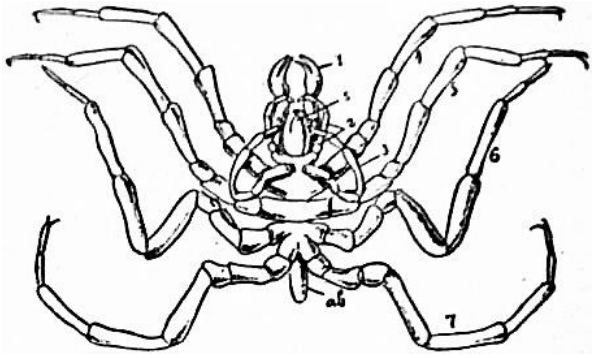


FIG. 42.—So-called “trilobite stage” of *Limulus polyphemus*. A, Dorsal; B, ventral view.

(from Korschelt and Heider, after Leuckart.)

The most important general change which has affected the structure of the nomomeristic Arachnida in the course of their historic development is the transition from an aquatic to a terrestrial life. This has been accompanied by the conversion of the lamelliform gill-plates into lamelliform lung-plates, and later the development from the lung-chambers, and at independent sites, of tracheae or air-tubes (by adaptation of the vasifactive tissue of the blood-vessels) similar to those independently developed in *Peripatus*, Diplopoda, Hexapoda and Chilopoda. Probably tracheae have developed independently by the same process in several groups of tracheate Arachnids. The nomomeristic Arachnids comprise two sub-classes—one a very small degenerate offshoot from early ancestors; the other, the great bulk of the class.

Sub-Class I. (of the Nomomeristica). PANTOPODA.—Nomomeristic Arachnids, in which the somites corresponding to mesosoma and metasoma have entirely aborted. The seventh, and sometimes the eighth, leg-bearing somite is present and has its leg-like appendages fully developed. Monomeniscous eyes with a double (really triple) cell-layer formed by invagination, as in the Eu-arachnida, are present The Pantopoda stand in the same relation to *Limulus* and *Scorpio* that *Cyamus* holds to the thoracostracous Crustacea. The reduction of the organism to seven leg-bearing somites, of which the first pair, as in so many Eu-arachnida, are chelate, is a form of degeneration connected with a peculiar quasi-parasitic habit resembling that of the crustacean Laemodipoda. The genital pores are situate at the base of the 7th pair of limbs, and may be repeated on the 4th, 5th, and 6th. In all known Pantopoda the size of the body is quite minute as compared with that of the limbs: the alimentary canal sends a long caecum into each leg (cf. the Araneae) and the genital products are developed in gonocoels also placed in the legs.



From Parker and Harwell’s *Text-book of Zoology*, after Hoek.

FIG. 43.—One of the Nymphonomorphous Pantopoda, *Nymphon hispidum*, showing the seven pairs of appendages 1 to 7; *ab*, the rudimentary opisthosoma; *s*, the mouth-bearing proboscis.

The Pantopoda are divided into three orders, the characters of which are dependent on variation in the presence of the full number of legs.

Order 1. (of the Pantopoda). Nymphonomorpha, Pocock (nov.) (fig. 43).—In primitive forms belonging to the family *Nymphonidae* the full complement of appendages is retained—the 1st (mandibular), the 2nd (palpiform), and the 3rd (ovigerous) pairs being well developed in both sexes. In certain derivative forms constituting the family *Pallenidae*, however, the appendages of the 2nd pair are either rudimentary or atrophied altogether.

Two families: 1. Nymphonidae (genus *Nymphon*), and 2. Pallenidae (genus *Pallene*).

Order 2. Ascorhynchomorpha, Pocock (nov.).—Appendages of the 2nd and 3rd pairs retained and

developed, as in the more primitive types of Nymphonomorpha; but those of the 1st pair are either rudimentary, as in the *Ascorhynchidae*, or atrophied, as in the *Colossendeidae*. In the latter a further specialization is shown in the fusion of the body segments.

Two families. 1. Ascorhynchidae (genera *Ascorhynchus* and *Ammothea*); 2. Colossendeidae (genera *Colossendeis* and *Discoarachne*).

Order 3. Pycnogonomorpha, Pocock (nov.).—Derivative forms in which the reduction in number of the anterior appendages is carried farther than in the other orders, reaching its extreme in the *Pycnogonidae*, where the 1st and 2nd pairs are absent in both sexes, and the 3rd pair also are absent in the female. In the *Hannoniidae*, however, which resemble the *Pycnogonidae* in the absence of the 3rd pair in the female and of the 2nd pair in both sexes, the 1st pair are retained in both sexes.

Two families: 1. Hannoniidae (genus *Hannonia*); 2. Pycnogonidae (genera *Pycnogonum* and *Phoxichilus*).

Remarks.—The Pantopoda are not known in the fossil condition. They are entirely marine, and are not uncommon in the coralline zone of the sea-coast. The species are few, not more than fifty (23). Some large species of peculiar genera are taken at great depths. Their movements are extremely sluggish. They are especially remarkable for the small size of the body and the extension of viscera into the legs. Their structure is eminently that of degenerate forms. Many frequent growths of coralline Algae and hydroid polyps, upon the juices of which they feed, and in some cases a species of gall is produced in hydroids by the penetration of the larval Pantopod into the tissues of the polyp.

Sub-Class II. (of the Nomomeristic Arachnida). EU-ARACHNIDA.—These start from highly developed and specialized aquatic branchiferous forms, exhibiting a prosoma with six pediform pairs of appendages, an intermediate prae-genital somite, a mesosoma of six somites bearing lamelliform pairs of appendages, and a metasoma of six somites devoid of appendages, and the last provided with a post-anal spine. Median eyes are present, which are monomeniscous, with distinct retinal and corneagenous cell-layers, and placed centrally on the prosoma. Lateral eyes also may be present, arranged in lateral groups, and having a single or double cell-layer beneath the lens. The first pair of limbs is often chelate or prehensile, rarely antenniform; whilst the second, third and fourth may also be chelate, or may be simple palps or walking legs.

An internal skeletal plate, the so-called “entosternite” of fibro-cartilaginous tissue, to which many muscles are attached, is placed between the nerve-cords and the alimentary tract in the prosoma of the larger forms (*Limulus*, *Scorpio*, *Mygale*). In the same and other leading forms a pair of much-coiled glandular tubes, the coxal glands (coelomocoels in origin), is found with a duct opening on the coxa of the fifth pair of appendages of the prosoma. The vascular system is highly developed (in the non-degenerate forms); large arterial branches closely accompany or envelop the chief nerves; capillaries are well developed. The blood-corpuscles are large amoebiform cells, and the blood-plasma is coloured blue by haemocyanin.

The alimentary canal is uncoiled and cylindrical, and gives rise laterally to large gastric glands, which are more than a single pair in number (two to six pairs), and may assume the form of simple caeca. The mouth is minute and the pharynx is always suctorial, never gizzard-like. The gonadial tubes (gonocoels or gonadial coelom) are originally reticular and paired, though they may be reduced to a simpler condition. They open on the first somite of the mesosoma. In the numerous degenerate forms simplification occurs by obliteration of the demarcations of somites and the fusion of body-regions, together with a gradual suppression of the lamelliferous respiratory organs and the substitution for them of tracheae, which, in their turn, in the smaller and most reduced members of the group, may also disappear.

The Eu-arachnida are divided into two grades with reference to the condition of the respiratory organs as adapted to aquatic or terrestrial life.

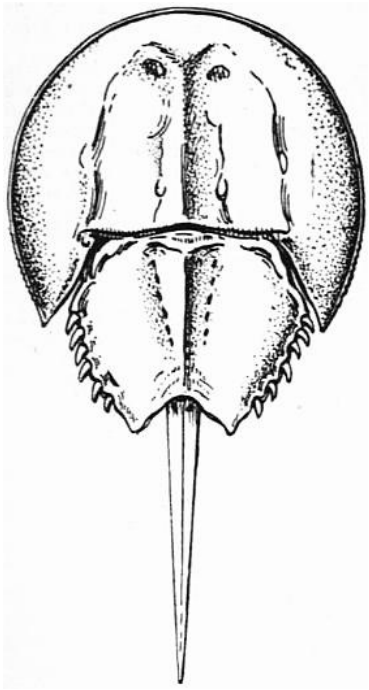
Grade *a* (of the Eu-arachnida). DELOBRANCHIA (Hydropheustea).

Mesosomatic segments furnished with large plate-like appendages, the 1st pair acting as the genital operculum, the remaining pairs being provided with branchial lamellae fitted for breathing oxygen dissolved in water. The prae-genital somite partially or wholly obliterated in the adult. The mouth lying far back, so that the basal segments of all the prosomatic appendages, excepting those of the 1st pair, are capable of acting as masticatory organs. Lateral eyes consisting of a densely packed group of eye-units (“compound” eyes).

ORDER 1. XIPHOSURA.—The prae-genital somite fuses in the embryo with the prosoma and disappears (see fig. 19). Not free-swimming, none of the prosomatic appendages modified to act as paddles; segments of the mesosoma and metasoma (= opisthosoma) not more than ten in number, distinct or coalesced.

Family—Limulidae (*Limulus*).
” *Belinuridae (*Belinurus*, *Aglaspis*, *Prestwichia*).
” *Hemiaspidae (*Hemiaspis*, *Bunodes*).

FIG. 44.—Dorsal view of *Limulus polyphemus*, Latr.



(From Parker and Haswell, *Text book of Zoology* after Leuckart.)

Remarks.-The Xiphosura are marine in habit, frequenting the shore. They are represented at the present day by the single genus *Limulus* (figs. 44 and 45; also figs. 7, 9, 11, to 15 and 20), often termed the king-crab, which occurs on the American coast of the Atlantic Ocean, but not on its eastern coasts, and on the Asiatic coast of the Pacific. The Atlantic species (*L. polyphemus*) is common on the coasts of the United States, and is known as the king-crab or horse-shoe crab. A single specimen was found in the harbour of Copenhagen in the 18th century, having presumably been carried over by a ship to which it clung.

A species of *Limulus* is found in the Buntersandstein of the Vosges; *L. Walchi* is abundant in the Oolitic lithographic slates of Bavaria.

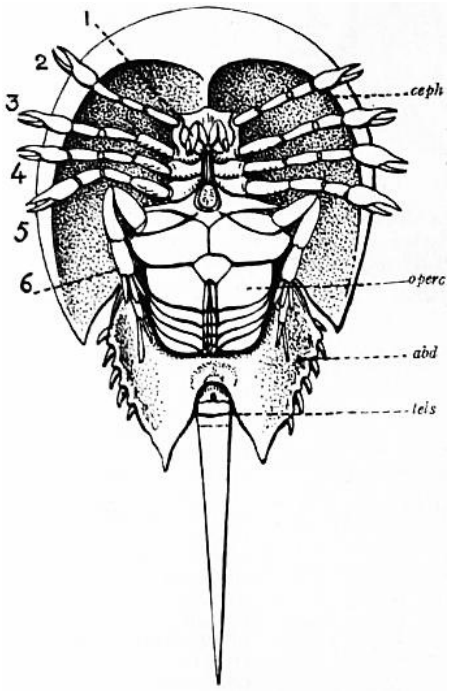


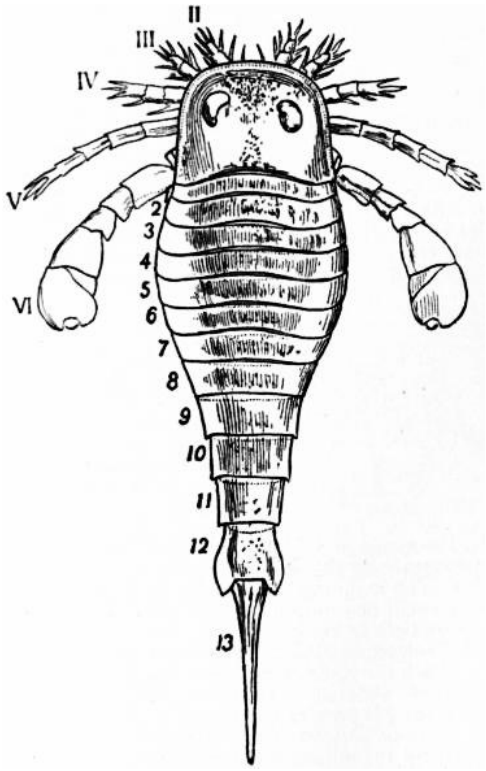
FIG. 45.—Ventral view of *Limulus polyphemus*.

1 to 6, The six prosomatic pairs of appendages.
abd, the solid opisthosomatic carapace.
tels, the post-anal spine (not the telson as the lettering would seem to imply, but only its post-anal portion).
operc, the fused first pair of mesosomatic appendages forming the genital operculum.

(From Parker and Haswell, *Text book of Zoology*, after Leuckart.)

The genera *Belinurus*, *Aglaspis*, *Prestwichia*, *Hemiaspis* and *Bunodes* consist of small forms which occur in Palaeozoic rocks. In none of them are the appendages known, but in the form of the two carapaces and the presence of free somites they are distinctly intermediate between *Limulus* and the Trilobitae. The young form of *Limulus* itself (fig. 40) is also similar to a Trilobite so far as its segmentation and trilobation are concerned. The lateral eyes of *Limulus* appear to be identical in structure and position with those of certain Trilobitae.

FIG. 46.—*Eurypterus Fischeri*, Eichwald. Silurian of Rootzikil. Restoration after Schmidt. The dorsal aspect is presented showing the prosomatic shield with paired compound eyes and the prosomatic appendages II. to VI. The small first pair of appendages is concealed from view by the carapace, 1 to 12 are the somites of the opisthosoma; 13, the post-anal spine.



(From Zittel's *Text-book of Palaeontology*, The Macmillan Co, New York, 1896.)

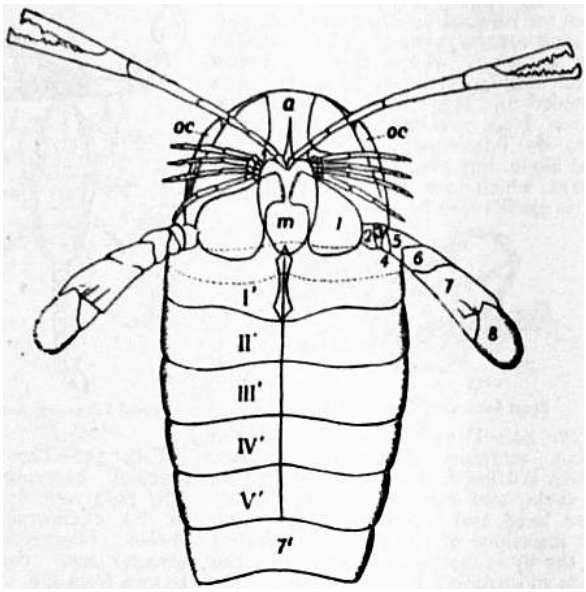
Order 2. Gigantostraca (figs. 46, 47).—Free-swimming forms, with the appendages of the 6th or 5th and 6th pairs flattened or lengthened to act as oars; segments of mesosoma and metasoma (= opisthosoma), twelve in number.

Appendages of anterior pair very large and chelate.

Sub-order Pterygotomorpha, Pterygotidae (*Pterygotus*).

Appendages of anterior pair minute and chelate.

Sub-order Eurypteromorpha
Stylonuridae (*Stylonurus*).
Eurypteridae (*Eurypterus*, *Slimonia*).



From Zittel's *Palaeontology*.

FIG. 47.—*Pterygotus osiliensis*, Schmidt. Silurian of Rootzikil. Restoration of the ventral surface, about a third natural size, after Schmidt.

a, Camerostome or epistoma.
m, Chilarium or metasternite of the prosoma (so-called metastoma).
oc, The compound eyes.
1 to 8, Segments of the sixth prosomatic appendage.
I′ to V′, First five opisthosomatic somites.
7′, Sixth opisthosomatic somite.

[Observe the powerful gnathobases of the sixth pair of prosomatic limbs and the median plates behind *m*. The dotted line on somite I indicates the position of the genital operculum which was probably provided with branchial lamellae.]

Remarks.—The Gigantostraca are frequently spoken of as "the Eurypterines." Not more than thirty species are known. They became extinct in Palaeozoic times, and are chiefly found in the Upper Silurian, though extending upwards as far as the Carboniferous. They may be regarded as "macrourous" Xiphosura; that is to say, Xiphosura in which the nomomeristic number of eighteen well-developed somites is present and the posterior ones form a long tail-like region of the body. There still appears to be some doubt whether in the sub-order Eurypteromorpha the first pair of prosomatic appendages (fig. 46) is atrophied, or whether, if present, it has the form of a pair of tactile palps or of minute chelae. Though there are indications of lamelliform respiratory appendages on mesosomatic somites following that bearing the genital operculum, we cannot be said to have any proper knowledge as to such appendages, and further evidence with regard to them is much to be desired. (For literature see Zittel, **22***.)

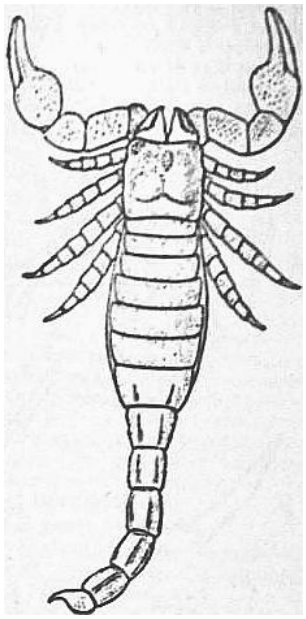
Grade *b* (of the Eu-arachnida). EMBOLOBRANCHIA (Aeropneustea).

In primitive forms the respiratory lamellae of the appendages of the 3rd, 4th, 5th and eth, or of the 1st and 2nd mesosomatic somites are sunk beneath the surface of the body, and become adapted to breathe atmospheric oxygen, forming the leaves of the so-called lung-books. In specialized forms these pulmonary sacs are wholly or partly replaced by tracheal tubes. The appendages of the mesosoma generally suppressed; in the more primitive forms one or two pairs may be retained as organs subservient to reproduction or silk-spinning. Mouth situated more forwards than in Delobranchia, no share in mastication being taken by the basal segments of the 5th and 6th pairs of prosomatic appendages. Lateral eyes, when present, represented by separate ocelli.

The prae-genital somite, after appearing in the embryo, either is obliterated (*Scorpio, Galeodes, Opilio* and others) or is retained as a reduced narrow region of the body, the "waist," between prosoma and mesosoma. It is represented by a full-sized tergal plate in the Pseudo-scorpiones.

Section α. *Pectinifera.*—The primitive distinction between the mesosoma and the metasoma retained, the latter consisting of six somites and the former of six somites in the adult, each of which is furnished during growth with a pair of appendages. Including the prae-genital somite (fig. 16), which is suppressed in the adult, there are thirteen somites behind the prosoma. The appendages of the 1st and 2nd mesosomatic somites persisting as the genital operculum and pectones respectively, those of the 3rd, 4th, 5th and 6th somites (? in *Palaeophonus*) sinking below the surface during growth in connexion with the formation of the four pairs of pulmonary sacs (see fig. 17). Lateral eyes monostichous.

Order 1. Scorpiones.—Prosoma covered by a single dorsal shield, bearing typically median and lateral eyes; its sternal elements reduced to a single plate lodged between or behind the basal segments of the 5th and 6th pairs of appendages. Appendages of 1st pair tri-segmented, chelate; of 2nd pair chelate, with their basal segments subserving mastication; of 3rd, 4th, 5th and 6th pairs similar in form and function, except that in recent and Carboniferous forms the basal segments of the 3rd and 4th are provided with sterno-coxal (maxillary) lobes, those of the 4th pair meeting in the middle line and underlying the mouth. The five posterior somites of the metasoma constricted to form a "tail," the post-anal sclerite persisting as a weapon of offence and provided with a pair of poison glands (see figs. 8, 10, 12, 13, 14, 15, 21 and 22).



Restored after Thorell's indications by R.I. Pocock.

FIG. 48.—Dorsal view of a restoration of *Palaeophonus nuncius*, Thorell. The Silurian scorpion from Gothland.

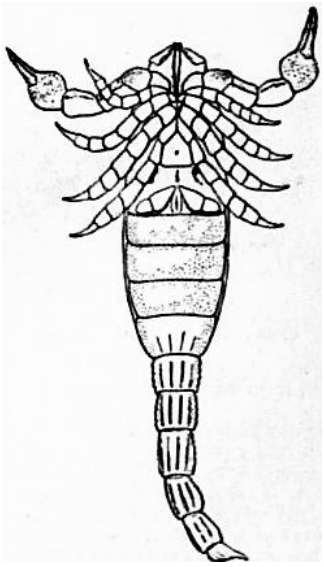
Sub-order Apoxypoda.—The 3rd, 4th, 5th and 6th pairs of appendages short, stout, tapering, the segments about as wide as long, except the apical, which is distally slender, pointed, slightly curved, and without distinct movable claws.

Family—Palaeophonidae, *Palaeophonus* (figs. 48 and 49).

Sub-order Dionychopoda.—The 3rd, 4th, 5th and 6th pairs of appendages slender, not evenly tapering, the segments longer than wide; the apical segment short, distally truncate, and provided with a pair of movable claws. Basal segments of the 5th and 6th pairs of appendages abutting against the sternum of the prosoma (see fig. 10 and figs. 51, 52 and 53).

Family—Pandinidae (*Pandinus, Opisthophthalmus, Urodacus*).
" Vejovidae (*Vaejovis, Jurus, Euscorpius, Broteas*).
" Bothriuridae (*Bothriurus, Cercophonius*).
" Buthidae (*Buthus, Centrums*).
" *Cyclophthalmidae (*Cydophthalmus*) Carboniferous.
" *Eoscorpiidae (*Eoscorpius, Centromachus*) Carboniferous.

FIG. 49.—Ventral view of a restoration of *Palaeophonus Hunteri*, Pocock, the Silurian scorpion from Lesmahagow, Scotland. Restored by R.I. Pocock. The meeting of the coxae of all the prosomatic limbs in front of the pentagonal sternum; the space for a genital operculum; the pair of pectens, and the absence of any evidence of pulmonary stigmata are noticeable in this specimen.



(See Pocock, *Quart Jour. Micr. Sci.*, 1901.)

Remarks on the Order Scorpiones.—The Scorpion is one of the great animals of ancient lore and tradition. It and the crab are the only two invertebrates which had impressed the minds of early men sufficiently to be raised to the dignity of astronomical representation. It is all the more remarkable that the scorpion proves to be the oldest animal form of high elaboration which has persisted to the present day. In the Upper Silurian two specimens of a scorpion have been found (figs. 48, 49), one in Gothland and one in Scotland, which would be recognized at once as true scorpions by a child or a savage. The Silurian scorpion *Palaeophonus*, differs, so far as obvious points are concerned, from a modern scorpion only in the thickness of its legs and in their terminating in strong spike-like joints, instead of being slight and provided with a pair of terminal claws. The legs of the modern scorpion (fig. 10; fig. 51) are those of a terrestrial Arthropod, such as a beetle; whilst those of the Silurian scorpion are the legs of an aquatic Arthropod, such as a crab or lobster. It is probable that the Silurian scorpion was an aquatic animal, and that its respiratory lamellae were still projecting from the surface of the body to serve as branchiae. No trace of "stigmata," the orifices of the lung-chambers of modern scorpions, can be found in the Scottish specimen of *Palaeophonus*, which presents the ventral surface of the animal to view. On the other hand, no trace of respiratory appendages excepting the pectens can be detected in the specimen (see fig. 49).

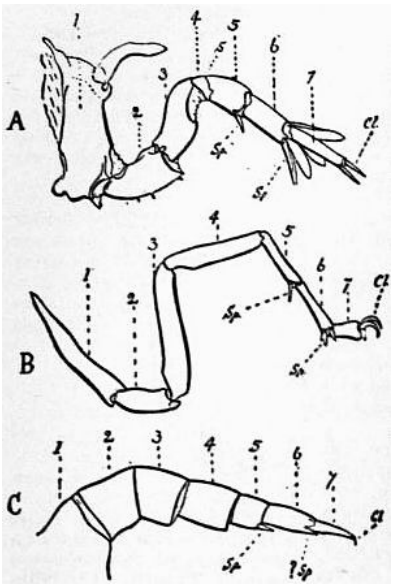
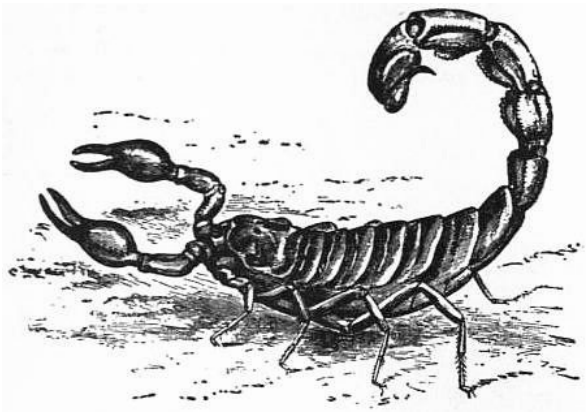


FIG. 50.—Comparison of the sixth prosomatic limb of a recent scorpion (B), of Palaeophonus (C), and of Limulus (A), showing their agreement in the number of segments; in the existence of a movable spine, Sp, at the distal border of the fifth segment; in the correspondence of the two claws at the free end of the limb of Scorpio with two spines similarly placed in Limulus; and, lastly, in the correspondence of the three talon-like spines carried on the distal margin of segment six of recent scorpions with the four larger but similarly situated spines on the leg of Limulus; *s*, groove dividing the ankylosed segments 4 and 5 of the Limulus leg into two.

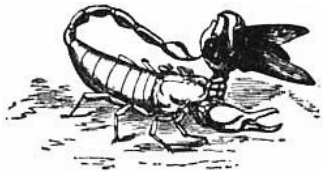
(After Pocock, *Q. J. Mic. Sci.*, 1901.)



From Lankester, *Journ. Linn. Soc. Zool.* vol. xvi., 1881.

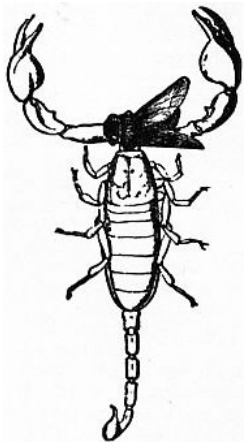
FIG. 51.—Drawing from life of the desert scorpion, *Buthusaustralis*, Lin., from Biskra, N. Africa.

Fossil scorpions of the modern type are found in the Coal Measures. At the present day scorpions of various genera are found in all the warm regions of the world. In Europe they occur as far north as Bavaria and the south of France. The largest species measure 9 in. from the front of the head to the end of the sting, and occur in tropical India and Africa. Between 200 and 300 species are known. The scorpions use their large chelae for seizing prey and for fighting with one another. They never use the sting when (as frequently happens) they attack another scorpion, because, as was ascertained by A.G. Bourne (**24**), the poison exuded by the sting has no injurious effect on another scorpion nor on the scorpion itself. The stories of a scorpion stinging itself to death when placed in a circle of burning coals are due to erroneous observation. When placed in such a position the scorpion faints and becomes inert. It is found (Bourne, **24**) that some species of scorpion faint at a temperature of 40° Cent. They recover on being removed to cooler conditions. A scorpion having seized its prey (usually a large insect, or small reptile or mammal) with the large chelae brings its tail over its head, and deliberately punctures the struggling victim twice with its sting (fig. 52). The poison of the sting is similar to snake-poison (Calmette), and rapidly paralyses animals which are not immune to it. It is probably only sickly adults or young children of the human race who can be actually killed by a scorpion's sting. When the scorpion has paralysed its prey in this way, the two short chelicerae are brought into play (fig. 53). By the crushing action of their pincers, and an alternate backward and forward movement, they bring the soft blood-holding tissues of the victim close to the minute pin-hole aperture which is the scorpion's mouth. The muscles acting on the bulb-like pharynx now set up a pumping action (see Huxley, **26**); and the juices—but no solid matter, excepting such as is reduced to powder—are sucked into the scorpion's alimentary canal. A scorpion appears to prefer for its food another scorpion, and will suck out the juices of an individual as large as itself. When this has taken place, the gorged scorpion becomes distended and tense in the mesosomatic region. It is certain that the absorbed juices do not occupy the alimentary canal alone, but pass also into its caecal off-sets which are the ducts of the gastric glands (see fig. 33).



From Lankester, *Journ. Linn. Soc.*

FIG. 52.—Drawing from life of the Italian scorpion *Euscorpius italicus*, Herbst, holding a blue-bottle fly with its left chela, and carefully piercing it between head and thorax with its sting. Two insertions of the sting are effected and the fly is instantly paralysed by the poison so introduced into its body.



From Lankester, *Journ. Linn. Soc.*

FIG. 53.—The same scorpion carrying the now paralysed fly held in its chelicerae, the chelae liberated for attack and defence. Drawn from life.

All Arachnida, including *Limulus*, feed by suctorial action in essentially the same way as *Scorpio*.

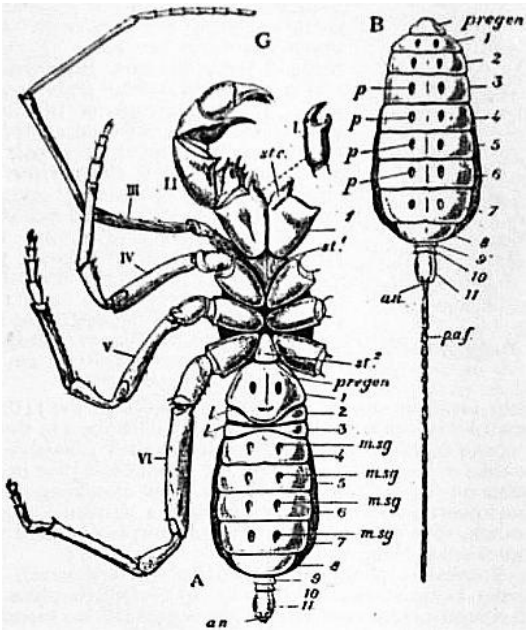
Scorpions of various species have been observed to make a hissing noise when disturbed, or even when not disturbed. The sound is produced by stridulating organs developed on the basal joints of the limbs, which differ in position and character in different genera (see Pocock, **27**). Scorpions copulate with the ventral surfaces in contact. The eggs are fertilized, practically in the ovary, and develop *in situ*. The young are born fully formed and are carried by the mother on her back. As many as thirty have been counted in a brood. For information as to the embryology of scorpions, the reader is referred to the works named in the bibliography below. Scorpions do not possess spinning organs nor form either snares or nests, so far as is known. But some species inhabiting sandy deserts form extensive burrows. The fifth pair of prosomatic appendages is used by these scorpions when burrowing, to kick back the sand as the burrow is excavated by the great chelae.

References to works dealing with the taxonomy and geographical distribution of scorpions are given at the end of this article (**28**).

Section β. *Epectinata.*—The primitive distinction between the mesosoma and the metasoma wholly or almost wholly obliterated, the two regions uniting to form an opisthosoma, which never consists of more than twelve somites and never bears appendages or breathing-organs behind the 4th somite. The breathing-organs of the opisthosoma, when present, represented by two pairs of stigmata, opening either upon the 1st and 2nd (Pedipalpi) or the 2nd and 3rd somites (Solifugae, Pseudo-scorpiones), or by a single pair upon the 3rd (? 2nd) somite (Opiliones) of the opisthosoma, there being rarely an additional stigma on the 4th (some Solifugae). The appendages of the 2nd somite of the opisthosoma absent, rarely minute and bud-like (some Amblypygi), never pectiniform. A prae-genital somite is often present either in a reduced condition forming a waist (Pedipalpi, Araneae, Palpigradi) or as a full-sized tergal plate (Pseudo-scorpiones); in some it is entirely atrophied (Solifugae, Holosomata, and Rhynchostomi). Lateral eyes when present diplostichous.

Remarks.—The Epectinate Arachnids do not stand so close to the aquatic ancestors of the Embolobranchia as do the Pectiniferous scorpions. At the same time we are not justified in supposing that the scorpions stand in any way as an intermediate grade between any of the existing Epectinata and the Delobranchia. It is probable that the Pedipalpi, Araneae, and Podogona have been separately evolved as distinct lines of descent from the ancient aquatic Arachnida. The Holosomata and Rhynchostomi are probably offshoots from the stem of the Araneae, and it is not unlikely (in view of the structure of the prosomatic somites of the Tartarides) that the Solifugae are connected in origin with the Pedipalpi. The appearance of tracheae in place of lung-sacs cannot be regarded as a starting-point for a new line of descent comprising all the tracheate forms; tracheae

seem to have developed independently in different lines of descent. On the whole, the Epectinata are highly specialized and degenerate forms, though there are few, if any, animals which surpass the spiders in rapidity of movement, deadliness of attack and constructive instincts.



From Lankester, *Q. J. Mic. Sci.* N.S. *vol.* xxi., 1881.

FIG. 54.—*Thelyphonus*, one of the Pedipalpi.

A, Ventral view.
I, Chelicera (detached).
II, Chelae.
III, Palpiform limb.
IV to VI, The walking legs.
stc, Sterno-coxal process (gnathobase) of the chelae.
st[1], Anterior sternal plate of the prosoma.
st[2], Posterior sternal plate of the prosoma.
pregen, Position of the prae-genital somite (not seen).
l, l, Position of the two pulmonary sacs of the right side.
1 to 11, Somites of the opisthosoma (mesosoma plus metasoma).
msg, Stigmata of the tergo-sternal muscles.
an, Anus.
B, Dorsal view of the opisthosoma of the same.
pregen, The prae-genital somite.
p, The tergal stigmata of the tergo-sternal muscles.
paf, Post-anal segmented filament corresponding to the post-anal spine of Limulus.

Order 2. Pedipalpi (figs. 54 to 59).—Appendages of 1st pair bisegmented, without poison gland; of 2nd pair prehensile, their basal segments underlying the proboscis, and furnished with sterno-coxal (maxillary) process, the apical segment tipped with a single movable or immovable claw; appendages of 3rd pair different from the remainder, tactile in function, with at least the apical segment many-jointed and clawless. The ventral surface of the prosoma bears prosternal, metasternal and usually mesosternal chitine-plates (fig. 55). A narrow prae-genital somite is present between opisthosoma and prosoma (figs. 55, 57). Opisthosoma consisting of eleven somites, almost wholly without visible appendages. Intromittent organ of male beneath the genital operculum (= sternum of the 1st somite of opisthosoma).

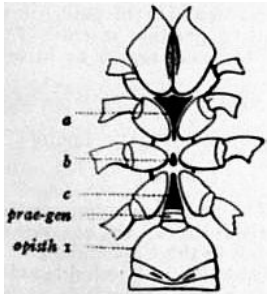


FIG. 55.—*Thelyphonus sp.* Ventral view of the anterior portion of the body to show the three prosomatic sternal plates *a, b, c*, and the rudimentary sternal element of the prae-genital somite; *opisth* 1, first somite of the opisthosoma.

From a drawing made by Pickard—Cambridge, under the direction of R.I. Pocock.

Note.—The possibility of another interpretation of the anterior somites of the mesosoma and the prae-genital somite must be borne in mind. Possibly, though not probably, the somites carrying the two lung-sacs correspond to the first two lung-bearing somites of *Scorpio*, and it is the genital opening which has shifted. The same caution applies in the case of the Araneae. Excalation of one or of two anterior mesosomatic somites, besides the prae-genital somite, would then have to be supposed to have occurred also.

Sub-order *a.* Uropygi.—Prosoma longer than wide, its sternal area very narrow, furnished with a

large prosternal and metasternal plate, and often with a small mesosternal sclerite. Appendages of 2nd pair with their basal segments united in the middle line and incapable of lateral movement; appendages of 3rd pair with only the apical segment many-jointed. Opisthosoma without trace of appendages; its posterior somites narrowed to form a movable tail for the support of the post-anal sclerite, which has no poison glands.

Tribe 1. Urotricha.—Dorsal area of prosoma covered with a single shield (? two in *Geralinura*), bearing median and lateral eyes. Post-anal sclerite modified as a long, many-jointed feeler. Appendages of 2nd pair folding in a horizontal plane, completely chelate, the claw immovably united to the sixth segment. Respiratory organs present in the form of pulmonary sacs.

Family—Thelyphonidae (*Thelyphonus* (fig. 54), *Hypoctonus*, **Geralinura*).

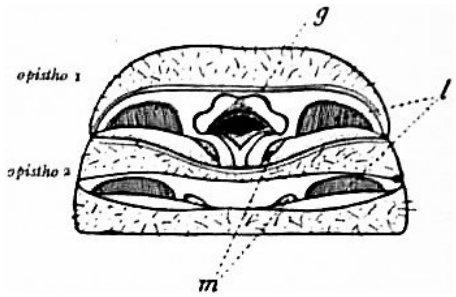


Fig. 56—*Thelyphonus assamensis* ♂. Ventral surface of the anterior region of the opisthosoma, the first somite being pushed upwards and forwards so as to expose the subjacent structures. *opistho* 1, First somite of the opisthosoma; *opistho* 2, second do.; *g*, genital aperture; *l*, edges of the lamellae of the lung-books; *m*, stigmata of tergo-sternal muscles.

(Original drawing by Pocock.)

Tribe 2. Tartarides.—Small degenerate forms with the dorsal area of the prosoma furnished with two shields, a larger in front covering the anterior four somites, and a smaller behind covering the 5th and 6th somites; the latter generally subdivided into a right and left portion. There is also a pair of narrow tergal sclerites interposed between the anterior and posterior shields. Eyes evanescent or absent. Appendages of 2nd pair folding in a vertical plane, not chelate, the claw long and movable. Post-anal sclerite short and undivided. No distinct respiratory stigmata behind the sterna of the 1st and 2nd somites of the opisthosoma.

Family-Hubbardiidae (*Schizomus*, *Hubbardia*) (figs. 57-59).

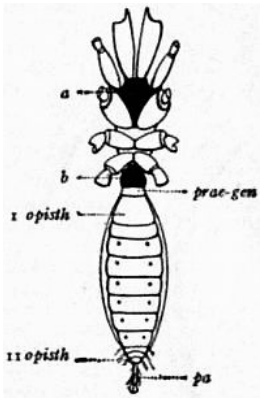


Fig. 57.—*Schizomus crassicaudatus*, one of the Tartarid Pedipalpi. Ventral view of a female with the appendages cut short near the base.

a, Prosternum of prosoma.
b, Metasternum of prosoma.
prae-gen, The prae-genital somite.
I *opisth*, First somite of the opisthosoma.
II *opisth*, Eleventh somite of the opisthosoma.
pa, Post-anal lobe of the female (compare the jointed filament in *Thelyphonus*, fig. 54).

(Original drawing by Pickard-Cambridge, directed by Pocock.)

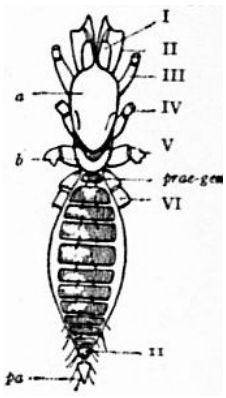


Fig. 58.—*Schizomus crassicaudatus*, a Tartarid Pedipalp. Dorsal view of a male with the appendages cut short.

I to VI. The prosomatic appendages.
a, Anterior plate.
b, Posterior plate of the prosomatic carapace.
prae-gen, Tergum of the prae-genital somite.
11, The eleventh somite of the opisthosoma.
pa, Post-anal lobe of the male—a conical body with narrow basal stalk.

(Original as preceding.)

Sub-order *b*. Amblypygi.—Prosoma wider than long, covered above by a single shield bearing median and lateral eyes, which have diplostichous ommatea. Sternal area broad, with prosternal, two mesosternal, and metasternal plates, the prosternum projecting forwards beneath the coxae of the 2nd pair of appendages. Appendages of 2nd pair folding in a horizontal plane; their basal segments freely movable; claw free or fused; basal segments of 4th and 5th pairs widely separated by the sternal area; appendages of 3rd pair with all the segments except the proximal three, forming a many-jointed flagellum. Opisthosoma without post-anal sclerite and posterior caudal elongation: with frequently a pair of small lobate appendages on the sternum of the 3rd somite. Respiratory organs, as in Urotricha.

Family—Phrynichidae (*Phrynichus*, *Damon*).
" Admetidae (*Admetus*, *Heterophrynus*).
" Charontidae (*Charon*, *Sarax*).
(Family ?)—**Graeophonus*.

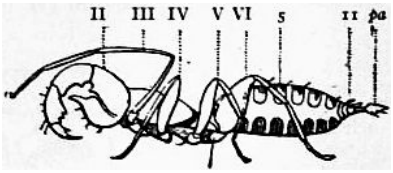


Fig. 59.—*Schizomus crassicaudatus*, one of the Pedipalpi. Lateral view of a male. II to VI, the prosomatic appendages, the first being concealed (see fig. 58); 5, the fifth, and 11, the eleventh tergites of the opisthosoma; *pa*, the conical post-anal lobe.

Remarks.—The Pedipalpi are confined to the tropics and warmer temperate regions of both hemispheres. Fossil forms occur in the Carboniferous. The small forms known as *Schizomus* and *Hubbardia* are of special interest from a morphological point of view. The Pedipalpi have no poison glands. (Reference to literature (**29**).)

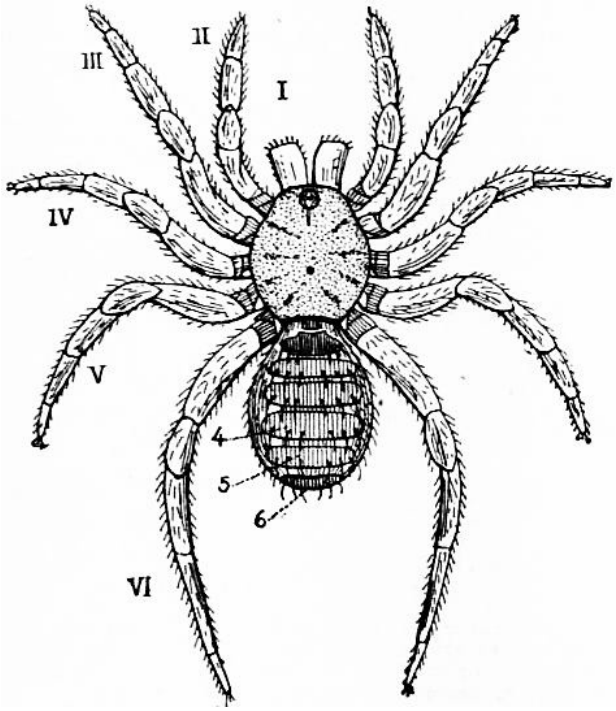


FIG. 60.—*Liphistius desultor*, Schiödte, one of the Araneae Mesothelae. Dorsal view. I to VI, the prosomatic appendages; 4, 5, 6, the fourth, fifth and sixth tergites of the opisthosoma. Between the bases of the sixth pair of limbs and behind the prosomatic carapace is seen the tergite of the small prae-genital somite.

(Original by Pickard-Cambridge and Pocock.)

Order 3. Araneae (figs. 60 to 64.).—Prosoma covered with a single shield and typically furnished with median and lateral eyes of diplostichous structure, as in the Amblypygi. The sternal surface wide, continuously chitinized, but with prosternal and metasternal elements generally distinguishable at the anterior and posterior ends respectively of the large mesosternurm. Prosternum underlying the proboscis. Appendages of 1st pair have two segments, as in Pedipalpi, but are furnished with poison gland, and are retroverts. Appendages of 2nd pair not underlying the mouth, but freely movable and, except in primitive forms, furnished with a maxillary lobe; the rest of the limb like the legs, tipped with a single claw and quite unmodified (except in ♂). Remaining pairs of appendages similar in form and function, each tipped with two or three claws. Opisthosoma when segmented showing the same number of somites as in the Pedipalpi; usually unsegmented, the prae-genital somite constricted to form the waist; the appendages of its 3rd and 4th somites retained as spinning mammillae. Respiratory organs (see fig. 63, *stg*), as in the Amblypygi, or with the posterior pair, rarely the anterior pair as well, replaced by tracheal tubes. Intromittent organ of male in the apical segment of the 2nd prosomatic appendage.

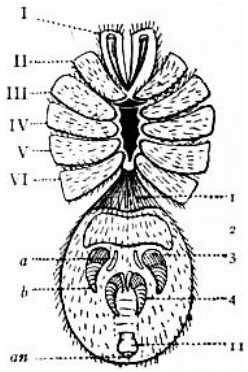


FIG. 61.—*Liphistius desultor*. Ventral view with the prosomatic appendages cut short excepting the chelicerae (1) whose sharp retroverts are seen. Between the bases of the prosomatic limbs an anterior and a posterior sternal plate (black) are seen. 1, The sternum of the first opisthosomatic or genital somite covering the genital aperture and the first pair of lung-sacs. In front of it the narrow waist is formed by the soft sternal area of the praegenital somite; 2, the sternite of the second opisthosomatic somite covering the posterior pair of lung-sacs; 3 and 4, the spinning appendages (limbs) of the opisthosoma; *a*, inner, *b*, outer ramus of the appendage; 11, sternite of the eleventh somite of the opisthosoma: in front of it other rudimentary sternites; *an*, anus.

(Original as above.)

Sub-order *a*. Mesothelae (see figs. 60 to 62).—Opisthosoma distinctly segmented, furnished with 11 tergal plates, as in the Amblypygi; the ventral surface of the 1st and 2nd somites with large sternal plates, covering the genital aperture and the two pairs of pulmonary sacs, the sternal plates from the 6th to the 11th somites represented by integumental ridges, weakly chitinized in the middle. The two pairs of spinning appendages retain their primitive position in the middle of the lower surface of the opisthosoma far in advance of the anus on the 3rd and 4th somites, each appendage consisting of a stout, many-jointed outer branch and a slender, unsegmented inner branch. Prosoma as in the Mygalomorphae, except that the mesosternal area is long and narrow.

Family—Liphistiidae (*Liphistius*, **Arthrolycosa*).

Sub-order *b*. Opisthothelae (see fig. 63).—Opisthosoma without trace of separate terga and sterna, the

segmentation merely represented posteriorly by slight integumental folds and the sterna of the 1st and 2nd somites by the opercular plates of the pulmonary sacs. The spinning appendages migrate to the posterior end of the opisthosoma and take up a position close to the anus; the inner branches of the anterior pair either atrophy or are represented homogenetically by a plate, the cribellum, or by an undivided membranous lobe, the colulus.

Tribe 1. Mygalomorphae.—The plane of the articulation of the appendages of the 1st pair to the prosoma (the retrovert) vertical, the basal segment projecting straight forwards at its proximal end, the distal segment or fang closing backwards in a direction subparallel to the long axis of the body. Two pairs of pulmonary sacs.

Families—Theraphosidae (*Avicularia*, *Poecilotheria*). Barychelidae (*Barychelus*, *Plagiobothrus*). Dipluridae (*Diplura*, *Macrothele*). Ctenizidae (*Cteniza*, *Nemesia*). Atypidae (*Atypus*, *Calommata*).

Tribe 2. Arachnomorpnae.—The plane of the articulation of the appendages of the 1st pair to the prosoma horizontal, the basal segment projecting vertically downwards, at least at its proximal end, the distal segment or fang closing inwards nearly or quite at right angles to the long axis of the body. The posterior pulmonary sacs (except in *Hypochilus*) replaced by tracheal tubes; the anterior and posterior pairs replaced by tracheal tubes in the Caponiidae.

Principal families—Hypochilidae (*Hypochilus*). Dysderidae (*Dysdera*, *Segestria*). Caponiidae (*Caponia*, *Nops*). Filistatidae (*Filistata*). Uloboridae (*Uloborus*, *Dinopis*). Argiapidae (*Nephila*, *Gasteracantha*). Pholcidae (*Pholcus*, *Artema*). Agelenidae (*Tegenuria*). Lycosidae (*Lycosa*). Clubionidae (*Clubiona*, *Olios*, *Sparassus*) Gnaphosidae (*Gnaphosa*, *Hemiclaea*). Thomisidae (*Thomisus*). Attidae (*Salticus*). Urocteidae (*Uroctea*). Eresidae (*Eresus*).

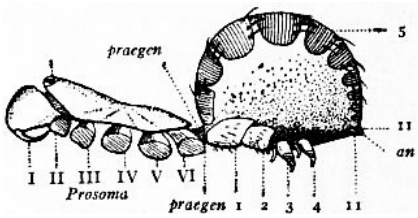


FIG. 62.—*Liphistius desultor*. Lateral view.

I to VI, Appendages of the prosoma cut off at the base.
o, Ocular tubercle.
prae-gen, The prae-genital somite.
1 and 2, Sternites of the first and second opisthosomatic somites.
3 and 4, Appendages of the third and fourth opisthosomatic somites, which are the spinning organs, and in this genus occupy their primitive position instead of migrating to the anal region as in other spiders.
5, Tergite of the fifth opisthosomatic somite.
11, Eleventh opisthosomatic somite; *an*, Anus.

(Original.)

Remarks on the Araneae.—The Spiders are the most numerous and diversified group of the Arachnida; about 2000 species are known. No noteworthy fossil spiders are known; the best-preserved are in amber of Oligocene age. *Protolycosa* and *Arthrolycosa* occur in the Carboniferous. Morphologically, the spiders are remarkable for the concentration and specialization of their structure, which is accompanied with high physiological efficiency. The larger species of Bird's Nest Spiders (*Avicularia*), the opisthosoma of which is as large as a bantam's egg, undoubtedly attack young birds, and M'Cook gives an account of the capture in its web by an ordinary house spider of a small mouse. The "retrovert" or bent-back first pair of appendages is provided with a poison gland opening on the fang or terminal segment. Spiders form at least two kinds of constructions—snares for the capture of prey and nests for the preservation of the young. The latter are only formed by the female, which is a larger and more powerful animal than the male. Like the scorpions the spiders have a special tendency to cannibalism, and accordingly the male, in approaching the female for the purpose of fertilizing her, is liable to be fallen upon and sucked dry by the object of his attentions. The sperm is removed by the male from the genital aperture into a special receptacle on the terminal segment of the 2nd prosomatic appendage. Thus held out at some distance from the body, it is cautiously advanced by the male spider to the genital aperture of the female.

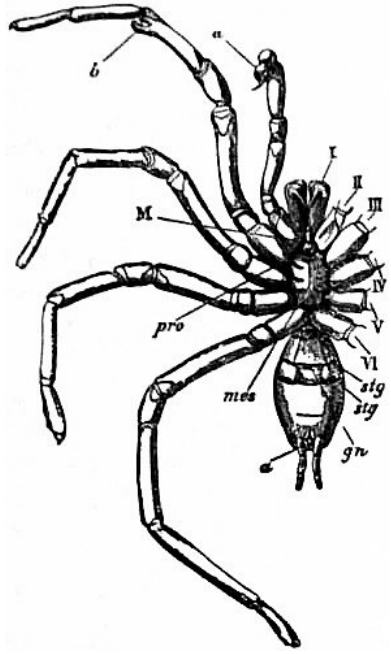


FIG. 63.—Ventral view of a male mygalomorphous spider.

I to VI, The six pairs of prosomatic appendages.
a, Copulatory apparatus of the second appendage.
b, Process of the fifth joint of the third appendage.
M, Mouth.
pro, Prosternite of the prosoma.
mes, Mesosternite of the prosoma: observe the contact of the coxae of the sixth pair of limbs behind it; compare *Liphistius* (fig. 61) where this does not occur.
stg, Lung aperture.
gn, Genital aperture.
a, Anus with a pair of backwardly migrated spinning appendages on each side of it; compare the position of these appendages in *Liphistius* (fig. 61).

(From Lankester, "Limulus an Arachnid.")

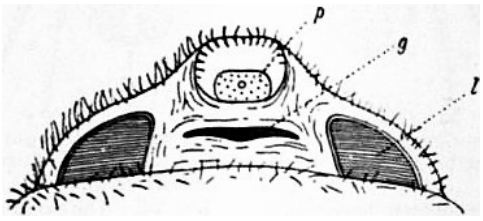


FIG. 64.—*Liphistius desultor*. Under side of the uplifted genital or first opisthosomatic somite of the female; *g*, genital aperture; *p*, pitted plate, probably a gland for the secretion of adhesive material for the eggs; *l*, the edges of the lamellae of the lung-books of the first pair.

(Original drawing by Pocock.)

For an account of the courtship and dancing of spiders, of their webs and floating lines, the reader is referred to the works of M'Cook (**30**) and the Peckhams (**31**), whilst an excellent account of the nests of trap-door spiders is given by Moggridge (**32**). References to systematic works will also be found at the end of this article (**33**).

Order 4. Palpigradi = Microthelyphonidae (see fig. 65).—Prosoma covered above by three plates, a larger representing the dorsal elements of the first four somites, and two smaller representing the dorsal elements of the 5th and 6th.

Its ventral surface provided with one prosternal, two mesosternal and one metasternal plate. Appendages of 1st pair consisting of three segments, completely chelate, without poison gland; of 2nd pair slender, leg-like, tipped with three claws, the basal segment without sterno-coxal process taking no share in mastication, and widely separated from its fellow of the opposite side; 3rd, 4th, 5th and 6th appendages similar in form to the 2nd and to each other.

Proboscis free, not supported from below by either the prosternum or the basal segments of the appendages of the 2nd pair.

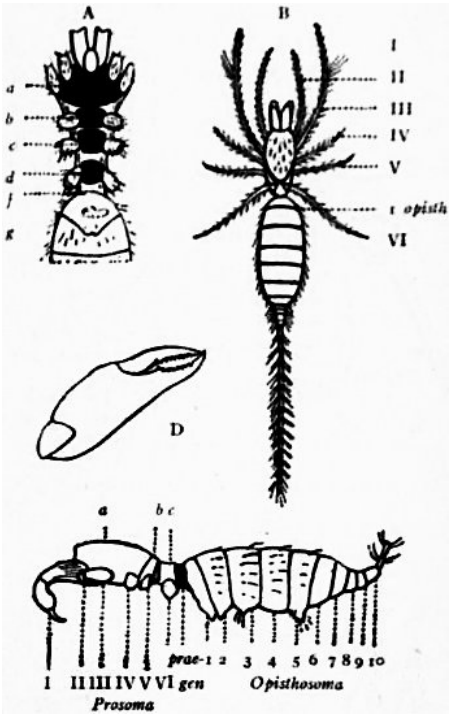


FIG. 65.—*Koenenia mirabilis*, Grassi, one of the Palpigradi.

A, Ventral view of prosoma and anterior region of opisthosoma with the appendages cut off near the base; *a* and *b*, prosternites; *c*, mesosternite; and *d*, metasternite of the prosoma; *f*, ventral surface of the prae-genital somite; *g*, sternite of the genital somite (first opisthosomatic somite).

B, Dorsal view. I to VI, prosomatic appendages; 1 *opisth*, genital somite (first opisthosomatic somite).

C, Lateral view, I to VI, prosomatic appendages; *a, b, c*, the three tergal plates of the prosoma; *prae-gen*, the prae-genital somite; 1 to 10, the ten somites of the opisthosoma.

D, Chelicera.

(Original drawing by Pocock and Pickard-Cambridge, after Hansen and Sörensen.)

Opisthosoma consisting of only ten somites, which have no tergal and sternal elements, the prae-genital somite contracted to form a “waist,” as in the Pedipalpi; the last three narrowed to form a caudal support for the many-jointed flagelliform telson, as in the Urotricha. Respiratory organs atrophied.

Family—Koeneniidae (*Koenenia*).

Remarks.—An extremely remarkable minute form originally described by Grassi (**34**) from Sicily, and since further described by Hansen (**35**). Recently the genus has been found in Texas, U.S.A. Only one genus of the order is known.

Order 5. Solifugae = Mycetophorae (see figs. 66 to 69).—Dorsal area of prosoma covered with three distinct plates, two smaller representing the terga of the 5th and 6th somites, and a larger representing those of the anterior four somites, although the reduced terga of the 3rd and 4th are traceable behind the larger plate. The latter bears a pair of median eyes and obsolete lateral eyes on each side. Sternal elements of prosoma almost entirely absent, traces of a prosternum and metasternum alone remaining. Rostrum free, not supported by either the prosternum or the basal segments of the appendages. Appendages of 1st pair large, chelate, bisegmented, articulated to the sides of the head-shield; appendages of 2nd pair simple, pediform, with protrusible (? suctorial) organ, and no claws at the tip; their basal segments united in the middle line and furnished with sterno-coxal process. Remaining pairs of appendages with their basal segments immovably fixed to the sternal surface, similar in form, the posterior three pairs furnished with two claws supported on long stalks; the basal segments of the 6th pair bearing five pairs of tactile sensory organs or malleoli. The prae-genital somite is suppressed. Opisthosoma composed of ten somites. Respiratory organs tracheal, opening upon the ventral surface of the 2nd and 3rd, and sometimes also of the 4th somite of the opisthosoma. A supplementary pair of tracheae opening behind the basal segment of the 4th appendage of the prosoma.

(? Intromittent organ of male lodged on the dorsal side of the 1st pair of prosomatic appendages.)

Families—Hexisopodidae (*Hexisopus*). Solpugidae (*Solpuga*, *Rhagodes*). Galeodidae (*Galeodes*).

Remarks.—These most strange-looking Arachnids occur in warmer temperate, and tropical regions of Asia, Africa and America. Their anatomy has not been studied, as yet, by means of freshly-killed material, and is imperfectly known, though the presence of the coxal glands was determined by Macleod in 1884. The proportionately enormous chelae (chelicerae) of the first pair of appendages are not provided with poison glands; their bite is not venomous.

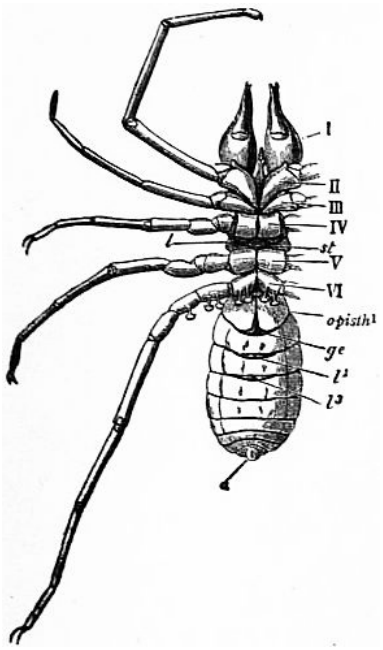


FIG. 66.—*Galeodes sp.*, one of the Solifugae. Ventral view to show legs and somites.

I to VI, The six leg-bearing somites of the prosoma.
opisth 1, First or genital somite of the opisthosoma.
ge, Site of the genital aperture.
st, Thoracic tracheal aperture.
l^2, Anterior tracheal aperture of the opisthosoma in somite 2 of the opisthosoma.
l^3, Tracheal aperture in somite 3 of the opisthosoma.
a, Anus.

(From Lankester, “Limulus an Arachnid.”)

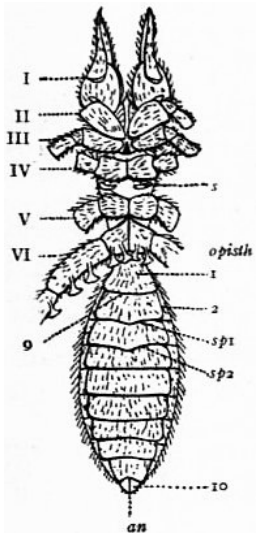


FIG. 67.—*Galeodes sp.*, one of the Solifugae. Ventral view with the appendages cut off at the base.

I to VI, Prosomatic appendages.
s, Prosomatic stigma or aperture of the tracheal system.
1, First opisthosomatic sternite covering the genital aperture *g*.
2, Second opisthosomatic sternite covering the second pair of tracheal apertures *sp1*.
sp2, The third pair of tracheal apertures.
10, The tenth opisthosomatic somite.
an, The anal aperture.

(Original by Pickard-Cambridge and Pocock.)

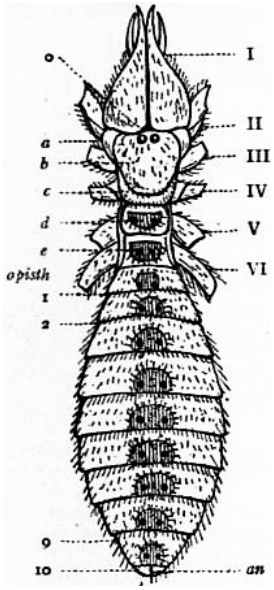


FIG. 68.—*Galeodes sp.*, one of the Solifugae. Dorsal view.

I to VI, Bases of the prosomatic appendages.
o, Eyes.
a, Lateral region of the cephalic plate to which the first pair of appendages are articulated.
b, Cephalic plate with median eye.
c, Dorsal element of somites bearing third and fourth pairs of appendages.
d, Second plate of the prosoma with fifth pair of appendages.
e, Third or hindermost plate of the prosoma beneath which the sixth pair of legs is articulated.
1, 2, 9, 10, First, second, ninth and tenth somites of the opisthosoma.
an, Anus.

(Original.)

Galeodes has been made the means of a comparison between the structure of the Arachnida and Hexapod insects by Haeckel and other writers, and it was at one time suggested that there was a genetic affinity between the two groups—through *Galeodes*, or extinct forms similar to it. The segmentation of the prosoma and the form of the appendages bear a homoplastic similarity to the head, pro-, meso-, and meta-thorax of a Hexapod with mandibles, maxillary palps and three pairs of walking legs; while the opisthosoma agrees in form and number of somites with the abdomen of a Hexapod, and the tracheal stigmata present certain agreements in the two cases. Reference to literature (**36**).

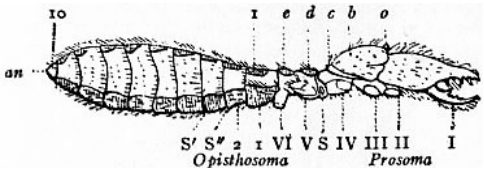


FIG. 69.—*Galeodes sp.*, one of the Solifugae.

I to VI, The six prosomatic limbs cut short.
o, The eyes.
b, *c*, Demarcated areae of the cephalic or first prosomatic plate corresponding respectively to appendages I, II, III, and to appendage IV (see fig. 68).
d, Second plate of the prosoma-carrying appendage V.
e, Third plate of the prosoma-carrying appendage VI. The prae-genital somite is absent.
1, First somite of the opisthosoma.
2, Second do.
S, Prosomatic tracheal aperture between legs IV and V.
S′ and S″, Opisthosomatic tracheal apertures.
10, Tenth

opisthosomatic somite.
an, Anus.

(Original.)

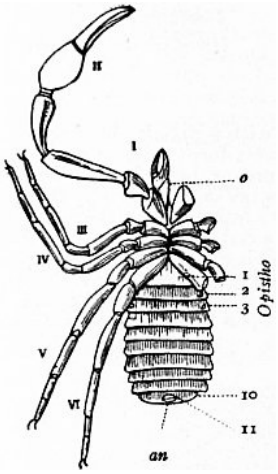


FIG. 70.—*Garypus litoralis*, one of the Pseudoscorpiones. Ventral view.

I to VI, Prosomatic appendages.
o, Sterno-coxal process of the basal segment of the second appendage.
1, Sternite of the genital or first opisthosomatic somite; the prae-genital somite, though represented by a tergum, has no separate ternal plate.
2 and 3, Sternites of the second and third somites of the opisthosoma, each showing a tracheal stigma.
10 and 11, Sternites of the tenth and eleventh somites of the opisthosoma.
an, Anus.

(Original by Pocock and Pickard-Cambridge.)

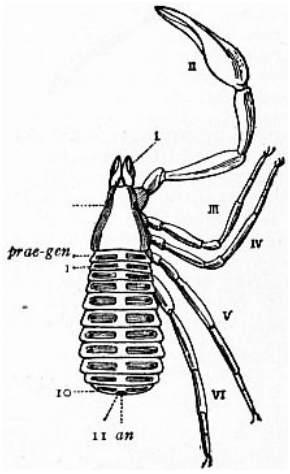


FIG. 71.—*Garypus litoralis*, one of the Pseudoscorpiones. Dorsal view.

I to VI, The prosomatic appendages.
o, Eyes.
prae-gen, Prae-genital somite.
1, Tergite of the genital or first opisthosomatic somite.
10, Tergite of the tenthsomite of the opisthosoma.
11, The evanescent eleventh somite of the opisthosoma.
an, Anus.

(Original.)

Order 6. Pseudoscorpiones = Chelonethi, also called Chernetidia (see figs. 70, 71, 72).—Prosoma covered by a single dorsal shield, at most furnished with one or two diplostichous lateral eyes; sternal elements obliterated or almost obliterated. Appendages of the 1st pair bisegmented completely chelate, furnished with peculiar organs, the *serrula* and the *lamina*. Appendages of 2nd pair very large and completely chelate, their basal segments meeting in the middle line, as in the Uropygi, and provided in front with membranous lip-like processes underlying the proboscis. Appendages of the 3rd, 4th, 5th and 6th pairs similar in form and function, tipped with two claws, their basal segments in contact in the median ventral line. The prae-genital somite wide, not constricted, with large tergal plate, but with its sternal plate small or inconspicuous. Opisthosoma composed, at least in many cases, of eleven somites, the 11th somite very small, often hidden within the both. Respiratory organs in the form of tracheal tubes opening by a pair of stigmata in the 2nd and 3rd somites of the opisthosoma. Intromittent organ of male beneath sternum of the 1st somite of the opisthosoma.

Sub-order *a*. Panctenodactyli.—Dorsal plate of prosoma (carapace) narrowed in front; the appendages of the 1st pair small, much narrower, taken together, than the posterior border of the carapace. Serrula on movable digit of appendages of 1st pair fixed throughout its length, and broader at its proximal than at its distal end; the immovable digit with an external process.

Family—Cheliferidae (*Chelifer* (figs. 70, 71, 72), *Chiridium*).
" Garypidae (*Garypus*).

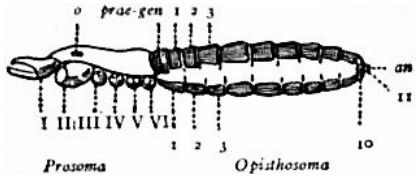


FIG. 72.—*Garypus litoralis*, one of the Pseudoscorpiones. Lateral view.

I to VI, of the six prosomatic appendages.
o, Eyes.
prae-gen, Tergite of the prae-genital somite.
1, Genital or first opisthosomatic somite.
2, 3, 10, The second, third and tenth somites of the opisthosoma.
11, The minute eleventh somite;
an, the anus.

(Original.)

Sub-order *b*. Hemictenodactyli.—Dorsal plate of prosoma scarcely narrowed in front; the appendages of the

1st pair large, not much narrower, taken together, than the posterior border of the carapace. The serrula or the movable digit free at its distal end, narrowed at the base; no external lamina on the immovable digit.

Family—Obisiidae (*Obisium, Pseudobisium*).
" Chthoniidae (*Chthonius, Tridenchthonius*).

Remarks.—The book-scorpions—so called because they were, in old times, found not unfrequently in libraries—are found in rotten wood and under stones. The similarity of the form of their appendages to those of the scorpions suggests that they are a degenerate group derived from the latter, but the large size of the prae-genital somite in them would indicate a connexion with forms preceding the scorpions. Reference to literature (**37**).

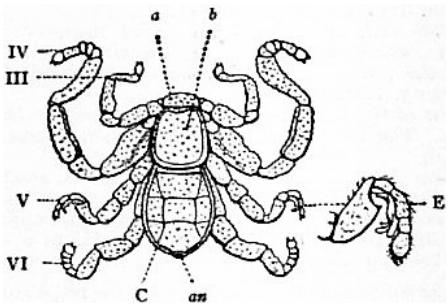


FIG. 73.—*Cryptostemma Karschii*, one of the Podogona. Dorsal view of male.

III to VI, The third, fourth, fifth and sixth appendages of the prosoma.
a, Movable (hinged) sclerite (so-called hood) overhanging the first pair of appendages.
b, Fused terga of the prosoma followed by the opisthosoma of four visible somites.
an, Orifice within which the caudal segments are withdrawn.
E, Extremity of the fifth appendage of the male modified to subserve copulation.

(Original drawing by Pocock and Pickard-Cambridge.)

Order 7. Podogona = Ricinulei (see figs. 73 to 76).—Dorsal area of prosoma furnished with two shields, a larger behind representing, probably, the tergal elements of the somites, and a smaller in front, which is freely articulated to the former and folds over the appendages of the 1st pair. Ventral area without distinct sternal plates. Appendages of 1st pair, bisegmented, completely chelate. Appendages of 2nd pair, with their basal segments uniting in the middle line below the mouth, weakly chelate at apex. Appendages of 3rd, 4th, 5th and 6th pairs similar in form; their basal segments in contact in the middle line and immovably welded, except those of the 3rd pair, which have been pushed aside so that the bases of the 2nd and 4th pairs are in contact with each other. A movable membranous joint between the prosoma and the opisthosoma, the generative aperture opening upon the ventral side of the membrane. Prae-genital somite suppressed; the opisthosma consisting of nine segments, whereof the first and second are almost suppressed and concealed within the joint between the prosoma and the opisthosoma; the following four large and manifest, and the remaining three minute and forming a slender generally-retracted tail like that of *Thelyphonus*. Respiratory organs tracheal, opening by a pair of spiracles in the prosoma above the base of the fifth appendage on each side. Intromittent organ of male placed at the distal end of the appendage of the 5th pair.

Family—Cryptostemmidae (*Cryptostemma, Poliochera*), Carboniferous.

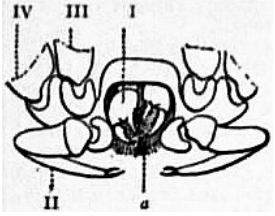


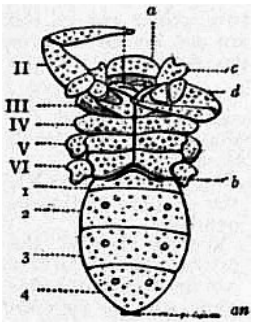
FIG. 74.—*Cryptostemma Karschii*, anterior aspect of the prosoma with the "hood" removed. I to IV, first to fourth appendages of the prosoma; *a*, basal segment of the second pair of appendages meeting its fellow in the middle line (see fig. 75).

(Original drawing by Pocock and Pickard-Cambridge.)

Remarks on the Podogona.—The name given to this small but remarkable group has reference to the position of the male intromittent organ (fig. 73, E). They are small degenerate animals with a relatively firm integument. Not more than four species and twice that number of specimens are known. They have been found in West Africa and South America. A fact of special interest in regard to them is that the genus Poliochera, from the Coal Measures, appears to be a member of the same group. The name Cryptostemma, given to the first-known genus of the order, described by Guérin-Méneville, refers to the supposed concealment of the eyes by the movable cephalic sclerite. Reference to literature (**38**).

FIG. 75.—*Cryptostemma Karschii*, one of the Podogona. Ventral view.

I to VI, The six pairs of appendages of the prosoma, the last three cut short.
1, 2, 3, 4, The four somites of the opisthosoma.



a, Visible hood overhanging the first pair of appendages.
b, Position of the genital orifice.
c, Part of 3rd appendage.
d, Fourth segment of 2nd appendage. Observe that the basal segment of appendage III does *not* meet its fellow in the middle line.

(Original drawing by Pocock and Pickard-Cambridge.)

Order 8. Opilione (see fig. 77).—Dorsal area of prosoma covered by a single shield usually bearing a pair of eyes. Sternal elements much reduced. Appendages of 1st pair large, three segmented and completely chelate; of 2nd pair either simple and pediform, or prehensile and subchelate; of remaining four pairs, similar in form, ambulatory in function; the basal segment of the 2nd, 3rd and sometimes of the 4th pairs of appendages furnished with sterno-coxal (maxillary) lobe. Opisthosoma confluent throughout its breadth with the prosoma, with the dorsal plate of which its anterior tergal plates are more or less fused; at most ten opisthosomatic somites traceable; the generative aperture thrust far forwards between the basal segments of the 6th appendages. Prae-genital somite suppressed. Respiratory organs tracheal, opening by a pair of stigmata situated immediately behind the basal segments of the 6th pair of appendages on what is probably the sternum of the 2nd opisthosomatic somite and also in some cases upon the 5th segment of the legs.

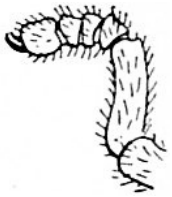


FIG. 76.—*Cryptostemma Karschii*. Extremity of the fifth pair of appendages of the female for comparison with that of the male E in fig. 73.

Intromittent organ of male lying within the genital orifice.

Sub-order *a*. Laniatores.—Orifice of foetid glands opening above the coxa of the 4th appendage, not raised upon a tubercle. Orifice of coxal gland situated just behind that of the foetid gland. Sternal plate of prosoma long and narrow, with a distinct prosternal element underlying the mouth. Coxae of 4th, 5th and 6th appendages immovable. Appendages of 2nd pair, strong, usually prehensile and spiny. Genital orifice covered by an operculum.

Families—Gonoleptidae (*Gonoleptes, Goniasoma*).
Biantidae (*Biantes*).
Oncopodidae (*Oncopus, Pelitnus*).
Trioenonychidae (*Trioenonyx, Acumontia*).

Sub-order *b*. Palpatores.—Orifice of foetid glands opening above the coxa of the 3rd appendage, not raised upon a tubercle. Orifice of coxal gland situated between the coxae of the 5th and 6th appendages. Sternal plate of prosoma usually short and wide, rarely longer than broad; with a larger or smaller prosternal element underlying the mouth. Coxae of 3rd, 4th, 5th and 6th appendages movable or immovable. Appendages of 2nd pair weak, pediform not prehensile. Genital orifice covered by an operculum.

Families—Phalangiidae (*Phalangium, Gagrella*).
Ischyropsalidae (*Ischyropsalis, Taracus*).
Nemastomidae (*Nemastoma*).
Trogulidae (*Trogulus, Anelasmocephalus*).

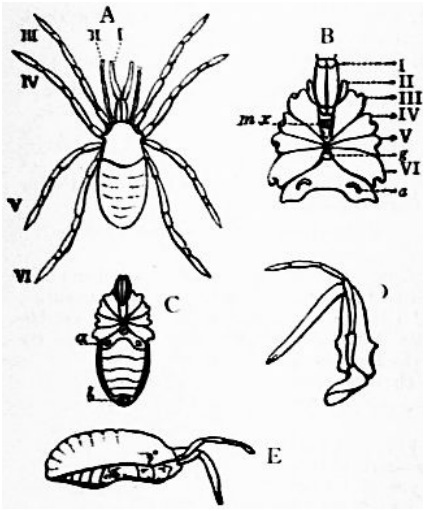
Sub-order *c. Cyphophthalmi* (*Anepignathi*).—Orifice of foetid glands opening on a tubercle situated near the lateral border of the carapace above the base of the 5th appendage. Orifice of coxal gland probably situated at base of coxa of 5th appendage; sternal plate of prosema minute or absent; no prosternal element underlying the mouth. Coxae of 5th and 6th, and usually also of 4th appendages immovable. Appendages of 2nd pair weak, pediform, not prehensile. Genital orifice not covered by an operculum.

Families—Sironidae (*Siro, Pettalus*).
Stylocellidae (*Stylocellus*).

Remarks on the Opiliones.—These include the harvest-men, sometimes called also daddy-long-legs, with round undivided bodies and very long, easily-detached legs. The intromittent organs of the male are remarkable for their complexity and elaboration. The confluence of the regions of the body and the dislocation of apertures from their typical position are results of degeneration. The Opiliones seem to lead on from the Spiders to the Mites. Reference to literature (**39**).

FIG. 77.—*Stylocellus sumatranus*, one of the Opiliones; after Thorell. Enlarged.

A, Dorsal view; I to VI, the six prosomatic appendages.
B, Ventral view of the prosoma and of the first somite of the opisthosoma, with the appendages I to VI cut off



at the base; *a*, tracheal stigma; *mx*, maxillary processes of the coxae of the 3rd pair of appendages; *g*, genital aperture.

C, Ventral surface of the prosoma and opisthosoma; *a*, tracheal stigma; *b*, last somite.

D, Lateral view of the 1st and 2nd pair of appendages.

E, Lateral view of the whole body and two 1st appendages, showing the fusion of the dorsal elements of the prosoma into a single plate, and of those of the opisthosoma into an imperfectly segmented plate continuous with that of the prosoma.

Apparently related to the Opiliones are two extinct groups, the Anthracomarti and Phalangiotarbi, which are not known to have survived the Carboniferous period. In the Anthracomarti the opisthosoma was movably articulated to the prosoma, and consisted of from eight to ten segments furnished with movable lateral plates, the anal segment being overlapped dorsally by a laminate expansion of the preceding segment. The carapace of the prosoma was unsegmented and often bore a pair of eyes. The appendages of the 2nd pair were slender and pediform; those of the 3rd, 4th, 5th and 6th pairs were similar in form and ambulatory in function with their basal segments arranged round a sternal area as in the order Araneae. The best-known genera were *Anthracomartus* and *Eophognus*.

In the Phalangiotarbi the appendages resembled those of the Anthracomarti, except that the basal segments of the last four pairs were usually approximated in the middle line leaving a long and narrow sternal area between; and the carapace of the prosoma was unsegmented. The prosoma and opisthosoma were broadly confluent and probably immovably welded together. The opisthosoma consisted of eight or nine segments, whereof the anterior five or six were very short in the dorsal region, and the posterior three exceptionally large with the anal orifice terminal.

Several genera have been established, the best-characterized being *Geraphognus* and *Architarbus*.

Order 9. Rhynchostomi = Acari (see fig. 78).—Degenerate Arachnids resembling the Opiliones in many structural points, but chiefly distinguishable from them by the following features:—The basal segments of the appendages of the 2nd pair are united in the middle line behind the mouth, those of the 3rd, 4th, 5th and 6th pairs are widely separated and not provided with sterno-coxal (maxillary) lobes, and take no share in mastication; the respiratory stigmata, when present, belong to the prosoma, and the primitive segmentation of the opisthosoma has entirely or almost entirely disappeared.

Sub-order *a*. *Notostigmata.*—Opisthosoma consisting of ten segments defined by integumental grooves, each of the anterior four of these furnished with a single pair of dorsally-placed spiracles or tracheal stigmata.

Family—Opilioacaridae (*Opilioacarus*).

Sub-order *b*. *Cryptostigmata.*—Integument hard, strengthened by a continuously chitinized dorsal and ventral sclerite. Tracheae typically opening by stigmata situated in the articular sockets (acetabula) of the 3rd, 4th, 5th and 6th pairs of appendages.

Family—Oribatidae (*Oribata, Nothrus, Hoplophora*).

Sub-order *c*. *Metastigmata.*—Integument mostly like that of the Cryptostigmata. Tracheae opening by a pair of stigmata situated above and behind the base of the 4th or 5th or 6th pair of appendages.

Families—Gamasidae (*Gamasus, Pteroptus*).
Argasidae (*Argas, Ornithodoros*).
Ixodidae (*Ixodes, Rhipicephalus*).

Sub-order *d*. *Prostigmata.*—Integument soft, strengthened by special sclerites, those on the ventral surface of the prosoma apparently representing the basal segments of the legs embedded in the skin. Tracheae, except in the aquatic species in which they are atrophied, opening by a pair of stigmata situated close to or above the base of the appendages of the 1st pair (mandibles).

Families—Trombidiidae (*Trombidium, Tetranychus*).
Hydrachnidae (*Hydrachna, Atax*).
Halacaridae (*Halacarus, Leptognathus*).
Bdellidae (*Bdella, Eupodes*).

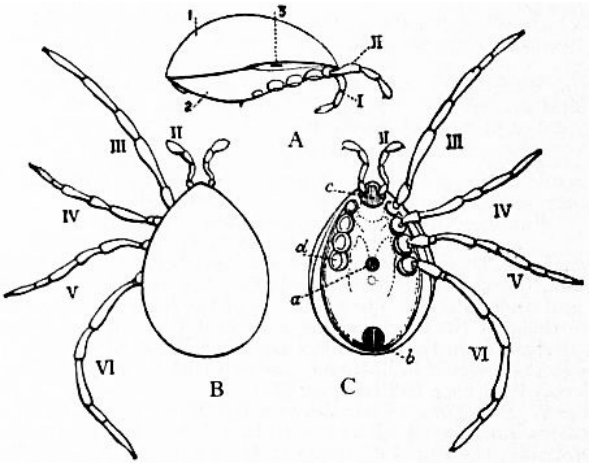


FIG. 78.—*Holothyrus nitidissimus*, one of the Acari; after Thorell.

A, Lateral view with appendages III to VI removed; 1, plate covering the whole dorsal area, representing the fused tergal sclerites of the prosoma and opisthosoma; 2, similarly-formed ventral plate; 3, tracheal stigma.
B, Dorsal view of the same animal; II to VI, 2nd to 6th pairs of appendages. The 1st pair of appendages both in this and in C are retracted.
C, Ventral view of the same; II to VI as in B; *a*, genital orifice; *b*, anus; *c*, united basal segments of the second pair of appendages; *d*, basal segment of the 6th prosomatic appendage of the right side. The rest of the appendage, as also of app. Ill, IV and V, has been cut away.

Sub-order *e*. *Astigmata*.—Degenerate, mostly parasitic forms approaching the Prostigmata in the development of integumental sclerites and the softness of the skin, but with the respiratory system absent.

Families—Tyroglyphidae (*Tyroglyphus, Rhizoglyphus*).
Sarcoptidae (*Sarcoptes, Analges*).

Sub-order *f*. *Vermiformia*.—Degenerate atracheate parasitic forms with the body produced posteriorly into an annulated caudal prolongation, and the 3rd, 4th, 5th and 6th pairs of appendages short and only three-jointed.

Family—Demodicidae (*Demodex*).

Sub-order *g*. *Tetrapoda*.—Degenerate atracheate gall-mites in which the body is produced posteriorly and annulated, as in *Demodex*, but in which the appendages of the 3rd and 4th pairs are long and normally segmented and those of the 5th and 6th pairs entirely absent.

Family—Eriophyidae (*Eriophyes, Phyllocoptes*).

Remarks on the Rhynchostomi.—The Acari include a number of forms which are of importance and special interest on account of their parasitic habits. The ticks (*Ixodes*) are not only injurious as blood-suckers, but are now credited with carrying the germs of Texas cattle-fever, just as mosquitoes carry those of malaria. The itch-insect (*Sarcoptes scabiei*) is a well-known human parasite, so minute that it was not discovered until the end of the 18th century, and "the itch" was treated medicinally as a rash. The female burrows in the epidermis much as the female trap-door spider burrows in turf in order to make a nest in which to rear her young. The male does not burrow, but wanders freely on the surface of the skin. *Demodex folliculorum* is also a common parasite of the sebaceous glands of the skin of the face in man, and is frequent in the skin of the dog. Many Acari are parasitic on marine and freshwater molluscs, and others are found on the feathers of birds and the hair of mammals. Others have a special faculty of consuming dry, powdery vegetable and animal refuse, and are liable to multiply in manufactured products of this nature, such as mouldy cheese. A species of Acarus is recorded as infesting a store of powdered strychnine and feeding on that drug, so poisonous to larger organisms. Reference to literature (**40**).

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(E. R. L.)

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1 See the article Arthropoda for the use of the term "prosthomere."

2 See fig. 12 in the article Arthropoda.

3 Though ten is the prevailing number of retinula cells and rhabdomeres in the lateral eye of Limulus, Watase states that they may be as few as nine and as many as eighteen.

4 A great deal of superfluous hypothesis has lately been put forward in the name of "the principle of convergence of characters" by a certain school of palaeontologists. The horse is supposed by these writers to have originated by

separate lines of descent in the Old World and the New, from five-toed ancestors! And the important consequences following from the demonstration of the identity in structure of Limulus and Scorpio are evaded by arbitrary and even phantastic invocations of a mysterious transcendental force which brings about "convergence" irrespective of heredity and selection. Morphology becomes a farce when such assumptions are made.

(E. R. L.)

5 A pair of round tubercles on the labram (camerostome or hypostoma) of several species of Trilobites has been described and held to be a pair of eyes (**22**). Sense-organs in a similar position were discovered in Limulus by Patten (**42**) in 1894.

6 The writer is indebted to R.I. Pocock, assistant in the Natural History departments of the British Museum, for valuable assistance in the preparation of this article and for the classification and definition of the groups of Eu-arachnida here given. The general scheme and some of the details have been brought by the writer into agreement with the views maintained in this article. Pocock accepts those views in all essential points and has, as a special student of the Arachnida, given to them valuable expansion and confirmation. The writer also desires to express his thanks to Messrs. Macmillan & Co. for permission to use figs. 22, 43, 44 and 45, which are taken from Parker and Haswell's *Text-book of Zoology*; and to Messrs. Swan Sonnenschein & Co. for the loan of several figures from the translations published by them of the admirable treatise on *Embryology* by Professors Korschelt and Heider; also to the publishers of the treatise on *Palaeontology* by Professor Zittel, Herr Oldenbourg and The Macmillan Co., New York, for several cuts of extinct forms.

7 Pocock suggests that the area marked vii. in the outline figure of the dorsal view of *Limulus* (fig. 7) may be the tergum of the suppressed prae-genital somite. Embryological evidence must settle whether this is so or not.

ARAD, or Ó-Arad, a town of Hungary, capital of the county of the same name, 159 m. S.E. of Budapest by rail. Pop. (1900) 53,903. It is situated on the right bank of the river Maros, and consists of the inner town and five suburbs. Arad is a modern-built town, and contains many handsome private and public buildings, including a cathedral. It is the seat of a Greek-Orthodox bishop, and possesses a Greek-Orthodox theological seminary, two training schools for teachers—one Hungarian, and the other Rumanian—and a conservatoire for music. The town played an important part in the Hungarian revolution of 1848-49, and possesses a museum containing relics of this war of independence. One of the public squares contains a martyrs' monument, erected in memory of the thirteen Hungarian generals shot here on the 6th of October 1849, by order of the Austrian general Haynau. It consists of a colossal figure of Hungary, with four allegorical groups, 312
and medallions of the executed generals. Arad is an important railway junction, and has become the largest industrial and commercial centre of south-eastern Hungary. Its principal industries are: distilling, milling, machinery-making, leather-working and saw-milling. A large trade is carried on in grain, flour, alcohol, cattle and wood. Arad was a fortified place, and was captured by the Turks during the wars of the 17th century, and kept by them till the end of that century. The new fortress, built in 1763, although small, was formidable, and played a great role during the Hungarian struggle for independence in 1849. Bravely defended by the Austrian general Berger until the 1st of July 1849, it was then captured by the Hungarian rebels, who made it their headquarters during the latter part of the insurrection. It was from it that Kossuth issued his famous proclamation (11th August 1849), and it was here that he handed over the supreme military and civil power to Görgei. The fortress was recaptured shortly after the surrender of Görgei to the Russians at Világos. The fortress is now used as an ammunition depot.

The town of Uj-Arad, *i.e.* New Arad (pop. 6124), situated on the opposite bank of the Maros, is practically a suburb of Arad, with which it is connected by a bridge. The town was founded during the Turkish wars of the 17th century. The works erected by the Turks for the capture of the fortress of Arad formed the nucleus of the new town.

Világos, the town where the famous capitulation of Görgei to the Russians took place on the 13th of August 1849, lies 21 m. by rail north-east of Arad.

ARAEOSTYLE (Gr. ἀραιός, weak or widely spaced, and στῦλος, column), an architectural term for the intercolumniation (*q.v.*) given to those temples where the columns had only timber architraves to carry.

ARAEOSYSTYLE (Gr. ἀραιός, widely spaced, and σύστυλος, with columns set close together), an architectural term applied to a colonnade, in which the intercolumniation (*q.v.*) is alternately wide and narrow, as in the case of the western porch of St Paul's cathedral and the east front of the Louvre by Perrault.

ARAGO, DOMINIQUE FRANÇOIS JEAN (1786-1853), French physicist, was born on the 26th of February 1786, at Estagel, a small village near Perpignan, in the department of the eastern Pyrenees. He was the eldest of four brothers. Jean (1788-1836) emigrated to America and became a general in the Mexican army. Jacques Étienne Victor (1799-1855) took part in L.C. de S. de Freycinet's exploring voyage in the "Uranie" from 1817 to 1821, and on his return to France devoted himself to journalism and the drama. The fourth brother, Étienne Vincent (1802-1892), is said to have collaborated with H. de Balzac in the *Héritière de Biragues*, and from 1822 to 1847 wrote a great number of light dramatic pieces, mostly in collaboration. A strong republican, he was obliged to leave France in 1849, but returned after the amnesty of 1859. In 1879 he was nominated director of the Luxembourg museum.

Showing decided military tastes François Arago was sent to the municipal college of Perpignan, where he began to study mathematics in preparation for the entrance examination of the polytechnic school. Within two years and a half he had mastered all the subjects prescribed for examination, and a great deal more, and, on going up for examination at Toulouse, he astounded his examiner by his knowledge of Lagrange. Towards the close of 1803 he entered the polytechnic school, with the artillery service as the aim of his ambition, and in 1804, through the advice and recommendation of S.D. Poisson, he received the appointment of secretary to the Observatory of Paris. He now became acquainted with Laplace, and through his influence was commissioned, with J.B. Biot, to complete the meridional measurements which had been begun by J.B.J. Delambre, and interrupted since the death of P.F.A. Méchain (1744-1804). The two left Paris in 1806 and began operations among the mountains of Spain, but Biot returned to Paris after they had determined the latitude of Formentera, the southernmost point to which they were to carry the survey, leaving Arago to make the geodetical connexion of Majorca with Ivica and with Formentera.

The adventures and difficulties of the latter were now only beginning. The political ferment caused by the entrance of the French into Spain extended to these islands, and the ignorant populace began to suspect that Arago's movements and his blazing fires on the top of Mount Galatzo were telegraphic signals to the invading army. Ultimately they became so infuriated that he was obliged to cause himself to be incarcerated in the fortress of Belver in June 1808. On the 28th of July he managed to escape from the island in a fishing-boat, and after an adventurous voyage he reached Algiers on the 3rd of August. Thence he procured a passage in a vessel bound for Marseilles, but on the 16th of August, just as the vessel was nearing Marseilles, it fell into the hands of a Spanish corsair. With the rest of the crew, Arago was taken to Rosas, and imprisoned first in a windmill, and afterwards in the fortress of that seaport, until the town fell into the hands of the French, when the prisoners were transferred to Palamos. After fully three months' imprisonment they were released on the demand of the dey of Algiers, and again set sail for Marseilles on the 28th of November, but when within sight of their port they were driven back by a northerly wind to Bougie on the coast of Africa. Transport to Algiers by sea from this place would have occasioned a weary stay of three months; Arago, therefore, set out for it by land under conduct of a Mahommedan priest, and reached it on Christmas day. After six months' stay in Algiers he once again, on the 21st of June 1809, set sail for Marseilles, where he had to undergo a monotonous and inhospitable quarantine in the lazaretto, before his difficulties were over. The first letter he received, while in the lazaretto, was from A. von Humboldt; and this was the origin of a connexion which, in Arago's words, "lasted over forty years without a single cloud ever having troubled it."

Through all these vicissitudes Arago had succeeded in preserving the records of his survey; and his first act on his return home was to deposit them in the Bureau des Longitudes at Paris. As a reward for his adventurous conduct in the cause of science, he was in September 1809 elected a member of the Academy of Sciences, in room of J.B.L. Lalande, at the remarkably early age of twenty-three, and before the close of the same year he was chosen by the council of the polytechnic school to succeed G. Monge in the chair of analytical geometry. About the same time he was named by the emperor one of the astronomers of the Royal Observatory, which was accordingly his residence till his death, and it was in this capacity that he delivered his remarkably successful series of popular lectures on astronomy, which were continued from 1812 to 1845.

In 1816, along with Gay-Lussac, he started the *Annales de chimie et de physique*, and in 1818 or 1819 he proceeded along with Biot to execute geodetic operations on the coasts of France, England and Scotland. They measured the length of the seconds-pendulum at Leith, and in Unst, one of the Shetland isles, the results of the observations being published in 1821, along with those made in Spain. Arago was elected a member of the Board of Longitude immediately afterwards, and contributed to each of its *Annuals*, for about twenty-two years, important scientific notices on astronomy and meteorology and occasionally on civil engineering, as well as interesting memoirs of members of the Academy.

In 1830, Arago, who always professed liberal opinions of the extreme republican type, was elected a member of the chamber of deputies for the Lower Seine, and he employed his splendid gifts of eloquence and scientific knowledge in all questions connected with public education, the rewards of inventors, and the encouragement of the mechanical and practical sciences. Many of the most creditable national enterprises, dating from this period, are due to his advocacy—such as the reward to L.J.M. Daguerre for the invention of photography, the grant for the publication of the works of P. Fermat and Laplace, the acquisition of the museum of Cluny, the development of railways and electric telegraphs, the improvement of the navigation of the Seine, and the boring of the artesian wells at Grenelle.

In the year 1830 also he was appointed director of the Observatory, and as a member of the chamber of deputies he was able to obtain grants of money for rebuilding it in part, and for the addition of magnificent instruments. In the same year, too, he was chosen perpetual secretary of the Academy of Sciences, in room of J.B.J. Fourier. Arago threw his whole soul into its service, and by his faculty of making friends he gained at once for it and for himself a world-wide reputation. As perpetual secretary it fell to him to pronounce historical *éloges* on deceased members; and for this duty his rapidity and facility of thought, his happy piquancy of style, and his extensive knowledge peculiarly adapted him.

In 1834 he again visited England, to attend the meeting of the British Association at Edinburgh. From this time till 1848 he led a life of comparative quiet—not the quiet of inactivity, however, for his incessant labours within the Academy and the Observatory produced a multitude of contributions to all departments of physical

science,—but on the fall of Louis Philippe he left his laboratory to join in forming the provisional government. He was entrusted with the discharge of two important functions, that had never before been united in one person, viz. the ministry of war and of marine; and in the latter capacity he effected some salutary reforms, such as the improvement of rations in the navy and the abolition of flogging. He also abolished political oaths of all kinds, and, against an array of moneyed interests, succeeded in procuring the abolition of negro slavery in the French colonies.

In the beginning of May 1852, when the government of Louis Napoleon required an oath of allegiance from all its functionaries, Arago peremptorily refused, and sent in his resignation of his post as astronomer at the Bureau des Longitudes. This, however, the prince president, to his credit, declined to accept, and made "an exception in favour of a *savant* whose works had thrown lustre on France, and whose existence his government would regret to embitter." But the tenure of office thus granted did not prove of long duration. Arago was now on his death-bed, under a complication of diseases, induced, no doubt, by the hardships and labours of his earlier years. In the summer of 1853 he was advised by his physicians to try the effect of his native air, and he accordingly set out for the eastern Pyrenees. But the change was unavailing, and after a lingering illness, in which he suffered first from diabetes, then from Bright's disease, complicated by dropsy, he died in Paris on the 2nd of October 1853.

Arago's fame as an experimenter and discoverer rests mainly on his contributions to magnetism and still more to optics. He found that a magnetic needle, made to oscillate over nonferruginous surfaces, such as water, glass, copper, &c., falls more rapidly in the extent of its oscillations according as it is more or less approached to the surface. This discovery, which gained him the Copley medal of the Royal Society in 1825, was followed by another, that a rotating plate of copper tends to communicate its motion to a magnetic needle suspended over it ("magnetism of rotation"). Arago is also fairly entitled to be regarded as having proved the long-suspected connexion between the aurora borealis and the variations of the magnetic elements.

In optics we owe to him not only important optical discoveries of his own, but the credit of stimulating the genius of A.J. Fresnel, with whose history, as well as with that of E.L. Malus and of Thomas Young, this part of his life is closely interwoven. Shortly after the beginning of the 19th century the labours of these three philosophers were shaping the modern doctrine of the undulatory theory of light. Fresnel's arguments in favour of that theory found little favour with Laplace, Poisson and Biot, the champions of the emission theory; but they were ardently espoused by Humboldt and by Arago, who had been appointed by the Academy to report on the paper. This was the foundation of an intimate friendship between Arago and Fresnel, and of a determination to carry on together further researches in this subject, which led to the enunciation of the fundamental laws of the polarization of light known by their names (see Polarization). As a result of this work Arago constructed a *polariscope*, which he used for some interesting observations on the polarization of the light of the sky. To him is also due the discovery of the power of *rotatory polarization* exhibited by quartz, and last of all, among his many contributions to the support of the undulatory hypothesis, comes the *experimentum crucis* which he proposed to carry out for comparing directly the velocity of light in air and in water or glass. On the emission theory the velocity should be accelerated by an increase of density in the medium; on the wave theory, it should be retarded. In 1838 he communicated to the Academy the details of his apparatus, which utilized the revolving mirrors employed by Sir C. Wheatstone in 1835 for measuring the velocity of the electric discharge; but owing to the great care required in the carrying out of the project, and to the interruption to his labours caused by the revolution of 1848, it was the spring of 1850 before he was ready to put his idea to the test; and then his eyesight suddenly gave way. Before his death, however, the retardation of light in denser media was demonstrated by the experiments of H.L. Fizeau and J.B.L. Foucault, which, with improvements in detail, were based on the plan proposed by him.

Arago's *Œuvres* were published after his death under the direction of J.A. Barral, in 17 vols., 8vo, 1854-1862; also separately his *Astronomie populaire*, in 4 vols.; *Notices biographiques*, in 3 vols.; *Notices scientifiques*, in 5 vols.; *Voyages scientifiques*, in 1 vol.; *Mémoires scientifiques*, in 2 vols.; *Mélanges*, in 1 vol.; and *Tables analytiques et documents importants* (with portrait), in 1 vol. English translations of the following portions of his works have appeared:—*Treatise on Comets*, by C. Gold, C.B. (London, 1833); also translated by Smyth and Grant (London, 1861); *Hist. éloge of James Watt*, by James Muirhead (London, 1839); also translated, with notes, by Lord Brougham; *Popular Lectures on Astronomy*, by Walter Kelly and Rev. L. Tomlinson (London, 1854); also translated by Dr W.H. Smyth and Prof. R. Grant, 2 vols. (London, 1855); *Arago's Autobiography*, translated by the Rev. Baden Powell (London, 1855, 1858); *Arago's Meteorological Essays*, with introduction by Humboldt, translated under the superintendence of Colonel Sabine (London, 1855), and *Arago's Biographies of Scientific Men*, translated by Smyth, Powell and Grant, 8vo (London, 1857).

ARAGON, or Arragon (in Span. *Aragón*), a captaincy-general, and formerly a kingdom of Spain; bounded on the N. by the Pyrenees, which separate it from France, on the E. by Catalonia and Valencia, S. by Valencia, and W. by the two Castiles and Navarre. Pop. (1900) 912,711; area, 18,294 sq. m. Aragon was divided in 1833 into the provinces of Huesca, Teruel and Saragossa; an account of its modern condition is therefore given under these names, which have not, however, superseded the older designation in popular usage.

Aragon consists of a central plain, edged by mountain ranges. On the south, east and west, these ranges, though wild and rugged, are of no great elevation, but on the north the Pyrenees attain their greatest altitude in the peaks of Aneto (11,168 ft.) and Monte Perdido (10,998 ft.)—also known as Las Tres Sorores, and, in French, as Mont Perdu. The central pass over the Pyrenees is the Port de Canfranc, on the line between Saragossa and Pau. Aragon is divided by the river Ebro (*q.v.*), which flows through it in a south-easterly direction, into two nearly equal parts, known as Trans-ibero and Cis-ibero. The Ebro is the principal river, and receives from the north, in its passage through the province, the Arba, the Gallego and the united waters of

the Cinca, Esera, Noguera Ribagorzana, Noguera Pallaresa and Segre—the last three belonging to Catalonia. From the south it receives the Jalon and Jiloca (or *Xalon* and *Xiloca*) and the Guadalope. The Imperial Canal of Aragon, which was begun by the emperor Charles V. in 1529, but remained unfinished for nearly two hundred years, extends from Tudela to El Burgo de Ebro, a distance of 80 m.; it has a depth of 9 ft., and an average breadth of 69, and is navigable for vessels of about 80 tons. The Royal Canal of Tauste, which lies along the north side of the Ebro, was cut for purposes of irrigation, and gives fertility to the district. Two leagues north-north-east of Albarracin is the remarkable fountain called Cella, 3700 ft. above the sea, which forms the source of the Jiloca; and between this river and the Sierra Molina is an extensive lake called Gallocanta, covering about 6000 acres. The climate is characterized by extreme heat in the summer and cold in the winter; among the mountains the snowfall is heavy, and thunderstorms are frequent, but there is comparatively little rain.

Within a recent geological period, central Aragon was undoubtedly submerged by the sea, and the parched chalky soil remains saturated with salt, while many of the smaller streams run brackish. As the mountains of Valencia and Catalonia effectually bar out the fertilizing moisture of the sea-winds, much of the province is a sheer wilderness, stony, ash-coloured, scarred with dry watercourses, and destitute of any vegetation except thin grass and heaths. In contrast with the splendid fertility of Valencia or the south of France, the landscape of this region, like the rest of central Spain, seems almost a continuation of the north African desert area. There are, however, extensive oak, pine and beech forests in the highlands, and many beautiful oases in the deeply sunk valleys, and along the rivers, especially beside the Ebro, which is, therefore, often called the "Nile of Aragon." In such oases the flora is exceedingly rich. Wheat, maize, rice, oil, flax and hemp, of fine quality, are grown in considerable quantities; as well as saffron, madder, liquorice, sumach, and a variety of fruits. Merino wool is one of the chief products.

In purity of race the Aragonese are probably equal to the Castilians, to whom, rather than to the Catalans or Valencians, they are also allied in character. The dress of the women is less distinctive than that of the men, who wear a picturesque black and white costume, with knee-breeches, a brilliantly coloured sash, black hempen sandals, and a handkerchief wound round the head.

Three counties—Sobrarbe, situated near the headwaters of the Cinca, Aragon, to the west, and Ribagorza or Ribagorça, to the east—are indicated by tradition and the earliest chronicles as the cradle of the Aragonese monarchy. These districts were never wholly subdued when the Moors overran the country (711-713). Sobrarbe especially was for a time the headquarters of the Christian defence in eastern Spain. About 1035, Sancho III. the Great, ruler of the newly established kingdom of Navarre, which included the three counties above mentioned, bequeathed them to Gonzalez and Ramiro, his sons. Ramiro soon rid himself of his rival, and welded Sobrarbe, Ribagorza and Aragon into a single kingdom, which thenceforward grew rapidly in size and power and shared with Castile the chief part in the struggle against the Moors. The history of this period, which was terminated by the union of Castile and Aragon under Ferdinand and Isabella in 1479, is given, along with a full account of the very interesting constitution of Aragon, under Spain (*q.v.*). At the height of its power under James I. (1213-1276), the kingdom included Valencia, Catalonia, the Balearic Islands and the considerable territory of Montpellier in France; while Peter III. (1276-1285) added Sicily to his dominions.

The literature relating to Aragon is very extensive. See, in addition to the works cited in the article Spain (section *History*), "Les Archives d'Aragon et de Navarre," by L. Cadier, in *Bibliothèque de l'École des Chartes*, 49 (Paris, 1888). Among the more important original authorities, the following may be selected:—for general history, *Anales de la corona de Aragón*, by G. Çurita, 3rd ed. in 7 folio volumes (Saragossa, 1668-1671; 1st ed. 1562-1580);—for ecclesiastical history, *Teatro histórico de las iglesias de Aragón* (Pamplona, 1770-1807); for economic history, *História de la economia politica de Aragón*, by I.J. de Asso y del Rio (Saragossa, 1798). For the constitution and laws of Aragon, see *Orígines del Justicia de Aragón*, &c., by J. Ribera Tarrago (Saragossa, 1897), and *Instituciones y reyes de Aragón*, by V. Balaguér (Madrid, 1896). The topography, inhabitants, art, products, &c., of the kingdom are described in a volume of the series *España* entitled *Aragón*, by J.M. Quadrado (Barcelona, 1886).

ARAGONITE, one of the mineral forms of calcium carbonate ($CaCO_3$), the other form being the more common mineral calcite. It crystallizes in the orthorhombic system, and the crystals are either prismatic or acicular in habit. Simple crystals are, however, rare; twinning on the prism planes (*M* in the figures) being a characteristic feature of the mineral (fig. 1). This twinning is usually often repeated on the same plane (fig. 2), and gives rise to striations on the terminal faces (*k*) of the crystals; often, also, three crystals are twinned together on two of the prism planes of one of them, producing an apparently hexagonal prism. The mineral is colourless, white or yellowish, transparent or translucent, has a vitreous lustre, and, in fact, is not unlike calcite in general appearance. It may, however, always be readily distinguished from calcite by the absence of any marked cleavage, and by its greater hardness (H. = 3½ − 4) and specific gravity (2.93); further, it is optically biaxial, whilst calcite is uniaxial. It is brittle and has a subconchoidal fracture; on a fractured surface the lustre is decidedly resinous in character.

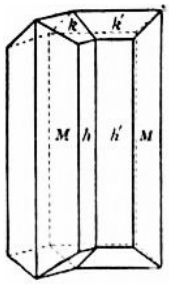

Fig. 1.

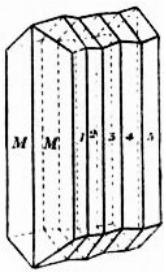

Fig. 2.

The mineral was first found, as reddish twinned crystals with the form of six-sided prisms, at Molina in Aragon, Spain, where it occurs with gypsum and small crystals of ferruginous quartz in a red clay. It is from this locality that the mineral takes its name, which was originally spelt arragonite. Fine groups of crystals of the same habit are found in the sulphur deposits of Girgenti in Sicily; also at Herrengrund near Neusohl in Hungary. At many other localities the mineral takes the form of radiating groups of acicular crystals, such as those from the haematite mines of west Cumberland: beautiful feathery forms have been found in a limestone cave in the Transvaal. Fibrous forms are also common. A peculiar coralloidal variety known as *flosferri* ("flower of iron") consists of radially arranged fibres: magnificent snow-white specimens of this variety have long been known from the iron mines of Eisenetz in Styria. The calcareous secretions of many groups of invertebrate animals consist of aragonite (calcite is also common); pearls may be specially cited as an example.

Aragonite is a member of the isomorphous group of minerals comprising witherite ($BaCO_3$), strontianite ($SrCO_3$), cerussite ($PbCO_3$) and bromlite ($(Ba, Ca)CO_3$); and crystals of aragonite sometimes contain small amounts of strontium or lead. A variety known as tarnowitzite, from Tarnowitz in Silesia, contains about 5% of lead carbonate.

Aragonite is the more unstable of the two modifications of calcium carbonate. A crystal of aragonite when heated becomes converted into a granular aggregate of calcite individuals: altered crystals of this kind (paramorphs) are not infrequently met with in nature, whilst in fossil shells the original nacreous layer of aragonite has invariably been altered to calcite. From a solution of calcium carbonate in water containing carbon dioxide crystals of calcite are deposited at the ordinary temperature, but from a warm solution aragonite crystallizes out. The thermal springs of Carlsbad deposit spherical concretions of aragonite, forming masses known as pisolite or *Sprudelstein*.

(L. J. S.)

ARAGUA, one of the smaller states of Venezuela under the redivision of 1904, lying principally within the parallel ranges of the Venezuelan Cordillera, and comprising some of the most fertile and healthful valleys of the republic. It is bounded E. by the Federal District and Maturin, S. by Guárico and W. by Zamora and Carabobo. Pop. (1905, est.) 152,364. Aragua has a short coast-line on the Caribbean west of the Federal District, but has no port of consequence. Cattle, swine and goats are raised, and the state produces coffee, sugar, cacao, beans, cereals and cheese. The climate of the higher valleys is subtropical, the mean annual temperature ranging from 74° to 80° F. The capital, La Victoria (pop. 7800), is situated in the fertile Aragua valley, 1558 ft. above sea-level and 36 m. south-west of Carácas. Other important towns are Barbacoas (pop. 13,109) on the left bank of the Guarico in a highly fertile region, Ciudad de Cura and Maracay (pop. 7500), 56 m. west-south-west of Carácas near the north-east shore of Lake Valencia. The last two towns are on the railway between Carácas and Valencia.

ARAGUAYA, Araguay or Araguia, a river of Brazil and principal affluent of the Tocantins, rising in the Serra do Cayapó, where it is known as the Rio Grande, and flowing in a north by east direction to a junction with the Tocantins at Sao Joao do Araguaya, or Sao Joao das Duas Barras. Its upper course forms the boundary line between Goyaz and Matto Grosso. The river divides into two branches at about 13° 20′ S. lat., and unites again at 10° 30′, forming the large island of Santa Anna or Bananal. The eastern branch, called the Furo, is the one used by boats, as the main channel is obstructed by rapids. Its principal affluent is the Rio das Mortes, which rises in the Serra de Sao Jeronymo, near Cuyabá, Matto Grosso, and is utilized by boatmen going to Pará. Of other affluents, the Bonito, Garças, Cristallino and Tapirapé on the west, and the Pitombas, Claro, Vermelho, Tucupá and Chavante on the east, nothing definite is known as the country is still largely unexplored. The Araguaya has a course of 1080 m., considerable stretches of which are navigable for small river steamers, but as the river below Santa Anna Island is interrupted by reefs and rapids in two places—one having a fall of 85 ft. in 18 m., and the other a fall of 50 ft. in 12 m.—it affords no practicable outlet for the products of the state. It was explored in part by Henri Coudreau in 1897.

See Coudreau's *Voyage au Tocantins-Araguaya* (Paris, 1897).

ARAKAN, a division of Lower Burma. It consists of a strip of country running along the eastern seaboard of the Bay of Bengal, from the Naaf estuary, on the borders of Chittagong, to Cape Negrais. Length from northern extremity to Cape Negrais, about 400 m.; greatest breadth in the northern part, 90 m., gradually diminishing towards the south, as it is hemmed in by the Arakan Yoma mountains, until, in the extreme south, it tapers away to a narrow strip not more than 15 m. across. The coast is studded with islands, the most important of which are Cheduba, Ramree and Shahpura. The division has its headquarters at Akyab and consists of four districts—namely, Akyab, Northern Arakan Hill Tracts, Sandoway and Kyaukpyu, formerly called Ramree. Its area is 18,540 sq. m. The population at the time of the British occupation in 1826 did not exceed 100,000. In 1831 it amounted to 173,000; in 1839 to 248,000, and in 1901 to 762,102.

The principal rivers of Arakan are—(1) the Naaf estuary, in the north, which forms the boundary between the division and Chittagong; (2) the Myu river, an arm of the sea, running a course almost parallel with the coast for about 50 m.; (3) the Koladaing river, rising near the Blue mountain, in the extreme north-east, and falling into the Bay of Bengal a few miles south of the Myu river, navigable by vessels of from 300 to 400 tons burden for a distance of 40 m. inland; and (4) the Lemyu river, a considerable stream falling into the bay a few miles south of the Koladaing. Farther to the south, owing to the nearness of the range which bounds Arakan on the east, the rivers are of but little importance. These are the Talak and the Aeng, navigable by boats; and the Sandoway, the Taungup and the Gwa streams, the latter of which alone has any importance, owing to its mouth forming a good port of call or haven for vessels of from 9 to 10 ft. draught. There are several passes over the Yoma mountains, the easiest being that called the Aeng route, leading from the village of that name into Upper Burma. The staple crop of the province is rice, along with cotton, tobacco, sugar, hemp and indigo. The forests produce abundance of excellent oak and teak timber.

The natives of Arakan trace their history as far back as 2666 B.C., and give a lineal succession of 227 native princes down to modern times. According to them, their empire had at one period far wider limits, and extended over Ava, part of China, and a portion of Bengal. This extension of their empire is not, however, corroborated by known facts in history. At different times the Moguls and Pegus carried their arms into the heart of the country. The Portuguese, during the era of their greatness in Asia, gained a temporary establishment in Arakan; but in 1782 the province was finally conquered by the Burmese, from which period until its cession to the British in 1826, under the treaty of Yandaboo, its history forms part of that of Burma. The old city of Arakan, formerly the capital of the province, is situated on an inferior branch of the Koladaing river. Its remoteness from the ports and harbours of the country, combined with the extreme unhealthiness of its situation, have led to its gradual decay subsequently to the formation of the comparatively recent settlement of Akyab, which place is now the chief town of the province. The old city (now Myohaung) lies 50 m. north-east of Akyab. The Maghs, who form nearly the whole population of the province, follow the Buddhist doctrines, which are universally professed throughout Burma. The priests are selected from all classes of men, and one of their chief employments is the education of children. Instruction is consequently widely diffused, and few persons, it is said, can be found in the province who are unable to read. The qualifications for entering into the priestly order are good conduct and a fair measure of learning—such conduct at least as is good according to Buddhist tenets, and such learning as is esteemed among their votaries.

The Arakanese are of Burmese origin, but separated from the parent stock by the Arakan Yoma mountains, and they have a dialect and customs of their own. Though conquered by the Burmese, they have remained distinct from their conquerors.

The Northern Arakan Hill Tracts district is under a superintendent, who is usually a police officer, with headquarters at Paletwa. The area of the Hill Tracts is 5233 sq. m.; pop. (1901) 20,682.

(J. G. Sc.)

ARAKCHEEV, ALEKSYEI ANDREEVICH, Count (1769-1834), Russian soldier and statesman, was descended from an ancient family of Great Novgorod. From his mother, Elizabeth Vitlitsaya, he inherited most of his characteristics, an insatiable love of work, an almost pedantic love of order and the most rigorous sense of duty. In 1788 he entered the corps of noble cadets in the artillery and engineering department, where his ability, especially in mathematics, soon attracted attention. In July 1791 he was made an adjutant on the staff of Count N.I. Saltuikov, who (September 1792) recommended him to the cesarevich Paul Petrovich as the artillery officer most capable of reorganizing the army corps maintained by the prince at Gatchina. Arakcheev speedily won the entire confidence of Paul by his scrupulous zeal and undeniable technical ability. His inexorable discipline (magnified into cruelty by later legends) soon made the Gatchina corps a model for the rest of the Russian army. On the accession of Paul to the throne Arakcheev was promptly summoned to St Petersburg, appointed military commandant in the capital, and major-general in the grenadier battalion of the Preobrazhenskoe Guard. On the 12th of December 1796, he received the ribbon of St Anne and a rich estate at Gruzina in the government of Novgorod, the only substantial gift ever accepted by him during the whole of his career. At the coronation (5th of April 1797) Paul created him a baron, and he was subsequently made quartermaster-general and colonel of the whole Preobrazhenskoe Guard. It was to Arakcheev that Paul entrusted the reorganization of the army, which during the latter days of Catherine had fallen into a state of disorder and demoralization. Arakcheev remorselessly applied the iron Gatchina discipline to the whole of the imperial forces, beginning with the Guards. He soon became generally detested by the army, but pursued his course unflinchingly and introduced many indispensable hygienic reforms. “Clean barracks are healthy barracks,” was his motto. Nevertheless, the opposition of the officers proved too strong for him, and on the 18th of March 1798 he was dismissed from all his appointments. Arakcheev’s first disgrace only lasted six months. On the 11th of August he was received back into favour, speedily reinstated in all his former offices, and on the 5th of May 1799 was created a count, the emperor

himself selecting the motto: “Devoted, not servile.” Five months later he was again in disgrace, the emperor dismissing him on the strength of a denunciation subsequently proved to be false. It was a fatal step on Paul’s part, for everything goes to prove that he would never have been assassinated had Arakcheev continued by his side. During the earlier years of Alexander, Arakcheev was completely overlooked. Only on the 27th of April 1803, was the count recalled to St Petersburg, and employed as inspector-general of the artillery. His wise and thorough reorganization of the whole department contributed essentially to the victories of the Russians during the Napoleonic wars. All critics agree, indeed, that the Arakcheev administration was the golden era of the Russian artillery. The activity of the inexhaustible inspector knew no bounds, and he neglected nothing which could possibly improve this arm. His principal reforms were the subdivision of the artillery divisions into separate independent units, the formation of artillery brigades, the establishment of a committee of instruction (1808), and the publishing of an *Artillery Journal*. At Austerlitz he had the satisfaction of witnessing the actual results of his artillery reforms. The commissariat scandals which came to light after the peace of Tilsit convinced the emperor that nothing short of the stern and incorruptible energy of Arakcheev could reach the sources of the evil, and in January 1808 he was appointed inspector-general and war minister. When, on the outbreak of the Swedish war of 1809, the emperor ordered the army to take advantage of an unusually severe frost and cross the ice of the Gulf of Finland, it was only the presence of Arakcheev that compelled an unwilling general and a semi-mutinous army to begin a campaign which ended in the conquest of Finland. On the institution of the “Imperial Council” (1st of January 1810), Arakcheev was made a member of the council of ministers and a senator, while still retaining the war office. Subsequently Alexander was alienated from him owing to the intrigues of the count’s enemies, who hated him for his severity and regarded him as a dangerous reactionary. The alienation was not, however, for long. It is true, Arakcheev took no active part in the war of 1812, but all the correspondence and despatches relating to it passed through his hands, and he was the emperor’s inseparable companion during the whole course of it. At Paris (31st of March 1814) Alexander, with his own hand, wrote the *ukaz* appointing him a field-marshal, but he refused the dignity, accepting, instead, a miniature portrait of his master. From this time Alexander’s confidence in Arakcheev steadily increased, and the emperor imparted to him, first of all, his many projects of reform, especially his project of military colonies, the carrying out of the details of which was committed to Arakcheev (1824). The failure of the scheme was due not to any fault of the count, but to the inefficiency and insubordination of the district officers. In Alexander’s last years Arakcheev was not merely his chief counsellor, but his dearest friend, to whom he submitted all his projects for consideration and revision. The most interesting of these projects was the plan for the emancipation of the peasantry (1818). On the accession of Nicholas I., Arakcheev, thoroughly broken in health, gradually restricted his immense sphere of activity, and on the 26th of April 1826, resigned all his offices and retired to Carlsbad. The 50,000 roubles presented to him by the emperor as a parting gift he at once handed to the Pavlovsk Institute for the education of the daughters of poor gentlemen. His last days he spent on his estate at Gruzina, carefully collecting all his memorials of Alexander, whose memory he most piously cherished. He also set aside 25,000 roubles for the author of the best biography of his imperial friend. Arakcheev died on the 21st of April 1834, with his eyes fixed to the last on the late emperor’s portrait. “I have now done everything,” he said, “so I can go and make my report to the emperor Alexander.” In 1806 he had married Natalia Khomutova, but they lived apart, and he had no children by her.

See Vasily Ratch, *Memorials of Count Arakcheev* (Rus.) (St Petersburg, 1864); Mikhail Ivanovich Semevsky, *Count Arakcheev and the Military Colonies* (Rus.) (St Petersburg, 1871); Theodor Schiemann, *Gesch. Russland’s unter Kaiser Nikolaus I.*, vol. i., *Alexander I.*, &c. (Berlin, 1904).

(R. N. B.)

ARAL, a lake or inland sea in the west of Asia, situated between lat. 43° 30′ and 46° 51′ N., and long. 58° 13′ and 61° 56′ E. It was known to the ancient Arab and Persian geographers as the Sea of Khwārizm or Kharezm, from the neighbouring district of the Chorasmians, and derives its present name from the Kirghiz designation of Aral-denghiz, or Sea of Islands. In virtue of its area (26,233 sq. m.) it is the fourth largest inland sea of the world. It has nearly the same length as width, namely about 170 m., if its northern gulf (Kichkineh-denghiz) is left out of account. Its depth is insignificant, the maximum being 220 ft. in a depression in the north-west, and the mean depth only 50 ft., so that notwithstanding its area it contains only eleven times as much water as the Lake of Geneva. Its altitude is 242½ ft. above the Caspian, *i.e.* about 155 ft. above the ocean. The lake is surrounded on the north by steppes; on the west by the rocky plateau of Ust-Urt, which separates it from the Caspian; on the south by the alluvial district of Khiva; and on the east by the Kyzyl-kum, or Red Sand Desert. On the north the shores are comparatively low, and the coast-line is broken by a number of irregular bays, of which the most important are those of Sary-chaganak and Paskevich. On the west an almost unbroken wall of rock extends from Chernychev Bay southwards, rising towards the middle to 500 ft. The southern coast is occupied by the delta of the Oxus (Jīhūn, Amu-darya), one of the arms of which, the Laudan, forms a swamp, 80 m. long and 20 broad, before it discharges into the sea. The only other tributary of any size that the sea receives is the Jaxartes (Sihun, Syr-darya) which enters towards the northern extremity of the east coast, and is suspected to be shifting its embouchure more and more to the north. This river, as well as the Amu, conveys vast quantities of sediment into the lake; the delta of the Syr-darya increased by 13¾ sq. m. between 1847 and 1900. The eastern coast is fringed with multitudes of small islands, and other islands, some of considerable size, are situated in the open towards the north and west. Kug-Aral, the largest, lies opposite the mouth of the Syr-darya, cutting off the Kichkineh-denghiz or Little Sea. The next largest island is the Nikolai, nearly in the middle. Navigation is dangerous owing to the frequency and violence of the storms, and the almost total absence of shelter. The north-east wind is the most prevalent, and sometimes blows for months together. The only other craft, except the steamships of the Russians, that venture on the waters, are the flat-bottomed boats of the Kirghiz.

In regard to the period of the formation of the Aral there were formerly two theories. According to Sir H.C.

Rawlinson (*Proc. Roy. Geog. Soc.*, March 1867) the disturbances which produced the present lake took place in the course of the middle ages; while Sir Roderick Murchison contended (*Journ. of Roy. Geog. Soc.*, 1867, p. cxliv. &c.) that the Caspian and Aral existed as separate seas before and during all the historic period, and that the main course of the rivers Jaxartes and Oxus was determined in a prehistoric era. The former based his opinion largely on historical evidence, and the latter trusted principally to geological data. There is no doubt that in recent historical times Lake Aral had a much greater extension than it has at the present time, and that its area is now diminishing. This is, of course, due to the excess of evaporation over the amount of water supplied by its two feeders, the Amu-darya and the Syr-darya, both of which are seriously drawn upon for irrigation in all the oases they flow through. Old shore lines and other indications point to the level of the lake having once been 50 ft. above the existing level. Nevertheless the general desiccation is subject to temporary fluctuations, which appear to correspond to the periods recently suggested by Eduard Brückner (b. 1862); for, whereas the lake diminished and shrank during 1850-1880, since the latter year it has been rising again. Islands which were formerly connected with the shore are now some distance away from it and entirely surrounded by water. Moreover, on a graduated level, put down in 1874, there was a permanent rise of nearly 4 ft. by 1901. The temperature at the bottom was found (1900-1902) by Emil Berg to be 33.8° Fahr., while that of the surface varied from 44.5° to 80.5° between May and September; the mean surface temperature for July was 75°. The salinity of the water is much less than that of the ocean, containing only 1.05% of salt, and the lake freezes every year for a great distance from its shores. The opinion that Lake Aral periodically disappeared, which was for a long time countenanced by Western geographers, loses more and more probability now that it is evident that at a relatively recent period the Caspian Sea extended much farther eastward than it does now, and that Lake Aral communicated with it through the Sary-kamysh depression. The present writer is even inclined to think that, besides this southern communication with the Caspian, Lake Aral may have been, even in historical times, connected with the Mortvyi Kultuk (Tsarevich) Gulf of the Caspian, discharging part of its water into that sea through a depression of the Ust-Urt plateau, which is marked by a chain of lakes (Chumyshty, Asmantai). In this case it might have been easily confounded with a gulf of the Caspian (as by Jenkinson). That the level of Lake Aral was much higher in post-Pliocene times is proved by the discovery of shells of its characteristic species of *Pecten* and *Mytilus* in the Kara-kum Desert, 33 m. south of the lake and at an altitude of 70 ft. above its present level, and perhaps even up to 200 ft. (by Syevertsov).

The fish of Lake Aral belong to fresh-water species, and in some of its rapid tributaries the interesting *Scaphirhynchus*, which represents a survival from the Tertiary epoch, is found. The fishing is very productive, the fish being exported to Turkestan, Merv and Russia. The shores of the lake are uninhabited; the nearest settlements are Kazala, 55 m. east, on the Syr, and Chimbai and Kungrad in the delta of the Amu.

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(P. A. K.)

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