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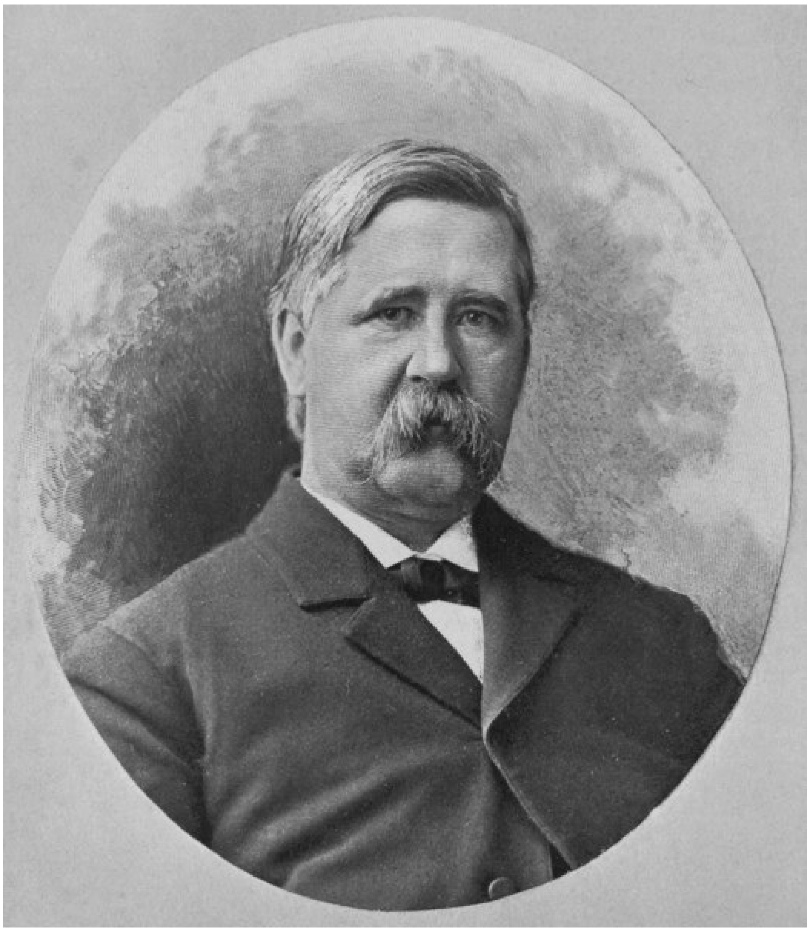

WILLIAM KEITH BROOKS.

APPLETONS' POPULAR SCIENCE MONTHLY.

JULY, 1899.

SCIENTIFIC METHOD AND ITS APPLICATION TO THE BIBLE.

By the Rev. DAVID SPRAGUE, B. D.

"Trained and organized common sense" is Professor Huxley's definition of science. There is probably no better.

The popular mind persists in thinking that there is a wide difference between science and knowledge in general. Yes, there is a wide difference, but it is just the difference that there is between a trained and organized *body* of men for the accomplishing of some great work, and a *crowd* of men unorganized and undisciplined. What unscientific knowledge has accomplished may be roughly seen in the condition of savage races to-day; while the changes wrought by knowledge trained and organized, in enlarging the sum of knowledge, in extending men's power of perception, and in increasing the facilities not merely for living, but for living well, are changes in comparison with which all others recorded in history are trifling.

It will be profitable for us, in order to get a clearer idea of scientific method, to trace as briefly as possible the history of science and the development of the scientific idea.

The very beginning of science is beyond our ken. We can form no idea of just what stage in the intellectual development of the race witnessed the rise of training and order in men's knowledge. Long before the dawn of history there must have been some degree of orderliness in men's knowledge—some grouping of facts, and reasoning from one thing to another. Rude classification would be made, e. g., among animals, as some were found to be good for food and others not; so among herbs, as to size, form, color, use for food and medicine, poisonous qualities, etc.; so among woods, as some were better adapted than others to use as instruments of war and of the chase. Men must also, very early in their development, have noticed the changes that took place in the heavens: the sun by day, the moon and the stars by night; have grouped the stars into little clusters here and there as they seemed rudely to resemble forms of things which they knew, and [Pg 290] as some were brighter than the rest; have begun to reckon periods of time according as position of sun and moon varied. In their observation of the heavens no other phenomenon would have attracted as much attention as an eclipse, and for a long time men would have ascribed this occasional phenomenon to the intervention of some supernatural power. In process of time, however, as their observations were made with more care and recorded, some regularity would be noticed in these, as in other phenomena of the skies; and the period of their recurrence being at last approximately known by those more learned than the rest, predictions of eclipses would be made and verified by what would seem to the multitude direct supernatural aid. Hence the earliest scientific records that have come down to us are of eclipses observed, and in time regularly predicted, by the Chaldeans; hence also the reputation that was always given to the Chaldeans of having magical power. Coming down now to the time when men first seemed to have a genuine spirit of scientific inquiry, we find it among the Greeks some five hundred years B. C. Whatever of rudely scientific work had been done before, seems to have been for practical or religious purposes. About that time, however, men began to investigate and speculate in order to find out the truth, and soon we see a class of men, known as philosophers, whose one aim was to find out, because they loved, the truth. "What they saw excited them to meditate, to conjecture, and to reason; they endeavored to account for natural events, to trace their causes, to reduce them to principles" (Whewell). They set about this, too, in no small, narrow way. They wanted to go right to the bottom of things, of everything at once, and to know the great principles, as they called them, of Nature and of life. That was the reason why the actual scientific results of Greek thought, with all its splendid powers, were so meager. Two things are the necessary conditions of science—facts, and the human power of reasoning. Two processes must be carried out in order to yield any scientific result: facts must be patiently accumulated, and the mind must set its reasoning powers to work on them. It was in the first of these that the Greeks were wanting. They did not realize the need of endless patience in learning the details of Nature's way of working. They wished to take in all of Nature with one tremendous sweep of thought. They did a little investigating and a great deal of reasoning. Occasionally, however, we find an instance of [Pg 291] inquiry into the cause of more definite and limited phenomena, which seems much more to suggest the true spirit of physical inquiry. We have one recorded by Herodotus, which is the more remarkable from being so nearly alone. It is in reference to the fact which he had observed about the flooding of the Nile—that it was flooded for one hundred days, beginning with the summer solstice; and that from that time it diminished, and was during the winter months very low. He tells us that he made pressing inquiries about the cause of it from many of the Egyptians, but that he found no satisfaction, and apparently little interest in the matter. Three different theories on the subject that had been propounded by the Greeks he examines in detail and confutes; and finally he states a theory of his own. And yet even in this instance of scientific inquiry he commits the usual fault of the Greeks—he does not pursue far enough the investigation of the facts of the case, and the absence of the facts he tries to make up for by exhaustive arguments on words used in describing the phenomena.

Strange as it may seem at a first glance, it is a very similar trouble that we find with the reasoning of Aristotle. It seems strange, I say, because we are accustomed to associate with Aristotle just those things which would seem to indicate a scientific temper, and to give promise of great results: 1. Extensive accumulation of facts. Many of those works of Aristotle which remain to us are vast treasuries of facts collected from almost every field of Nature, and we have reason for thinking that he made other wonderful collections of facts which have not come down to us. His work has been a standing marvel to all time. 2. Extraordinary powers of reasoning. 3. The fact that he asserted in the strongest terms the need of building up the whole superstructure of knowledge on *experience*. And yet throughout his works, side by side with the evidences of profound knowledge and profound speculation, there are repeated instances of reasonings which are not only unsound, but altogether puerile—e. g., in the beginning of his treatise on the heavens he proves the world to be perfect by reasoning of the following kind: "The bodies of which the world is composed are solids, and therefore have three dimensions. Now, three is the most perfect number; it is the first of numbers, for of one we do not speak as a number; of two we say both; but three is the first number of which we say all; moreover, it has a beginning, a middle, and an end." That is a fair instance of his scientific incompetency. He has the facts, he is able to reason, but he does not reason *according to* the facts; he loses sight of them and builds up great arguments on words and names. To give one more example: "He is endeavoring to explain the fact that when the sun's light passes through a hole, whatever be the form of the hole, the [Pg 292] bright image, if formed at any considerable distance from the hole, is circular. This, of course, is easily seen to be a necessary consequence of the circular figure of the sun, if we conceive light to be diffused from the luminary by means of straight rays proceeding from every point. But Aristotle attempts to explain the fact by saying that the sun's light has a circular nature which it always tends to manifest. He employs the vague and loose conception of a circular *quality* instead of the distinct conception of rays" (Whewell).

It is a kind of reasoning which may be applied with great show of success to everything, but which really proves nothing.

And so, as a matter of fact, Aristotle did not leave one single scientific generalization of value to succeeding ages.

Did not the Greeks then do anything in the way of physical science that was to stand? Yes, there was a little work that was exact, and therefore lasting. Archimedes established the fundamental principle on the one hand of the lever, on the other of pressure in fluids—that is to say, laid the stable foundation of the sciences of statics and hydrostatics. Euclid developed, if he did not discover, the law of the reflection of light. Pythagoras discovered, and his followers developed, some of the fundamental principles of harmonics. Greater than any of the others in genuine scientific work was Hipparchus, who, with many erroneous theories, yet really laid the permanent foundation of the science of astronomy. Only one more name need be mentioned among the ancients—that of Ptolemy, who seemed possessed of a genuinely scientific spirit. He accomplished little original work, made no broad generalization (what is known as the Ptolemaic system was in reality the system of Hipparchus), but more than any other of the ancients he is the type of the true scientist in these respects—the accuracy of his observations, the thoroughness of his work at every point, and the really great additions that he made to science in the way of verifying, correcting, and extending the theory he received. He lived in the early part of the second century A. D.

And the next name to attract our notice is that of Copernicus, more than twelve hundred years later. What is the meaning of that lapse of time? After such noble foundations had been laid, was there no great scientific work built thereon in all those centuries? Absolutely none. It will be well for us to think for a moment of what were the reasons for that barrenness, for the same causes are more or less at work at all times to hinder the growth of science and the extension of scientific method.

1. And what strikes us most forcibly at the outset is a lack of the sense of the importance of physical science. Through most of that period Christianity dominated the best thought of Europe, [Pg 293] and the tremendous practical problems that confronted the Church for a long time threw everything else into the shade; for a long time, I said, during the early part of this period in especial, when the Church in general seemed to realize its responsibility to win the whole world to its Master, and every individual coming into the Church was made to feel that the Church's work was above everything else in the world. The importance of an exhaustive knowledge of the facts of Nature seemed trifling when compared with questions of character and future life, and making the world feel the power of Christ. Eusebius only expressed the thought of much of his age when he said, speaking of those who pursued the study of physical science, "It is not through ignorance of the things admired by them, but through contempt of their useless labor, that we think little of these matters, turning our souls to the exercise of better things." And with that deliberate turning away from such subjects there would come of necessity that indistinctness of ideas about natural things which is fatal to all scientific investigation. Witness these words of Lactantius: "To search for the causes of natural things; to inquire whether the sun be as large as he seems; whether the moon is convex or concave; whether the stars are fixed in the sky or float freely in the air; of what size and of what material are the heavens, whether they be at rest or in motion; what is the magnitude of the earth, on what foundations it is suspended and balanced—to dispute and conjecture on such matters is just as if we chose to discuss what we think of a city in a remote country, of which we never heard but the name." As Whewell, from whom these last two quotations are taken, says, "It is impossible to express more forcibly that absence of any definite notions on physical subjects which led to this tone of thought."

2. Contributing, without doubt, largely to that indistinctness of ideas, and to the low value put upon physical science, was the mysticism common to the early and the mediæval Church, and to the world at large for many hundred years—the mysticism, that is to say, the habit of assigning supernatural agencies to the various phenomena of Nature, and of regarding them as subject to the vicissitudes of arbitrary will rather than as following out the workings of a consistent orderly plan. There is no need of any attempt to show how fatal such a spirit is to science, nor how that spirit seemed for a long while to dominate the world. "It changed physical science to magic; astronomy to astrology; the study of the composition of bodies to alchemy; and even mathematics was changed till it became the contemplation of the spiritual relations of number and figure." That the Church was not, as has been often charged, responsible for this spiritualizing temper of [Pg 294] the age is apparent to any one familiar with the development of Greek philosophy and with the history of the superstitions of the Roman Empire. Nevertheless, it is also true that that temper has been increased in the past and is fostered to-day by the undue emphasis which the Church has placed upon the miraculous character of early Christianity.

3. We notice in the history of the thought of this period, both in the Church and in the world at large, a disposition rather to examine, criticise, and comment upon the work of others, than to do investigating and thinking of one's own. That such a spirit should be found in the Church is not to be wondered at, for the authority of Christ and his apostles would seem to leave no room for originality of thinking on religious subjects, and the sacred Scriptures would give abundant scope for the exercise of the highest learning and of intellectual penetration in interpreting. But the same tendency is noticed outside of the Church, as the great schools of interpreters of Aristotle and of Plato, and the large volumes of abstracts and compilations from preceding writers, bear witness. But when vast learning and ability are expended, rather on such labors than on investigation into the secrets of Nature, science does not thrive.

4. And once again we observe the gradually increasing dogmatic tendency of the Church, the claim to be the repository of all knowledge, the stifling of thought, and of investigation into what might lead men away from the truth and the "faith once delivered to the saints."

It seemed best to give in detail these four evident reasons for the barrenness of science during those centuries, because, as I said, the same things to-day, though with decreasing force, interfere with the progress of science and the extension of scientific method. I shall refer to them again a little further on.

The great revival of four centuries ago in art, in learning, in religion, reached also to science. At last the spell of ignorance, of unreasoning prejudice, of offensive dogmatism, and of vague mysticism, that had held the world for so long, was broken. The new life of science was feeble at first, and remained long in its swaddling clothes. It was about the middle of the sixteenth century that Copernicus gave his great work to the world; then no great work again for nearly one hundred years, when Kepler, Galileo, and Stevinus arise. But the century has not been an idle one. Everywhere men have been awakening to the new light, have begun to think freely and fearlessly; are no longer deterred by the cry of magic or the prohibition of church dignitaries from investigating into Nature for themselves. And so, when in the seventeenth century those mighty ones appeared, thoughtful people in great numbers were found to welcome the new [Pg 295] truths; and at almost the same time Descartes by his essay on Scientific Method, and Bacon by the Novum Organum, were able to give an impetus to scientific investigation such as the world had never felt before.

The history of the progress of science from that time to this is too complex to receive any treatment in a paper of this character. How it has been throughout a record of successive triumphs; how gradually one department after another of Nature's workings has been mastered and reduced to orderly system; how all systems have been themselves reduced to one, harmonious and complete, in the magnificent generalization of evolution; how all the time not only has the sum of knowledge been steadily augmented, but the power of acquiring knowledge marvelously enlarged—all of that we know. That which has accomplished such results is science, and the process employed has been scientific method. We are in a position now to have a fairly intelligent idea of it. Look at it and see.

"Scientific method" is not, of course, a technical expression, as are induction, deduction, etc. Yet it means something very definite. It is that method of dealing with phenomena which reason declares and experience has shown to insure the greatest accuracy in results. There are in the complete process four necessary steps: 1. Observation of facts. 2. Comparison and classification, or generalization. 3. Deduction. 4. Verification.

We can see these steps alike in the simplest scientific attempt of our remote ancestors, and in the work of a Newton or a Darwin.

To use an illustration of the former suggested by the book of Leviticus. In very early times it was noticed that animals that had both the characteristics of being cloven-hoofed and of chewing the cud were good for food. A new animal is discovered having those characteristics. It is argued from the general principle laid down that this new animal is good for food, and the matter is verified by experiment. There are the four distinct steps: observation of the facts, drawing a principle from the comparison of the facts, deducing as to the particular case, verifying. The result is, of course, not only a classifying of the particular case, but also the extension of the principle. So with the generalization of the law of gravitation. Numberless facts were observed with the greatest care; from them the principle was generalized; from that again deductions were made as to particular cases; and the results were verified. But though the steps of the process are the same in both instances, yet what a vast difference between them! Take the first step, the observation of facts. All that the thought of the earlier age could do was to note a few striking [Pg 296] resemblances and differences among the animals that roamed the neighboring forests. What could be done in the later age, ay, what the scientific temper of the age demanded, was the most rigidly careful examination of multitudes of facts; examination by a trained mind and with all the improved appliances which science and art had given to the world, and then submitted to the searching scrutiny of other trained minds, with like appliances. Or take the last step, verification. In one case it meant finding the effect upon the taste and upon the health. In the other, what it meant may be judged from the account we have of one of Newton's investigations. In applying his hypothesis of gravitation (it was only a hypothesis then) to the motion of the moon, there was a very slight divergence, about two feet a minute, between the time of the revolution of the moon in its orbit, as he calculated it and as he observed it. He was not satisfied until, *eighteen years after*, on account of an improvement made in the method of taking observations, he was able to obtain what he regarded as a verification.

And so what we learn from the history of science is the gradual *development* of scientific method. Scientific method in the work of Hipparchus meant a very different thing from the scientific method of the Chaldeans. Very different still is the scientific method of studying the heavens to-day. So to an even greater degree is there a difference between the scientific method of studying the earth to-day and as our fathers studied it. It is not merely the multitude of facts that we have learned, nor the marvelous instruments that we have made to aid us in our observations; it is also, and by no means least, this—that men all these centuries have been *learning* to observe, to reason, and to verify.

We may say that science and scientific method have grown and developed together: the development of one has invariably advanced the development of the other, and, on the other hand, where one has remained stationary, or has retrograded, so has the other.

History has enabled us to see this other fact also: that the conditions which interfered with the growth of science in the past not only interfere with it always, wherever they exist, but to very much the same degree interfere with the free application of scientific method. What those conditions were during one long period of history we saw—a failure to realize its importance as compared with questions of conduct; a tendency to comment rather than investigate; a tendency to ascribe everything to spiritual agency rather than to natural causes; and lastly, dogmatism. We very well know how, as a matter of fact, those very conditions do interfere with the application of scientific method to-day.

How far is scientific method applicable to the investigation of the Bible? Is there any department of human knowledge to which scientific method of investigation is not applicable? If scientific method is what we defined it to be, that method of dealing with phenomena which reason declares and experience has shown to insure the greatest accuracy in results, then there is obviously no department of knowledge to which that method is not applicable, for it means simply the method which will bring us nearest to the truth. When we are dealing with the highest spiritual verities we use that method which will bring us nearest to the truth; we are bound to use it in the interest of truth! That does not mean that we are to look for material causes for spiritual phenomena; nor does it mean that those things which in their nature appeal to the sensibilities, or have to do with conduct, or require an exercise of faith, must, in order for us to find out the truth, be removed from the domain of sensibility, conduct, faith. That would be a most unscientific method of investigation. The very first canon of scientific method is that it be appropriate to the matter in hand. And so in investigating the truths which are distinctly taught in the Bible—truths which are of the nature of a revelation of God's will and which are designed to reach and affect the whole nature of man—to take no account of other faculties in a man besides his power of apprehending intellectually, and of reasoning logically, would be unscientific beyond hope of pardon. [Pg 297]

But what I wish especially to consider is a different kind of investigation of the Bible—one not concerned with the truths taught in the Bible, but with the Bible itself, as a collection of writings that has come down to us from the past. What is the nature of these writings? Who are their authors? Are there any of them which have more than one author? Are there any which are compilations from several different sources? What is the age in which these works were written or compiled? All of those, and similar questions, are not only the appropriate but the necessary inquiries of a truth-loving mind. They will continue to be asked until they are satisfactorily answered. With reference to other writings, the persistence of such inquiries will depend, except in cases of pure curiosity, upon the importance of such writings to the world. On that principle there will be no cessation of inquiries concerning the Bible until they are, as I said, satisfactorily answered, for no other writings are to be compared, in their importance to the world, with the writings of the Bible. How can such answers be given? Where does competency to give answer lie? Does it lie in the authority of the Church? Not to lay any stress upon the fact, one way or the other, that the Church, except in certain localities, has never declared on the canon of the Bible, [Pg 298] much less on the questions proposed above, there is no such authority residing in the Church, unless we grant the claim sometimes made for her, to infallibility. With those making such a claim we must, within the limits of this paper, decline to argue.

But if not the Church, what other authority can give us the answers we seek? The authority of primitive tradition, or of the opinions of great commentators, or of the great mass of Christian people of modern times? Authority which is so shadowy in other things that might be mentioned would surely count for nothing in a matter as grave as this. Or can particular expressions of the Bible itself be taken to settle the matter once for all? But as to most of those very questions the Bible itself is silent; and if it had spoken, yet the question of competent authority would only be put one step further back. Or, once again, can the answer come from "the spirit which is in man," guided by God's Spirit? But in this, as in the instance mentioned above, that which has been shown to be incompetent in so many other things can not be called competent in this.

There is, there can be, according to the requirement of our minds, only one answer which will satisfy; it is that which is determined by purely scientific method—that is to say, according to the nature of the subject, that method of investigating literary works which reason declares and experience has shown to insure the greatest accuracy in results. That method is known by the name of the "Higher Criticism."

What is the history of the higher criticism? One would imagine, from the language often used by the opponents of its application to the Bible, that it was an arbitrary method of criticism, invented in these rationalizing times expressly for the purpose of doing away with the divine character of the Bible. But higher criticism has been in use in examining the classics and other (nonscriptural) writings of former ages for fully two hundred years. The first one to state its fundamental principles was Du Pin, in his New History of Ecclesiastical Writers, published in 1694. In 1699 Bentley published his famous examination of the epistles of Phalaris, according to the methods and principles of the higher criticism. There is no better instance of scientific investigation as to authenticity. These epistles had been commonly accepted by scholars as the work of Phalaris, and accounted of great value. Bentley, by his searching examination of them, proved them to be the forgery of a sophist, so conclusively that no scholar worthy of the name has ventured to question the result since. That, I say, was in 1699.

The first work in the way of higher criticism of the Bible, Eichhorn's Introduction to the Old Testament, was not published till nearly one hundred years later. [Pg 299]

But that very modernness of the work brings it with some into disfavor. "If that is the true way of investigating the biblical writings," they say, "why are we so long in finding it out? Why did not the fathers of the Church—mighty, indeed, as many of them were, with keenness of insight into the Bible, with profound knowledge of its characteristics, with substantially the same evidence before them as we have now—why did not they give us the principles of the higher criticism, if those principles are true?"

For the very same reason as science in general has not until very lately begun to do its true work. How meager is all the scientific work done in the ages of the past in comparison with that done during the last three hundred years! Men were not up to it; they were only learning the scientific method. So, the scientific method of examining literature, men have not learned till within the past two hundred years. Having all the facts before them which we have now would avail nothing without the knowledge of *how* to observe, to classify, to deduce, to verify, any more in the field of letters than in the field of Nature; any more in the Bible than in other literary works. Among the immense benefits which science has conferred upon the world, surely this should not be accounted the least, that it has taught us a method by which we may find out with ever-growing certainty the truth concerning the Bible itself.

What, then, should be the attitude of lovers of truth toward the higher criticism of the Bible? It can be only one—openness of mind to the ready acceptance of its work. Not that all its present results are to be accepted as final, for its work is still confessedly incomplete. Moreover, we can not fail to see that all investigations into the sacred Scriptures have not been prompted by a genuine love of truth, nor carried on with that judicial mind that should characterize every one working in the name of science. So that not all that has been done in the name of the higher criticism has been according to scientific method. Nevertheless, there are results already obtained, bearing the stamp of truth—such as the composite character of the Hexateuch; the double authorship of Isaiah; the post-exilic date of many of the Psalms—results which to a scientific mind have the practical certainty of a demonstration, but which the great majority of Christian ministers, who are supposed to look at such things intelligently, are not ready to accept.

Are not the ministry in general more zealous to do as St. Paul says, "Hold fast that which is good," than either to do, as he also says, "Prove all things," or to make sure that what they hold fast is the best? Well, undoubtedly that is the better way to do, if they are to do only one—to "hold fast that which is good." And yet it is a blessed thought that every brave, fearless effort which men make toward finding out the truth, with every help that they can get from reason and a knowledge of the past, is an effort after God.

GEOLOGY OF THE KLONDIKE GOLD FIELDS.[1]

By ANGELO HEILPRIN,

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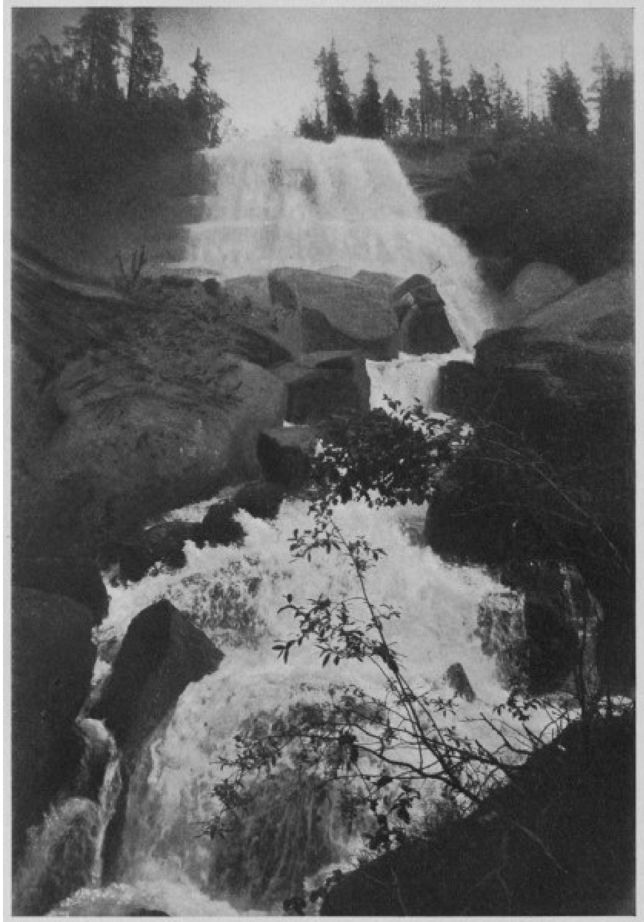


A Bit of Norway in Alaska.—Cascade near Skaguay.

The gold fields of the Klondike or Troandik district, as officially designated, lie along or immediately about the waters, whether direct or tributary, of the Klondike, an eastern affluent of the Yukon, which discharges into the "father of northern waters" at the site of Dawson. The Klondike itself, whose upper waters are as yet only imperfectly known, seemingly carries but little gold, the main quantity of the precious metal and that which has made the region famous being contributed by one of its southern arms, the Bonanza, and by a tributary of this, the Eldorado. Hunker Creek, draining a mountainous district several miles to the eastward of the Bonanza, and like it a southern affluent of the Klondike, finds promise of a wealth but little if at all inferior to that of the Bonanza. In a broader or more popular sense, the Klondike region not only embraces the special district so designated in the books of the Gold Commissioner, but also the entire tract which heads up to the sources of the streams that have before been mentioned, and thereby, with Quartz, Sulphur, and Dominion Creeks as tributaries of Indian River, takes in the greater portion of the Indian River mining district, and with Baker, Reindeer, and other creeks on the west, the official districts indicated by these names as well. With this limitation the region roughly defines an area about forty miles square, whose northern boundary lies somewhat to the north of the sixty-fourth parallel of latitude, and on the west reaches to within about thirty-five miles of the international boundary, the one hundred and forty-first meridian of west longitude.

This area of approximately fifteen hundred square miles, which but little exceeds that of Rhode Island or of the county of Cornwall in England, may be broadly characterized as being gently [Pg 301] mountainous, with elevations of five hundred to fifteen hundred feet, and in the highest parts of about twenty-two hundred feet. Its lowest depression is the valley of the Yukon, which, in itself occupying a position about fourteen hundred feet above the sea, gives to these points absolute elevations of three and nearly four thousand feet. Dome Mountain, or, as it is frequently designated, simply "The Dome," and less often "Solomon's Dome," "King Dome," and "Mount Ophir," appears to be the culminating point of the entire region; and its prominent position at the water parting of Bonanza, Hunker, Sulphur, and Dominion Creeks makes it a noble figure in the landscape, and the most interesting single feature to the prospector and miner. No absolute determinations for altitude have as yet been made for it, but when crossing the summit it seemed to me that it could not be much under four thousand feet, and I believe that Mr. Ogilvie gives to it about thirty-five hundred feet. The landscape which this mountain dominates is surpassingly beautiful, and I know of no finer view from similarly low mountains than that which this one commands. The sharply incised wooded valleys of the different streams that head up to it tear the mountain into projecting buttresses, and in the ridge that leads off from it southwestward contracts it to the extent of forming for half a mile or more a narrow backbone or saddle. In this respect it reminded me much of Mount Katahdin, in Maine. On a clear day the distant main mass of the snow-capped Rocky Mountains is sharply outlined against the northeastern sky, a most impressive setting to the verdant slopes that trend off toward it, only to disappear in the belt of plain that separates the two mountain systems. I was unfortunate in not getting the full benefit of this view, as at the time of my first crossing the atmosphere was very cloudy, and on the second it was so surcharged with smoke from forest fires in the valleys of Gold Bottom, Quartz, and Sulphur Creeks that hardly more than the foreground was visible.

A succession of five or six knobs runs out from the ridge to which reference has been made and which trends off in the direction of the head waters of Eldorado, and these, together with the main Dome, are sometimes spoken of as the "Seven Domes," but they have no particular significance in the orographic detail and can not even be said to be clearly defined to the eye. Dome Mountain is held in a respect bordering almost on veneration by the Klondikers, inasmuch as it is generally thought to be the mainspring of the gold supply which is contained in the streams that fall off from it, and this means nearly all the good and the promising streams of the entire region. And, in truth, there is for the moment no way of absolutely disposing of the miner's suppositions, nor can the circumstance that little or no gold has yet been found in place either on [Pg 302] or in the mountain be given much value in the discussion of the probable origin of the gold, inasmuch as the same negative condition confronts us in a study of the rocks of all other parts of the same and adjoining regions. Assuming that alluvial gold is in the main a derivative from reef gold, it is certainly strange that streams flowing in well-nigh opposite directions, and yet rising within very short distances of one another, should be so largely charged with gold, unless they [Pg 303] have obtained it from a common source; nor can the fact, as received and reported by most miners, but of the full import of which I have not yet fully made up my mind, that the different streams carry different classes of gold, be argued away as having no significance in this connection. Claim holders profess at most times to be able to distinguish between Eldorado gold and that of Bonanza, between the gold of Bonanza and that of Hunker or Dominion, and so on; and there is no question that marked differences in color and in the contours of the coarse flakes and nuggets do present themselves, and even in narrower limits than has here been outlined. Thus, the gold from French Hill, abreast of Claim 17 on Eldorado, has a distinctiveness that is largely its own, and hardly follows the gold of the rest of the Eldorado tract; and the same is true of the gold of Skookum Hill in its relations to that of Bonanza, and also of that of Victoria Gulch. Moreover, the recent assays that have been made by the Bank of British North America and the Canadian Bank of Commerce, in Dawson, of the gold of the different creeks and gulches show plainly that marked differences as to fineness are distinctive qualities—at least they appear to be such at the present time. Thus, while Eldorado and Bonanza gold generally assays but about $15.50 or $15.80 to the ounce, Dominion gold shows as high as $17.80, and Hunker close to $18.50; the gold of Bear Creek, a minor tributary of the Klondike, is reported to actually give $19.20 to the ounce, falling only behind the almost pure specimens that have been reported from

American Creek and Mynook, and to which a valuation of nearly $20 has been given. If these assumed facts continue to be proved true, then they must argue in favor of a distribution of gold from largely localized spots or areas, a conclusion that is also pointed to by a number of other circumstances. On the other hand, there are some facts which point in quite the opposite direction, and some of these will be referred to later on.

None of the mountains of the region even approximates the snow line, which would here probably occupy a position not much below six thousand feet, and on the northern face perhaps even rise to seven thousand feet. Not a vestige of snow was seen by me when crossing the Dome, not even in the most sheltered hollows, a condition that at first strikes one as strange, considering that in so many parts of our own mountains of equal or less elevation snow may be found lingering through a long period of the summer months. But here the greatly protracted hours of summer daylight and heat, together with the correspondingly diminished period of night, when a regelation might take place or melting at least could be arrested, have a marked [Pg 304] influence in dissipating the winter's snows and ice when these are not particularly heavy. I did not find the August heat quite so intense on the mountain tops as I had been led to suppose that it would be, but there was quite enough of it to satisfy an ample vegetation and to make heavy garments in walking more than a luxury. Unfortunately, my thermometer was away from me at this time, and as sensation in this dry northern climate is so difficult to gauge by the standard of [Pg 305] the mercurial index, I shall not hazard a guess as to the actual reading.

The Vale of Eldorado.

Taking the mountains in their entirety, it is difficult from single points of view to determine for them any definite relation. There are so many valleys in close proximity to one another, some very ancient and others relatively modern, and with trends so opposed in all directions, that in the absence of a dominant ridge or mass this relation becomes very confused; and I was not in a position, with the limited time at my command and the deficiency of rock outcrops, to positively define any main line or axis of uplifts. Yet I suspect that there is one such, with a generally east and west bearing, whose trend might correspond with that of the ridge already referred to, which, with a southwesterly deflection, unites Dome Mountain with the mass that separates the upper Eldorado from Chief Gulch. What strikes one as particularly interesting in the conformation of some of these mountains when seen from an elevation is their hummocky appearance. This is particularly noticeable in the mountains which close in the Eldorado and Bonanza Valleys. With considerable actual elevations, they convey the impression of being merely swells or undulations of an open surface, very much like magnified morainic knolls in a glaciated country. This depressed type of mountain structure, with the evidence of its expanded valleys and gently flowing contours, carries with it the proof of long-continued degradation, and of a history whose pages read far back into geological chronology.

With the evidences of antiquity before us, there are yet indications, amounting, it seems to me, almost to proof, that many of the more pronounced features of the region date their origin from only a comparatively recent period. Such is the case with a number of valleys that are tributary to the main ones, and even the latter appear to have been modified by late stream displacements. Taking the Eldorado or Bonanza, with their open U-shaped troughs and in most parts gently sloping banks, as types of the older valleys, it is surprising to note how many of their tributaries have the deeply incised and narrow contours; and I am led almost to conclude that some of these are really of very late construction. The stream displacements, which, by reason of the indices they give to the finding of new placers, are now beginning to be so attentively studied by the miner and prospector, are emphatic in their testimony in this direction.[2] One has but to note the triangular area that is included between French Gulch (tributary to Eldorado abreast of Claims [Pg 306] 17 and 18) and Adams Creek (tributary to Bonanza at Claim 6 below Discovery) to be convinced of the actuality of recent transformations. Most of the miners regard the high-level gravels of this tract—of French Hill, Gold Hill (opposite to Grand Forks Village), Skookum Hill, and Adams Hill—so rich in gold as to make the claims fairly the rivals of the creek claims, as representing the ancient high-level flow of the Eldorado and Bonanza, but I am convinced that this is not the case (although it is certain that both streams mentioned did at one time flow at as high, and even considerably higher, levels). The materials that so largely distinguish these bench or hillside gravels (placers) are in greater part rounded bowlders or cobbles of white quartz, with a marked deficiency of the fragmented schists and slates which make pay dirt and bed rock in the course of the streams below.

Grand Forks Village.—Valley of the Bonanza.

Per contra, the creek claims of Eldorado and Bonanza contain, as a rule, only an insignificant quantity of the rounded quartz bowlders, while almost everywhere where excavations have been made the body and substance of the output are the flattened and discoid parts of the mother-rock of most of the region—quartzitic, micaceous, hornblendic, and chloritic schists, and with them a less quantity of gneissic and dioritic rock. The high quartz-capped knob to which reference has already been made as marking the water parting of French, Nine Mile, and Adams Creeks, has large quartz masses entering into its composition, whether as bosses, dikes, or veins, and to them, or rather their wasted parts, must we look for the source which has so generously supplied the materials of the French-Adams Hills benches. There has been a bad break-up in this quarter, and the materials resulting from it have been swept into the confluence (delta) of the two streams which define the main valleys. Furthermore, the descending arcuate contour lines which are so well marked by terrace slopes on that face of French Hill which is turned to the corner of Eldorado and French Gulch, show plainly the receding course, in the direction of south, of French Creek (Gulch). On the hill slopes south of the position which it now occupies there is none of that deposit which lies to the north of it; the riches of French Hill are delimited by French Gulch, and even in the gulch itself there is nothing that can be compared with what is found on the heights. Again, on the side of Eldorado opposite to French and Gold Hills there is the same deficiency as regards the characteristic bench deposits, and this also holds true with the Bonanza opposite Skookum and Adams Hills. If these high-level deposits were in fact the ancient waste of the Eldorado and Bonanza, we should naturally expect to find at least "outliers" on the less favored [Pg 307]
bank of the streams, and surely in the case of the Eldorado former evidence of this deposition ought to be had on the hillsides, similarly contoured to those of the north, which lie south of and immediately adjoining French Gulch.

Sluicing on the Bonanza.

Through virtually the entire Klondike tract and far beyond it on all sides there are evidences of high water flows. No more perfect presentation of high-level terraces can be had than that which defines the first line of heights, of perhaps one hundred and fifty to two hundred feet, which so beautifully impress the landscape of the Yukon about Dawson. The observer, from a still loftier elevation, notes these flat-topped banks, having the regularity of railroad constructions, following the course of the river as far as the eye can reach, here perhaps interrupted by a too steeply washed buttress, elsewhere washed to low level by some stream which has taken a transverse direction. A somewhat higher line of benches curves around the still higher points of eminence, and defines the course of water across country—such, at least, it is to-day. And all the way to the top, scattered evidences of the recent presence of water can still be found. I met with rolled or water-worn pebbles so near to the top (the actual summit and not the position of the signal flag) of the high peak overlooking Dawson that it may safely be assumed that they also occur on the very apex (about eleven hundred feet above the present level of the Yukon), a conclusion which is more than strengthened by the finding of pebbles at even a greater elevation on the French-Adams Creek knob. While thus presenting the evidence of high water levels, I am far from convinced that this evidence points exclusively to river flows. Much more does it appear that, in one part of its history at least, we are dealing with the evidences of the past existence of large lakelike bodies of water, perhaps even of a vast inland sea. The contours of the country in a sort of ill-defined way suggest this interpretation—an interpretation that is not, however, without evidence to support it, and which seems also to have been entertained before me by McConnell and by Israel Russell. The latter investigator has, indeed, given the name of Lake Yukon to a former extensive body of water, of which the existing Lakes Lebarge, Marsh, Tagish, and Bennett, with the connecting Yukon, are only dissociated parts. This lake is assumed to have been about one hundred and fifty miles in length, with a surface elevated between twenty-five hundred and twenty-seven hundred feet above the sea. [Pg 308]

First in the line of evidence may perhaps be taken the universality of wash gravel and of terrace *débris* and the great heights which they occupy. While I have not myself observed such evidences of water action on the very summit of the Dome, there is reason to believe that they do or at least did exist. Most of this summit, in its narrowed form and rapidly descending slopes, has been, if one may use the expression, more than washed off, and could hardly be expected to retain for any great length of time accumulations of loose fragmental material. But at least its far-off continuation near the source (right fork) of Eldorado Creek bears some of it on its shoulder, and I [Pg 309] have also seen it in an excavation on the loftily located Claim 71 of that stream. Nearly abreast of the international boundary, the one hundred and forty-first meridian of west longitude (Greenwich), McConnell and Russell noted the terrace line of the Yukon River as high up as seven hundred and thirty feet, which is still about four hundred feet below the point where I obtained wash gravel on the peak back of Dawson; but Dr. George Dawson found the terraces on Dease Lake to rise to thirty-six hundred and sixty feet, and elsewhere he calls attention to having come across water-rolled gravel at an elevation of forty-three hundred feet, which would probably exceed by about six hundred feet the culminating point of Dome Mountain. Such high water could, with the existing configuration of the land surface, hardly define any other feature than that of a large interior sea or of a series of lake basins; and while it may be argued that there has been sufficient degradation of the land surface since the period of the height of water to permit us to reconstruct a contour that would be in harmony with altered and reduced river courses, and relieve us from the necessity of invoking the assistance of lacustrine bodies in a solution of the problem, it does not seem to me likely that this has been the case. The physiognomy of the upper Yukon Valley supports this contention, and even to-day the river has not yet fully escaped from a lacustrine condition which is merely fragmental of a previous state.

On one point bearing upon the succession of events in the upper Yukon Valley, and which has its connection with the history of the Klondike region, my conclusions differ somewhat from those that have been expressed by Dawson. This pertains to the deposit of volcanic ash which is so marked a feature of the accumulations of the river's banks. For nearly three hundred miles by the course of the river a stratum of pumiceous ash, ordinarily not more than four or six inches in thickness, constitutes almost without break the top layer but one of the banks on either side, and that which is above it is generally only the insignificant soil or subsoil which immediately supports the vegetation. So persistent is this ash layer, and so uniformly does it hold to an even thickness and to its exact position beneath the surface, that without further examination one would be tempted to believe from a little distance that it was merely the ordinary subsoil layer from which the color had been leached out by vegetable growths. Here and there, where there have been local disturbances or water washings have produced concentration, it may have acquired a development of a few feet, and occasionally it has accommodated itself to flexures or saggings of the deposits which it normally caps as a horizontal zone. Dr. Dawson, in commenting [Pg 310] upon its occurrence, correctly assumes that it represents one continuous volcanic eruption, the date of which might fall well within a period of a few hundred years, and he speculates as to its being possibly associated with an outbreak from Mount Wrangel or some active cone which is represented by the Indians to exist in the region of the upper White River. Beyond this, from the normality of its position, and the assumed fact that no fluviatile or aqueous deposits have been found overlying it, the same observer argues that the outbreak must have taken place subsequent to the formation of the present river courses and their valleys, a conclusion in which I do not see my way to concur. The only satisfactory interpretation of this vast uniformly placed and uniformly layered deposit of ash is to me that which assumes a deposition in a widely extended lake basin, or in shallow lagoon waters which already in part occupied the present valley surfaces. In such waters precipitation from long-continued suspension would proceed gradually and evenly, to the end of shaping a deposit of nearly uniform development and of vast extent. Such depositions we find in the valleys lying north of the City of Mexico (Zumpango, Tequixquiac) and in the lacustrine area of Anahuac, also in the famous fossiliferous basin of Florissant, in Colorado. With the subsequent formation or reformation of the river's course we should have this deposit cut through, with the result of presenting the even layer which is so persistent in its following. This method would also account for the anomalous position in which we find the ash deposits; while still holding the same relation to the top surface, it occasionally rises far above what might be assumed to be its normal height or level above the water's surface—from four to ten feet—a condition that would hardly be in consonance with the assumption that the ash was deposited after the actual river channels had been cut. But other and more direct proof of aqueous occupation after the laying of the ash is had in the fact that in one place at least, and doubtless many more such will be found on closer investigation, lacustrine or fluviatile shells (subfossils) occur in the layer overlying the ash. A locality of this kind is found on the right bank not many miles above the Five Finger Rapids. Here, at a height of not more than four feet above the river, I had the pleasure of determining species of *Limnea* and *Physa*, associated singularly enough with *Helix*, in the layers immediately above and below the ash bed, and in both horizons the species were identical. This isolated fact speaks volumes for itself. Had this been the region of Helena, Ark., I should have been prompted to class the bed with a portion of the Mississippi loess. What interested me further in this connection was the fact that up to this time I had failed to bring to light one solitary mollusk from the upper Yukon, and to all inquiries regarding the existence of [Pg 311] shellfish in this northern water invariably a negative reply was received. Only on that day did I again obtain success in my malacological effort, the almost icy waters rewarding my search with a single specimen—unfortunately subsequently lost—of a *Bythinella*, or some closely related type, so that even to-day my knowledge does not permit me to state if the subfossil species of the [Pg 312] banks have their living representatives, either specific or generic, in the almost wholly noncalcareous waters of the existing river. The question from more points than one is interesting, and deserves more than passing attention. It may be remarked in this place that the only other fluviatile invertebrate which I found in these waters was a white siliceous coating sponge, whose statoblasts were well visible to the naked eye. Unfortunately, the loss of my specimens has prevented determination, a circumstance the more to be deplored as these fresh-water sponges are the most northern in habit known to the zoölogist.[3]

There is evidence of another kind pointing to a comparative newness of much of the present course of the Yukon. The feature has been noticed alike by nongeographers and geographers, and by geologists as well, that the arm which carries the greatest volume of water does not everywhere occupy the main orographic valley. Thus, as Dawson has well pointed out, in coming up the stream the valley of the Big Salmon appears to be more nearly the continuation of the main valley below than that which still (and properly) continues to be designated the Lewes (Yukon) above; and this is still more markedly the case with the Hootalinqua (Teslin-too or Newberry River) at the confluence with the Thirty Mile. Even the valley of the Pelly at its junction with the Yukon, near Fort Selkirk, would perhaps to most persons suggest itself as the main channel of erosion. There is no hardship to geological facts in invoking the aid of great displacements to account for a condition which to my mind is well impressed upon the landscape; for, even without the proper or fully satisfactory evidence in hand to support the view, I fully believe that the greater part of the upper Yukon tract only recently emerged from a lacustrine condition. Nor is it to me by any means certain that this emergence or final reconstruction of the land surface into valley tracts need be more than a few hundred years old, or necessarily older than the deposition of the volcanic ash, which is hypothetically carried back to Dawson to a possible five hundred years or so. If it should be objected that we know of no such rapid change in the configuration of a land surface brought about by aqueous agencies, it might be answered that the mechanics of erosion in a pre-eminently drift-covered region, under subarctic conditions and with the influence of a most powerful and energetic stream near by, have neither been studied nor observed.

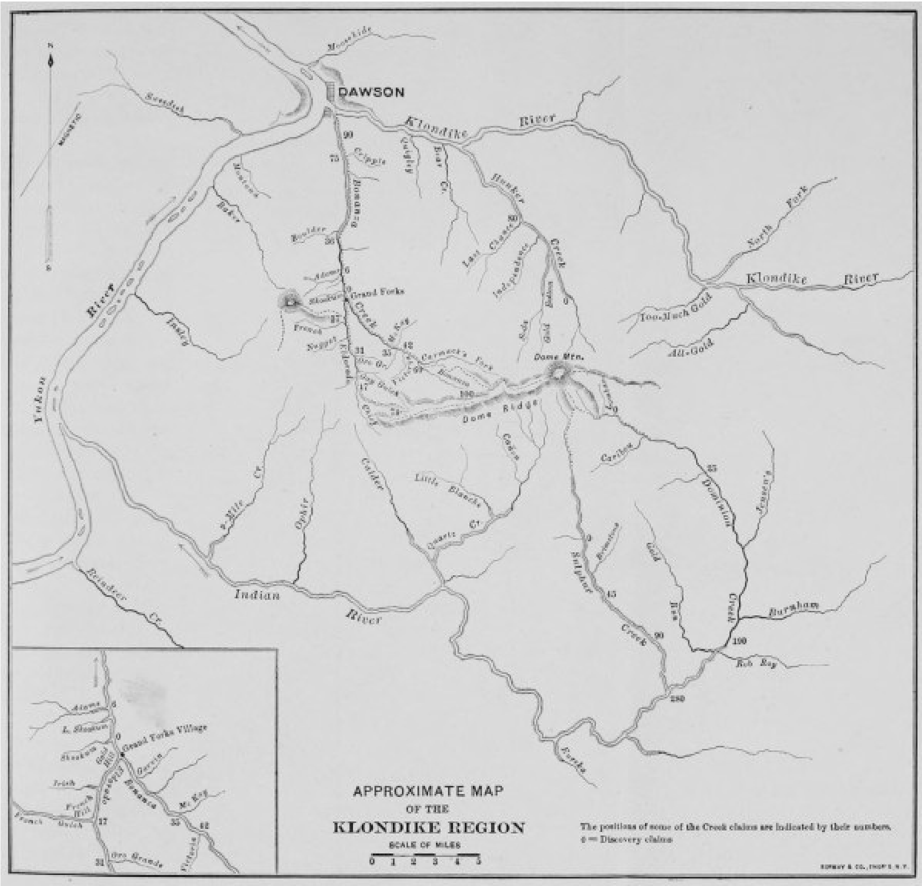
Let us examine the possibilities of the case. As an initiatory premise it might be assumed, without [Pg 313] much chance of either affirmation or denial, that the degradation of the land surface in the immediate valleys of the main streams is or has been in the past taking place at the rate of half a line per day; so far as the eye and ordinary instruments of measurement are concerned this is a quite inappreciable amount, and I see no reason why it may not be assumed as the working power of the Yukon. With this rate of erosion a valley trough or contour of about a foot and a third might be formed in the period of a single year, or of nearly seven hundred feet in five hundred years; and if we lessen the daily erosion to one quarter of the amount stated—i. e., to an eighth of a line—we should still have in this same period of five hundred years, speaking broadly, a trough of about one hundred and seventy-five feet depth, quite sufficient to have brought about most marked changes in the aspect of a drift-covered lagoon region, and perhaps ample to account for those physiognomic peculiarities which have been discovered. I am fully impressed with the magnitude of the distance which separates the amount of erosion which I have assumed —an eighth of a line daily—from the "one foot in six thousand years," which has been preached categorically from lecturn and text-book for the better part of a quarter of a century and threatens to make dogma for still another period of equal length; but the conditions here are entirely different from those of average continental denudation—in fact, have as nearly nothing in common as they can have. My observations in the tropics and subtropics have most impressively taught me the lesson of rapid changes, and with the conditions that are and have been associated with the Yukon, I am prepared for the lesson of equal change in the north. But, as a matter of fact, are we not taught of a removal in the west central United States of some twelve thousand feet of rock strata in a period not impossibly considerably less than two hundred thousand years?

The one foot in sixteen years has here likewise nothing in common with the "prevailing" rate of continental destruction.

While stalled on a bar on the Yukon River, about two miles above Fort Selkirk, I was much impressed with the mechanical work of the stream. The gravel and pebbles were being hurried along rapidly under the lash of a five to six mile current, and their groans were audible frequently when they themselves were invisible. Every few minutes our steamer would swerve from her seemingly fixed position by the undercutting of the bar, and perhaps it would be not far from the truth in saying that we should be to-day in very nearly the same position that we were in then had it not been for this undermining action of the stream. Let it be remembered that the Yukon has a current ranging up to seven miles, or to eight, as some of the navigators say, and that in certain months it is swiftly ice-bound both on top and at the bottom, and heavily charged with bowlders, and one may well realize the work of which it is capable. That with which I have debited it is purely hypothetical or conjectural, but it may serve a purpose in the elucidation of the main problem.

In its more distinctively geological relations the Klondike region may be broadly defined as one composed in the main of schists and schistose rocks, defining an area of considerable disturbance. Owing to the limited number of outcrops, by far the greater part of the surface being still buried beneath vegetation of one kind or another, the variety of rocks included within the region can best be told from an examination of creek bowlders or the different dumps that mark hundreds of diggings and prospect holes along the various valleys and gulches. Some of this output, in which may be found fragments of quartz and quartzitic schist, of mica, hornblende, and chloritic schists and slates, of granitic gneiss and gneissose granite, porphyry, diabase, diorite, and quartz (quartzite), is probably extra-territorial, having been washed in at a time when a more extensive foreign water had access to the region; but there is enough of outcrop to show that most, and perhaps all, of the types here indicated are really a part of the tract. The schists and schistose rocks, whose age from direct evidence in the field I was unable to determine, but which are almost certainly the equivalents in greater part of the Birch Creek series, as described by Spurr from the American side (Birch Creek and Forty Mile districts), constitute the kernel of the region. Observation is as yet too limited to permit of a positive classification of these schists according to their natural relations, and the reasons that have prompted some to consider them as being in part of pre-Paleozoic age are not quite clear to me, although they may easily be such. Of granite and true gneiss in position I saw practically nothing, and the limestones and marble were not sufficient in quantity to permit me to identify the heavy beds which are considered to be the distinguishing element of the Forty Mile series. The beds where exposed show in most parts steep dips—in places standing almost vertically—but in how far these dips are uniform or the reverse, or in any way define a line of strike with anticlinals and synclinals, must be left for future close examination to ascertain.

Great lumps of white or pinkish quartz, some of them *in situ*, others washed or rolled down the open slopes, occur at many points of some of the mountain elevations, indicating the presence of dikes and gash veins, and in part of interstratified beds containing this material. I found much of it at several "horizons" of the slope back of French Hill, and also as a cap overlying the badly cleaved and fragmented schists of the summit (three thousand feet?) of the prominent knob which dominates this region. The same type of "kidney" quartz appears at repeated intervals on the slope leading up to the Dome, almost immediately after leaving the junction of Carmack's Fork with the Bonanza, and also on the saddle ridge which might properly be considered to be a part of the summit of Dome Mountain. Prospectors have in nearly all cases staked these assumed outcrops of quartz, recognizing them as ledges, and in a number of them have claimed the discovery of the "mother lode." So far as visible gold is concerned, I have in nearly all cases found them to be absolutely barren, and I do not think at this time that there is much chance of finding anything materially valuable in them, although events might prove the reverse. Most of the quartz that has so far been discovered in direct association with the gold—that is to say, wrapped up with or within itself, as in the case of the quartz-gold nuggets of French Hill—is of a gray-blue or pinkish tint and of a granular and nonspathic type, therefore differing materially in aspect and structure from the quartz of the hillsides and from the greater number of the quartz bowlders that are contained in the dumps or have been removed from bed rock. Some of the bowlders or rolled pebbles containing coarse gold are of the same character of quartz as the quartz of the hillsides. Notably one such was shown to me as coming from a high-bench claim (Millett's) on Adams Hill (left "limit" [bank] of Bonanza, between Little Skookum and Adams Creek), and other similar fragments taken from the rock *in situ* were observed on Gay Gulch and the ridge which separates the head waters of this stream from those of Eldorado. In a dump at the mouth of Gay Gulch (a right-hand tributary of Eldorado abreast of Claim 37) I found fragments of rotted quartz which were well sprinkled with fine gold.



APPROXIMATE MAP OF THE KLONDIKE REGION

It does not by any means appear so conclusive to me as seemingly it does to Professor Spurr that because in some gulches the gold heads up in increasing quantities the nearer we approach the beginnings (heads) of these gulches, and that with this approach the coarseness of the grains and nuggets likewise increases, we are necessarily forced to assume that the travel of the gold at large has been confined within the boundaries of the gulches in which it is at present contained, or that its source is to be sought near by. A number of the most "solid" streams of the Klondike region, such as the Bonanza and Eldorado, if we are permitted to judge from the evidence of outputs and of prospects up to the present time, hardly sustain the conditions of the American creeks. The richest claims on the Eldorado are, starting from its mouth—the junction of the Bonanza—4, 5, 12, 13, 29, 30, 31, 36, with other claims abundantly rich between these. Number 30 is, I believe, generally considered to be the banner claim, and it is situated about three miles up—far enough, perhaps, to sustain in a superficial way Professor Spurr's generalization as to location—and above it 36 is not unlikely to show up as well as any of the other creek claims below. But the valley of Eldorado, whether constricted or open, continues for miles beyond either of its two head forks—that which is known as Eldorado proper, and the one, Chief, or Chief Isaac Gulch, which is geographically the continuation. So little has been found above 36 or 37 that the stream in that part is ordinarily spoken of as being barren. Again, so far as the tributaries on either side of Eldorado are concerned, and the possibility that they are responsible for the gold that is contained in the main stream between 37 and 1 rather than the Eldorado itself—a condition in no way impossible or improbable—it can only be said for them that up to this time they have, with the possible exception of Oro Grande (tributary to Eldorado abreast of Claim 31), yielded very little gold themselves, and have hardly given indication of containing much of a supply. I have used the words "up to this time" advisedly, because I am aware upon how little the evil reputation of a gulch rests, and how prospectors deceive themselves by the character of their defective prospect holes. Hence, while my argument is drawn from existing evidence, it can not be assumed that this evidence is by any means sufficient to warrant a conclusion. It is by no means unlikely that some of the lateral gulches will really be found to be largely gold-bearing, and of such Gay Gulch and the left-fork ascending of Eldorado (Eldorado proper above 47) appear to me the most promising.[4]

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The condition of the Bonanza is very similar to that of the Eldorado. Its greatest wealth, as so far determined, is concentrated in its middle course, beginning about five miles above its mouth and terminating some six miles below its source. But very little gold, if the information given to me is correct, has been taken out from or determined to exist in the tract lying above Claim 42 above Discovery, or the mouth of Victoria Gulch (left-hand tributary, whose source is found on a ridge from the opposite side of which Gay Gulch descends to the Eldorado), and yet the valley continues open and without material change for at least two miles, and with a certain contraction for four miles more. Barring the Eldorado and the streams coming in from the same side nearest to it—Big Skookum, Little Skookum, and Adams—few if any of the side gulches of the Bonanza are known to be really rich in gold, and for the moment, at least, they can hardly be looked upon as having furnished the main supply to the main stream.

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THE RACE PROBLEM IN THE UNITED STATES.

By BOOKER T. WASHINGTON,

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I have been asked a number of times during the last few months the cause of and the cure for the riots that have taken place recently in North Carolina and South Carolina. I am not at all sure that what I shall say will answer these questions in a satisfactory way, nor shall I attempt to narrow my expressions to a mere recital of what has taken place in these two States. I prefer to discuss the problem in a broader manner.

In the first place, in politics I am a Republican, but have always refrained from activity in party measures, and expect to pursue this policy in the future; so in this article I shall refrain, as I always have done, from entering upon any discussion of mere party politics, in the narrow and usual sense. What I shall say of politics will bear upon the race problem and the civilization of the South in the larger sense. In no case would I permit my political relations to stand in the way of my speaking and acting in the manner that I believe is going to be for the permanent interest of my race and the whole South, regardless of mere party name and organization.

In 1873 the negro in the South had reached the point of greatest activity and influence in public life, so far as the mere holding of elective office was concerned. From this date those who have kept up with the history of the South have noticed that the negro has steadily lost in the number of elective offices held. In saying this I do not mean that the negro has gone backward in the real and more fundamental things of life. On the contrary, he has gone forward faster than has been true of any other race in history, under anything like similar circumstances.

If we can answer the question as to why the negro has lost ground in the matter of holding elective office in the South, perhaps we shall find that our reply will prove to be our answer also as to the cause of the recent riots in North Carolina and South Carolina. Before beginning a discussion of the question I have asked, I wish to say that this change in the political influence of the negro has continued from year to year, notwithstanding the fact that for a long time he was [Pg 318] protected politically, by force of Federal arms and the most rigid Federal laws, and still more effectively, perhaps, by the voice and influence in the halls of legislation of such advocates of the rights of the negro race as Charles Sumner, Benjamin F. Butler, James A. Garfield, Oliver P. Morton, Carl Schurz, and Roscoe Conkling; and on the stump and through the public press by those great and powerful negroes, Frederick Douglass, John M. Langston, Blanche K. Bruce, John R. Lynch, P. B. S. Pinchback, Robert Browne Elliot, and many others; but the negro has continued for twenty years to have fewer representatives in the State and national legislatures. The reduction has continued until now it is to the point where, with few exceptions, he is without representatives in the lawmaking bodies of the State and of the nation.

Now, let us find, if we can, a cause for this. The negro is fond of saying that his present condition is due to the fact that the State and Federal courts have not sustained the laws passed for the protection of the rights of his people, but I think we shall have to go deeper than this, because I believe that all agree that court decisions, as a rule, represent the public opinion of the community or nation creating and sustaining the court.

At the beginning of his freedom, it was unfortunate that those of the white race who won the political confidence of the negro were not, with few exceptions, men of such high character as would lead them to assist him in laying a firm foundation for his development. Their main purpose appears to have been, for selfish ends in too many instances, merely to control his vote. The history of the reconstruction era will show that this was unfortunate for all the parties in interest.

It would have been better, from any point of view, if the native Southern white man had taken the negro, at the beginning of his freedom, into his political confidence, and exercised an influence and control over him before his political affections were alienated. In the light of present experience, I think all will now agree that the ballot would have meant more to the negro and would have been more lasting in its results, would have caused less opposition, if it had been given to him gradually, as he came into possession of education.

The average Southern white man has the idea to-day that if the negro were permitted to get any political power all the mistakes of the reconstruction period would be repeated. He forgets or ignores the fact that thirty years of acquiring education and property and character have produced a higher type of black man than existed thirty years ago.

But to be more specific for all practical purposes, there are two political parties in the South—a [Pg 319] black man's party and a white man's party. In saying this, I do not mean that all white men are Democrats, for there are some white men in the South of the highest character who are Republicans, and there are a few negroes in the South of the highest character who are Democrats. It is the general understanding that all white men are Democrats, or the equivalent, and that all black men are Republicans. So long as the color line is the dividing line in politics, so long will there be trouble.

The white man feels that he owns most of the property, furnishes the negro most of his employment, that he pays most of the taxes, and, besides, has had years of experience in government. There is no mistaking the fact that the feeling which, in some way, has heretofore taken possession of the negro—that to be manly and stand by his race he must oppose the Southern white man with his vote—has had much to do with intensifying the opposition to him.

The Southern white man says that it is unreasonable for the negro to come to him, in a large measure, for his clothes, board, shelter, and education, and for his politics to go to men a thousand miles away. The Southern white man argues that when the negro votes he should in a larger measure try to consult the interests of his employer, just as the Pennsylvania employee tries to vote for the interests of his employer.

The Southern white man argues, further, that much of the education which has been given the negro has been defective in not preparing him to love labor and to earn his living at some special industry, and has, in too many cases, resulted in tempting him to live by his wits as a political creature, or by trusting to his "influence" as a political timeserver.

Then there is no mistaking the fact that much opposition to the negro in politics is due to the circumstance that the Southern white man has not got accustomed to seeing the negro exercise political power, either as a voter or as an officeholder. Again, we want to bear it in mind that the South has not yet reached the point where there is that strict regard for the enforcement of the law against either black or white men that there is in many of our Northern and Western States. This laxity in the enforcement of the laws in general, and especially of criminal laws, makes such outbreaks as those in North Carolina and South Carolina of easy occurrence.

Then there is one other consideration which must not be overlooked: it is the common opinion of almost every black man and almost every white man that nearly everybody who has had anything to do with the making of laws bearing upon the protection of the negro's vote has proceeded on [Pg 320] the theory that all the black men for all time are going to vote the Republican ticket, and that all the white men in the South are going to vote the Democratic ticket; in a word, all seemed to have taken it for granted that the two races are always going to oppose each other in their voting.

In all the foregoing statements I have not attempted to define my own views or position, but simply to describe conditions as I have observed them, that might throw light upon the cause of our political troubles.

As to my own position in all these matters I do not favor the negro's giving up anything which is fundamental and which has been guaranteed to him by the Constitution of the United States. It is not best for him to relinquish any of his rights; nor would his doing so be best for the Southern white man. Every law placed in the Constitution of the United States was placed there to encourage and stimulate the highest citizenship. If the negro is not stimulated and encouraged by just State and national laws to become the highest type of citizen, the result will be worse for the Southern white man than for the negro. Take the State of South Carolina, for example, where nearly two thirds of the population are negroes. Unless these negroes are encouraged by just election laws to become taxpayers and intelligent producers, the white people of South Carolina will have an eternal millstone about their necks.

In addressing the Southern white people at the opening of the Atlanta Exposition, in 1895, I said:

"There is no escape through law of man or God from the inevitable:

"'The laws of changeless justice bind
  Oppressor with oppressed;
And close as sin and suffering joined
  We march to fate abreast.'

"Nearly sixteen millions of hands will aid you in pulling the load upward, or they will pull against you the load downward. We shall constitute one third and more of the ignorance and crime of the South, or one third of its intelligence and progress; we shall contribute one third to the business and industrial property of the South, or we shall prove a veritable body of death, stagnating, depressing, retarding every effort to advance the body politic."

Subsequently, in an open letter to the State Constitutional Convention of Louisiana, I wrote:

"I am no politician; on the other hand, I have always advised my race to give attention to acquiring property, intelligence, and character, as the necessary basis of good citizenship, rather than to mere political agitation. But the question upon which I write is out of the region of [Pg 321] ordinary politics: it affects the civilization of two races, not for to-day alone, but for a very long time to come; it is up in the region of duty of man to man, of Christian to Christian.

"Since the war no State has had such an opportunity to settle for all time the race question, so far as it concerns politics, as is now given to Louisiana. Will your convention set an example to the world in this respect? Will Louisiana take such high and just grounds in respect to the negro that no one can doubt that the South is as good a friend to the negro as he possesses elsewhere? In all this, gentlemen of the convention, I am not pleading for the negro alone, but for the morals, the higher life of the white man as well; for the more I study this question, the more I am convinced that it is not so much a question as to what the white man will do with the negro as to what the negro will do with the white man's civilization.

"The negro agrees with you that it is necessary to the salvation of the South that restriction be put upon the ballot. I know that you have two serious problems before you: ignorant and corrupt government on the one hand, and on the other a way to restrict the ballot, so that control will be in the hands of the intelligent, without regard to race. With the sincerest sympathy with you in your efforts to find a good way out of the difficulty, I want to suggest that no State in the South can make a law that will provide an opportunity or temptation for an ignorant white man to vote and withhold the opportunity or temptation for an ignorant colored man without injuring both men. No State can make a law that can thus be executed without dwarfing for all time the morals of the white man in the South. Any law controlling the ballot that is not absolutely just and fair to both races will work more permanent injury to the whites than to the blacks.

"The negro does not object to an educational and property test, but let the law be so clear that no one clothed with State authority will be tempted to perjure and degrade himself by putting one interpretation upon it for the white man and another for the black man. Study the history of the South, and you will find that where there has been the most dishonesty in the matter of voting, there you will find to-day the lowest moral condition of both races. First, there was the temptation to act wrongly with the negro's ballot. From this it was an easy step to act dishonestly with the white man's ballot, to the carrying of concealed weapons, to the murder of a negro, and then to the murder of a white man, and then to lynching. I entreat you not to pass a law that will prove an eternal millstone about the necks of your children.

"No man can have respect for the Government and officers of the law when he knows, deep down in his heart, that the exercise of the franchise is tainted with fraud. [Pg 322]

"The road that the South has been compelled to travel during the last thirty years has been strewn with thorns and thistles. It has been as one groping through the long darkness into the light. The time is not far distant when the world will begin to appreciate the real character of the burden that was imposed upon the South when four million ex-slaves, ignorant and impoverished, were given the franchise. No people has ever been given such a problem to solve. History has blazed no path through the wilderness that could be followed. For thirty years we have wandered in the wilderness. We are now beginning to get out. But there is only one road out, and all makeshifts, expedients, profit-and-loss calculations, but lead into swamps, quicksands, quagmires, and jungles. There is a highway that will lead both races out into the pure, beautiful sunshine, where there will be nothing to hide and nothing to explain, where both races can grow strong and true and useful in every fiber of their being. I believe that your convention will find this highway; that it will enact a fundamental law that will be absolutely just and fair to white and black alike.

"I beg of you, further, that in the degree that you close the ballot box against the ignorant you open the schoolhouse. More than one half of the population of your State are negroes. No State can long prosper when a large part of its citizenship is in ignorance and poverty, and has no interest in government. I beg of you that you do not treat us as an alien people. We are not aliens. You know us; you know that we have cleared your forests, tilled your fields, nursed your children, and protected your families. There is an attachment between us that few understand. While I do not presume to be able to advise you, yet it is in my heart to say that if your convention would do something that would prevent for all time strained relations between the two races, and would permanently settle the matter of political relations in one Southern State, at least, let the very best educational opportunities be provided for both races; and add to this an election law that shall be incapable of unjust discrimination, at the same time providing that in proportion as the ignorant secure education, property, and character, they will be given the right of citizenship. Any other course will take from one half your citizens interest in the State, and hope and ambition to become intelligent producers and taxpayers, to become useful and virtuous citizens. Any other course will tie the white citizens of Louisiana to a body of death.

"The negroes are not unmindful of the fact that the white people of your State pay the greater portion of the school taxes, and that the poverty of the State prevents it from doing all that it desires for public education; yet I believe that you will agree with me that ignorance is more costly to the State than education; that it will cost Louisiana more not to educate the negroes than it will to educate them. In connection with a generous provision for public schools, I believe that nothing will so help my own people in your State as provision at some institution for the highest academic and normal training in connection with thorough training in agriculture, mechanics, and domestic economy. The fact is that ninety per cent of our people depend upon the common occupations for their living, and outside of the cities eighty-five per cent rely upon agriculture for support. Notwithstanding this, our people have been educated for the most part since the war in everything else but the very thing most of them live by. First-class training in agriculture, horticulture, dairying, stock raising, the mechanical arts, and domestic economy would make us intelligent producers, and not only help us to contribute our proportion as taxpayers, but would result in retaining much money in the State that now goes outside for that which can be as well produced at home. An institution which will give this training of the hand, along with the highest mental culture, would soon convince our people that their salvation is largely in the ownership of property and in industrial and business development, rather than in mere political agitation. [Pg 323]

"The highest test of the civilization of any race is in its willingness to extend a helping hand to the less fortunate. A race, like an individual, lifts itself up by lifting others up. Surely no people ever had a greater chance to exhibit the highest Christian fortitude and magnanimity than is now presented to the people of Louisiana. It requires little wisdom or statesmanship to repress, to crush out, to retard the hopes and aspirations of a people, but the highest and most profound statesmanship is shown in guiding and stimulating a people, so that every fiber in the body and soul shall be made to contribute in the highest degree to the usefulness and ability of the State. It is along this line that I pray God the thoughts and activities of your convention be guided."

As to the cure for such outbreaks as have recently hurt North Carolina and South Carolina, I would say that the remedy will not come by the Southern white man's being merely cursed by the Northern white man or by the negro. Again, it will not come by the Southern white man merely depriving the negro of his rights and privileges. Both of these methods are but superficial, irritating, and must in the nature of things be short-lived. The statesman, to cure an evil, resorts to enlightenment, to stimulation; the politician to repression. I have just remarked that I favor the [Pg 324] giving up of nothing that is guaranteed to us by the Constitution of the United States, or that is fundamental to our citizenship. While I hold to these views as strongly as any one, I differ with some as to the method of securing the permanent and peaceful enjoyment of all the privileges guaranteed to us by our fundamental law.

In finding a remedy, we must recognize the world-wide fact that the negro must be led to see and feel that he must make every effort possible in every way possible to secure the friendship, the confidence, the co-operation of his white neighbor in the South. To do this, it is not necessary for the negro to become a truckler or a trimmer. The Southern white man has no respect for a negro who does not act from principle. In some way the Southern white man must be led to see that it is to his interest to turn his attention more and more to the making of laws that will in the truest sense elevate the negro. At the present moment, in many cases, when one attempts to get the negro to co-operate with the Southern white man, he asks the question, "Can the people who force me to ride in a Jim Crow car, and pay first-class fare, be my best friends?" In answering such questions, the Southern white man as well as the negro has a duty to perform.

In the exercise of his political rights I should advise the negro to be temperate and modest, and more and more to do his own thinking, rather than to be led or driven by a political "boss" or by political demagogues.

I believe the permanent cure for our present evils will come though a property and educational test for voting that shall apply honestly and fairly to both races. This will cut off the large mass of ignorant voters of both races that is now proving so demoralizing a factor in the politics of the Southern States.

But most of all it will come through industrial development of the negro! It is for this reason that I have believed in General Armstrong's theory of industrial education. In the first place, industrial education makes an intelligent producer of the negro, who becomes of immediate value to the community rather than one who yields to the temptation to live merely by politics or other parasitical employments. In the next place, industrial development will make the negro soon become a property-holder, and when a citizen becomes a holder of property he becomes a conservative and thoughtful voter. He is going to think about the measures and individuals to be voted for. In proportion as the negro increases his property interests he becomes important as a taxpayer. When the negro becomes a large taxpayer, he will see that it is to his interest to consult with his white neighbor about the measures to be voted for. There is little trouble between the [Pg 325] negro and the white man as to matters of education, and when it comes to the negro's business development the black man has implicit faith in the advice of the Southern white man. When the negro gets into trouble in the courts, which require a bond to be given, in nine cases out of ten he goes to a Southern white man for advice and assistance. Every one who has lived in the South knows that in many of the church troubles among the colored people the ministers and other church officers apply to the nearest white minister for assistance and instruction. As soon as we have grown to the point where we shall consult the Southern white man about our politics as we now consult him about our business, legal, and religious matters, there will be a change for the better in the situation.

The object lesson of a thousand negroes in every county in the South owning neat and comfortable homes, possessing skill, industry, and thrift, with money in the bank, who are large taxpayers and co-operate with the white men in the South in every manly way for the development of their own communities and counties, will go a long way in a few years toward changing the present status of the negro as a citizen as well as the attitude of the whites toward the blacks.

In proportion as the negro grows along industrial and business lines he will divide in his politics on economic issues, just as the white man in other parts of the country now divides his vote.

In proportion as the South grows in business prosperity the whole South will divide its vote on economic issues, just as other portions of the country divide their vote. When we can enact laws that result in honestly cutting off the large ignorant and nontaxpaying vote, and when we can bring both races to the point where they will co-operate with each other in politics in matters of business, religion, and education, the problem will be in a large measure solved, and political outbreaks will cease.

Colonel George Earl Church, speaking of the Indians of the country of the Amazons, relates of the chief of a horde of Yocaré savages whom he met among the falls of the Madeira, a young fellow twenty-five years old, that "he appeared to know everything that was going on around him. He seemed to have eyes in the back of his head, so acute were his senses. His hearing appeared to indicate, and his mind to define, the thousand things which were occurring in the tropical forest around us. Instinctively, he classified and estimated them at their true value as if they were under close and accurate analysis. As he sat dining with me at my camp table, in the simplicity of his nature and modesty of his nakedness, I could not help thinking that, in the evolution of man, many magnificent qualities have been sacrificed upon the altar of civilization."

THE ANTIQUITY OF MAN IN NORTH AMERICA. [Pg 326]

By Dr. CHARLES C. ABBOTT.

The claim of satisfactory evidence of the extreme antiquity of man in the valley of the Delaware River has been soberly discussed and intemperately ridiculed until the public, both scientific and general, have become tired of hearing the subject mentioned; but this is no valid reason why the truth should not be ascertained. If man in a paleolithic stage of culture did exist on the Atlantic seaboard of North America, then we have a basis upon which to build—a tangible starting point from which to date a history of human activities on this continent. As it is, we have but an immense array of facts, largely unrelated, and the greater portion sadly distorted and misleading because of the reckless theories set forth with them by their discoverers, and undoubtedly there never has been, in the whole range of scientific agitation of a simple question, as great a volume of reckless assertion, illogical deduction, and disregard of exact statement. The main question was often wholly lost sight of, and the author's sole purpose that of demonstrating some one else in error. Predetermination on the part of many has been fatal to the value of their field work. Convinced on theoretical grounds, such are necessarily blinded when on the spot where positive evidence occurs. He who does not desire the object searched for seldom finds it; and, later in the day, pride declines to accede to the just demands of candor—the admission of having reached a wrong conclusion.

There probably would not have been as much attention paid to the subject of man's growth in culture on this continent had not the proposition of a sequence from paleolithic to Indian, with an intervening period, seemed to necessitate a dating back to the Glacial epoch, which naturally brought geological erudition to bear upon the question, and since then, most surprisingly, there has been confusion worse confounded, rather than a flood of light. Much has been written, but we can not yet be confident which author is most nearly correct; and the latest report, showing sad evidences of haste, is vitiated by evident determination to modernize every trace of man, whether the facts warranted such procedure or not.

What is held, primarily, to be an evidence of paleolithic man is a wrought stone implement, that in Europe was characteristic of his handiwork. Here, in the valley of the Delaware, this same form of implement has been confidently asserted to be a rejected piece of stone—usually argillite—that failed to lend itself to reduction to a finished blade or spear point. If this could be established as of invariable application, however the supposed "reject" occurred, then the whole [Pg 327] matter would be brought to a quick conclusion. But the "reject" theory has utterly failed of establishment. The typical paleolithic implement is not characteristic of the refuse of an arrow-maker's workshop site, and the familiar arrow points of small size, nor even the long, thin blades of several times their length, were reduced from masses greatly larger than the desired form. The refuse of many a chipping site shows this conclusively; and, as hundreds of failures demonstrate, many an arrowhead was made from a pebble but a trifle larger than the finished object.

But admit, for argument's sake, the identity in shape of a "reject" and a "paleolithic" implement; this does not prove their identity in age and origin, and it is not an unwarranted or illogical suggestion to draw a distinction between the two, where the conditions under which they occur suggest a possibility of diverse history. Rather than demonstrating that all rudely chipped stones are "failures," it should be shown that paleolithic man, as we know of him in Europe, could not possibly have existed here. This has not only never been attempted, but the conditions during and immediately subsequent to the glaciation of the river valley have been asserted, time and again, to have been favorable for man's existence. Furthermore, it has not been shown that a typical paleolithic implement could not have been available on this continent, as it undoubtedly was in Europe, as an effective weapon, and it must be remembered that the fauna of the Delaware Valley was, in glacial times, very like that of parts of Europe in what we may call the reindeer period. Like conditions may not have produced like results in the case of early man, but what was practicable in Europe was certainly so in America, and the question resolves itself into that of determining if any trace of man that has been discovered in the valley of the Delaware can be dated back to a time preceding the Indian as he was when first he came in contact with the European. Did, in other words, the Indian bring his art with him from Europe or Asia, or did he experience a growth in culture from paleolithic simplicity to neolithic complexity?

The whole subject hinges on the distribution of these traces of man. If from the first day of his occupancy until the European replaced the Indian the immediate valley of the river had undergone no change, then the imperishable relics of the first and last savage would remain associated, and position alone would tell nothing concerning any particular object's age or origin, but, at the present day, except the contents of graves, not a stone implement of the Delaware Indians rests where chance or the intention of its one-time owner placed it. Indeed, save a few bowlders of the largest size, few natural objects on the immediate shores of the river are as first seen by William Penn and his associates. This fact has not been duly considered, and unwarranted conclusions have been published as established truths—all, of course, eliminating antiquity from the Indian history of the region. The fact that a so-called paleolithic implement was found lying on the surface of the river's shore has resulted in a pen picture of a modern Indian attempting to fashion a blade and tossing the pebble aside in disgust. Why, indeed, could not an Indian walk on exposed gravel and pick up a pebble as well as we can to-day? [Pg 328]

There are two considerations to which we must give heed when this question is asked. We are, in the first place, tacitly informed that the Indian was given to chipping stone in this haphazard way to supply a sudden need upon the spot, all of which is not only not a reasonable assumption, but absolutely incorrect, as argillite bowlders and pebbles, which are not abundant in the gravels, were not habitually used, but, instead, the mineral was systematically mined and selected with skill, so that failures were reduced to a minimum. Then, again, if the object as found has been lying undisturbed on the river shore for centuries—two centuries at least—why is it that the chips are not there also? These are never found under such circumstances. In fact, they are very rarely found at all in the gravel where the implement itself occurs, and in numbers they exceed the "reject" or finished object at least as ten to one. Furthermore, we are asked to believe that the river shore where we find rude implements is the same to-day as when the Indian wandered along it centuries ago. Fig. 1 shows clearly how the never-resting tidal flow wears away the shore, carrying sand and fine gravels from one point and spreading it elsewhere to form a sand bar, it may be, and turning the channel from one side of the stream to the other, and so exposing long reaches of the shore to wasting, that for many a year had been fixed and apparently secure. Often the mud is entirely removed from the underlying gravel, and abundant traces of Indian occupation are brought to light, and, less frequently, so strong a current attacks a given point that even the gravel is moved and deep holes are formed, to be filled in time with the wasting shore from a point perhaps a mile away. This is the story of the river of to-day, and so it has been for centuries; and yet we are asked to believe that we can fill the moccasin prints of the Indian by walking now along the water's edge. I submit that it is asking a great deal too much.

Fig. 1.—Wasting River Shore due to Tidal Flow.

It has been suggested that rudely chipped implements, when found on the gravelly shore of the river, have fallen out from the bank and rolled down from where they had long been lying. This is [Pg 329] not at all improbable; but how does this modernize the object, when the gravel extends quite to the surface? The pebbles and bowlders at the top of the bank are clearly as much a part of the deposit as are those at its base, and while the surface may be—is, in fact—less ancient than the deeper gravels, still they can not be dissociated; and it is a significant fact that we find, on the gravel at the foot of the bluff or other exposure, only the rude argillite objects at the water's edge or on the flat laid bare at low tide, and not a general assortment of the Indian's handiwork, including pottery; and we must not overlook the fact that the "gravel-bed" implements bear evidence of all the conditions to which the gravel itself has been subjected—this one stained by manganese, that incrusted with limonite; this fresh as the day it was chipped, because lost in sand and water and not subsequently exposed to the atmosphere; that buried and unearthed, rolled, scratched, and water-worn until much of its artificiality has disappeared. The history of almost every specimen is written upon it, and not one tells such a story as has been told about it by the advocates of the "Indian-reject" theory.

Much has been written on the natural history of the gravel that is so marked a feature of the river valley, particularly at the head of tide water, and almost every essay differs in more or less [Pg 330] degree from its fellows in the matter of the gravel's age as a well-defined deposit. Its origin no one can question, nor the agencies by which it was brought to where we now find it. Ice and water did the work, nor have they ceased entirely to add to the bulk transported in strictly glacial times—perhaps it were better to say in superlatively glacial time, as the river even now can be positively glacial upon occasion, as Fig. 2 demonstrates. The main channel has often been completely blocked with ice and the water forced into new directions and spread over the lowlands or flats, which it denudes of its surface soil, and once within recent years the stream found an old channel, deepened it, and for a time threatened to leave a flourishing riverside town an inland one. Ice accumulated in this way year after year must necessarily affect the river's banks, and yet the extent of "damage" is trifling usually, in comparison with that of the water, particularly when agitated by passing steamboats or violent winds; and now, too, the ice of our present winters does not transport coarse pebbles to any significant extent. I am convinced of this since the examination I gave acres of ice, when the river was gorged with it, some years ago. It was possible to walk for miles over the ice, as shown in Fig. 2, and to see it under exceedingly favorable circumstances, and a most careful search failed to reveal a stone larger than a pigeon's egg incased in this ice, which was all gently floated from far up the stream and stranded here; and where piled up upon the shores it usually remains until melted, and really acts as armor plate, protecting the ground from abrasion when the floods incident to the "break-up" prevail. Such are the present-day considerations, and they have a direct bearing upon the question of man's antiquity here because, first, the river valley has not varied for hundreds of years, except in becoming wider, the low shores receding, and the stream becoming broader and more shallow. In earliest Indian times the river was subject to freshets and ice gorges as now, but never did the water become so dammed up as to overflow the broad plateaus, areas of glacial gravel, that at the close of the Glacial period were within the boundary of the river. The Delaware was a very different stream then—*crescendo* for thousands of years, and *diminuendo* for thousands since—until now it barely hints at what once was. But not even in the height of its glacial activity was the climate so severe that the waters contained no fish, nor the forests of the high surrounding hills harbored no game. Never was it as bleak as the arctic region of to-day, and as man maintains a footing there, why should he not have done so here, where life was ever more easily sustained? True; but did he live here in glacial time?

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Fig. 2.—Ice-Gorged River.
Reproducing on a small scale the conditions of the Glacial epoch.

It has been stated in the most positive manner, which only positive evidence could warrant, that so-called paleolithic implements have not been found *in situ* in gravel deposits at a distance from the river, and such, *if there were such*, as appeared to be in the gravel, were recent intrusions. This statement, in its several parts and its entirety, is absolutely incorrect, and no excuse can be offered for its publication. It is to be explained, however, because avowedly predetermined. Wherever the glacial gravel of the Delaware tide-water region is found, there paleolithic implements occur, as they also do on and in the surface of areas beyond the gravel boundary. We accept, notwithstanding the unscientific source of the suggestion, the statement that post-glacial floods inhumed all traces of man found beneath the superficial soils, and find that, if these traces are considered in that light, some mysterious power was behind the senseless flood, and always buried argillite paleolithic implements far down in the gravel, and then selected argillite artifacts of more specialized forms for the overlying sands and reserved the pottery and jasper arrow points for the vegetation-sustaining soil. This, as stated, is absurd, but such is the order of occurrence of the traces of early man in the upland fields, and these are to be considered [Pg 332] carefully before a final conclusion can be reached. The broad, elevated plateau extending eastward from the present bank of the river offers facilities for studying the evidences of man's occupancy in this region such as are to be found in few localities. The principal reason for this is that almost no local disturbance has occurred since the original deposition of the sand that overlies the gravel and underlies the soil. The natural history of these underlying sands has recently received a good deal of attention, because, unlike the deeper gravels, there is perfect accord as to the occurrences therein of artificially chipped objects; and the suggestion that they are of intrusive origin being set aside as untenable, the geologists are now divided on the question whether the sand is wind-blown, a modified dune, and so not necessarily old even in years, or the result of intermitting overflow of water, usually carrying a considerable amount of sand and often heavy with washings from some distant clay bank. The objections to the "eolian" theory are that pebbles and bowlders, even of considerable weight, are scattered at all elevations through the sand, and these pebbles, as a rule, do not present any evidence of exposure to eroding sands, but are smooth and glassy, or the typical water-worn pebbles of a brook or the river bed, and more significant is the fact that the sands themselves are of different degrees of fineness, layer upon layer, and are nowhere clean or free from clay; and finally the thin layers of clay are clearly continuous over such extensive areas that in no sense can they be called segregations of that material. On the other hand, a carefully instituted comparison of the sand from the surface of the field to its junction with the gravel proper shows its identity with a deposit made by water in comparatively recent times. No difference whatever could be detected. The sand dune, modified by rains and finally leveled to a plain, presents, in section, no such appearance as the sands that overlie the gravels of glacial origin. Without a scintilla of reason, however, many geologists declare that no deposit of sand can be of any geological significance *if it contains traces of man not clearly intrusive*. The latter fact necessitates the former claim, all of which, I submit, is nonsense.

Fig. 3 illustrates how artificially chipped pebbles occur in this underlying sand. The upper portion shows the superficial soil removed to its point of contact with the sand. This is determined by the change of color from dark brown to light yellowish brown, and it is generally so very abrupt a change that no doubt arises as to where the soil ends and the sand begins. The sand proper is shown by the position of the object—the measuring rule and trowel. It will be noticed that the implement is lying flat, as such an object would almost necessarily be if transported by water, and not perpendicular, as would be the case if it had fallen down some root-hole, animal's or insect's burrow, or opening in the earth from any cause, and now obliterated. [Pg 333]

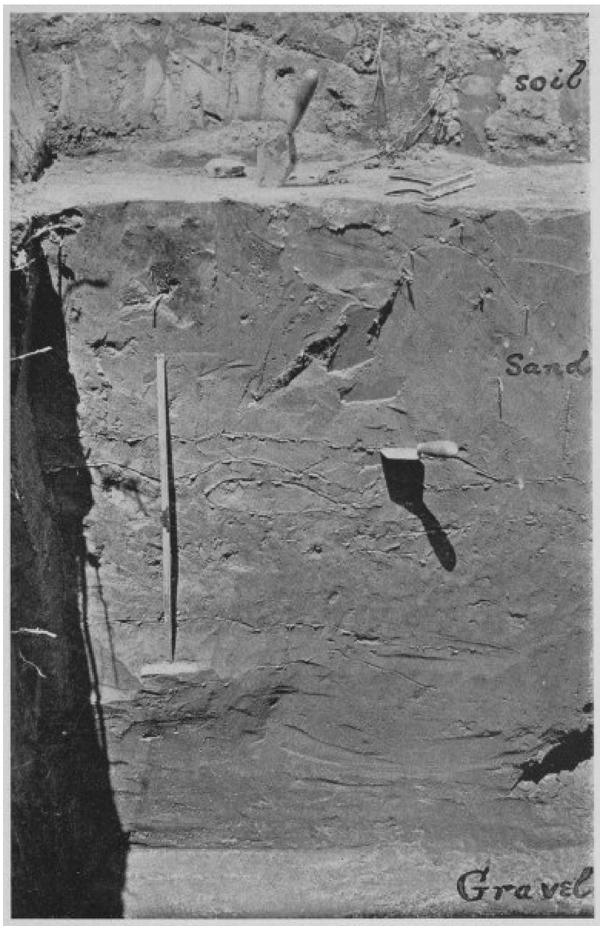

Fig. 3.—Occurrence of an Argillite Implement in Glacial Stratified Sand.

[Pg 334] The presence of these artificial flakes, blades, and other forms of simple implements can only be explained by considering them as a constituent part of the containing bed, having been brought hither by the same agency that brought the sand, pebbles, and clay. When standing before a newly made section of this implement-bearing deposit it is easy to picture the slow progress of its accumulation. The broad plain has been subjected to overflow, now of water bearing only sand, and then of muddy water; now with current strong enough to roll small pebbles from some distant point, and then periods when the sun shone on the new deposit, dried it, and the loose sand was rippled by the wind. Floods of greater volume occasionally swept across the plain, and ice-incased pebbles were dropped upon its surface, and with this building up of the plateau to a higher level there were also brought to it traces of man's handiwork. Of this, I think, there can be no doubt now. Years ago I endeavored to show from the distribution of rude argillite implements of specialized forms, as arrow points and small blades, trimmed flakes and scrapers, that these objects were older, as a class, than jasper and quartz implements and weapons, and that pottery was made only in the rudest way before "flint" chipping—jasper and quartz—was established. The more exhaustively this subject was followed up, the proposition became more evidently true, and to-day it is unqualifiedly confirmed by the results obtained from systematically digging deeply over wide areas of country. The fact that argillite continued in use until the very last does not affect this conclusion.

As the high land, now forty or more feet above the river and beyond the reach of its floods of greatest magnitude, was once continually overflowed and gradually built up by the materials the water spread upon it, it is evident that the conditions were materially different when such things happened from what now obtains, and the whole configuration of the country to-day points to but the one conclusion: that these plateau-building floods occurred so long ago as when the river flowed at a higher level and possessed a greater transporting power than at present. This, it is true, was long after the coarse gravel and huge bowlders were transported from the hillsides of the upper valley, but it was before the river was confined to its present channel, and more significantly before what may be called the soil-making period, itself of long duration and the time of the Indian as such. Not an argillite chip from the sands beneath the soil but speaks of the distant day when this plateau was an almost barren plain, and man saw it, roamed over it, and perhaps dwelt upon it, when but the scantiest vegetation dotted its surface, and only upon the hills beyond its boundary were there trees and herbage.

Even if we consider the agency of the streams that now are but insignificant inflowing brooks in spreading, during their freshet stages, sand over level areas, we must still go back to a time when they were streams of infinitely greater magnitude than they have been for many centuries, and before, too, the Indian was a skilled chipper of jasper and a potter of taste, else why the absence of these products of his skill in the deeper sands? It matters not how we look at it, whether as geologists or archæologists, or whether it is all post-glacial, or the starting point is still so distant as ice-age activities, the sequence of events is unaffected. We still have paleolithicity in the gravel, argillite and the discovery of pottery synchronous with the deposition of the gravel-capping sand, and, lastly, the Indian. [Pg 335]

The record is not a difficult one to read, and never has been, and the manifold attempts to modernize all traces of man on the eastern coast of North America can safely be relegated to the limbo of misdirected energy. Studied in the proper spirit and after the needful preliminary study of archæology as a whole, the student will find himself, when in the field—ever a more desirable place than the museum—face to face with evidences of an antiquity that is to be measured by centuries rather than by years.

THE USE OF ACETYLENE.

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It is now five years since the use of acetylene as an illuminant was suggested to the public, and it may be of interest to give a sketch of what has been done during this time, especially as it seems that with the year 1899 the tentative period which must characterize every new industry is in some respects passed, and a period of solid and well-directed industrial effort, backed by ample capital, has begun. The knowledge gained during this tentative period by the laboratory experiments of scientific men, and by the practical work of inventors and promoters, has made it possible for the industry to enter on its new phase. To understand its present and to foresee its future importance it is necessary briefly to review the work of the last years.

In May, 1892, Mr. Thomas Willson, a Canadian electrician, tried to make the metal calcium in an electric furnace in his works at Spray, North Carolina, by heating a mixture of lime and coal dust. He thought that the lime (calcium oxide) would act on the coal (carbon) to form calcium and carbon monoxide. He did not succeed in getting calcium, but found in the furnace a brown, [Pg 336] crystalline mass, which was decomposed by pouring water on it, yielding an inflammable gas. Willson is not a chemist, and he therefore sent specimens of the material to several men of science to determine its nature. It was shown to be calcium carbide, a compound of calcium and carbon, formed by the action of the carbon on the calcium oxide. The reaction expressed in chemical symbols is $CaO + 3C = CaC_2 + CO$. The gas formed by the action of water was acetylene, a compound of carbon and hydrogen. The reaction is $CaC_2 + H_2O = C_2H_2 + CaO$; calcium carbide and water form acetylene and lime. If water enough is added, the lime is slaked, and slaked lime, or calcium hydroxide, $Ca(OH_2)$, is formed. Neither calcium carbide nor acetylene was a new discovery; acetylene was discovered by Edmund Davy in 1836, and its properties were studied by Berthelot in 1862. Impure calcium carbide was first made in 1862 by Wöhler, who described its decomposition by water into acetylene and lime. What was there new, then, in Willson's discovery? Two important facts: (1) He was the first to make carbide by a method applicable commercially; (2) he was the first to make crystalline carbide. Wöhler's carbide was impure and amorphous; Willson's, nearly pure and crystalline, so that he succeeded in obtaining United States patents for crystalline carbide, and, as all carbide made by commercial processes is crystalline, its manufacture is covered by Willson's patents.

In the same year, 1892, Prof. Henri Moissan, of Paris, announced the discovery of crystalline calcium carbide. Moissan's discovery, too, was an accidental one. He was reducing refractory metallic oxides in an electric furnace made of lime. At the close of the article in which he reports his work to the French Academy of Sciences (*Comptes Rendus de l'Académie Française*, vol. cxii, page 6, December 12, 1892) he refers in two lines to the formation of an ill-defined carbide of calcium by the action of the carbon electrodes on the lime of which his furnace was made.

As is common with most important inventions, there is a dispute as to the priority of making carbide by an electric furnace; and the wonder is, not that there is a dispute, but that there are so few claimants. A few words of explanation of the electric furnace will show why. The enormous heat of the electric furnace (2000° to 3000° C.) is caused by an electric arc, formed by currents playing between carbon electrodes; carbon is often used in the furnace processes; here we have one constituent of calcium carbide. Lime, the material for the other constituent, withstands heat better than any other common substance excepting magnesia; naturally, inventors would use it, as Moissan did, as a refractory lining to the furnace. Electric furnaces were not new. The conditions then were such that the discovery of the carbide was fairly forced on experimenters, [Pg 337] and, as we have seen, the discoveries of Willson and Moissan were both accidental.

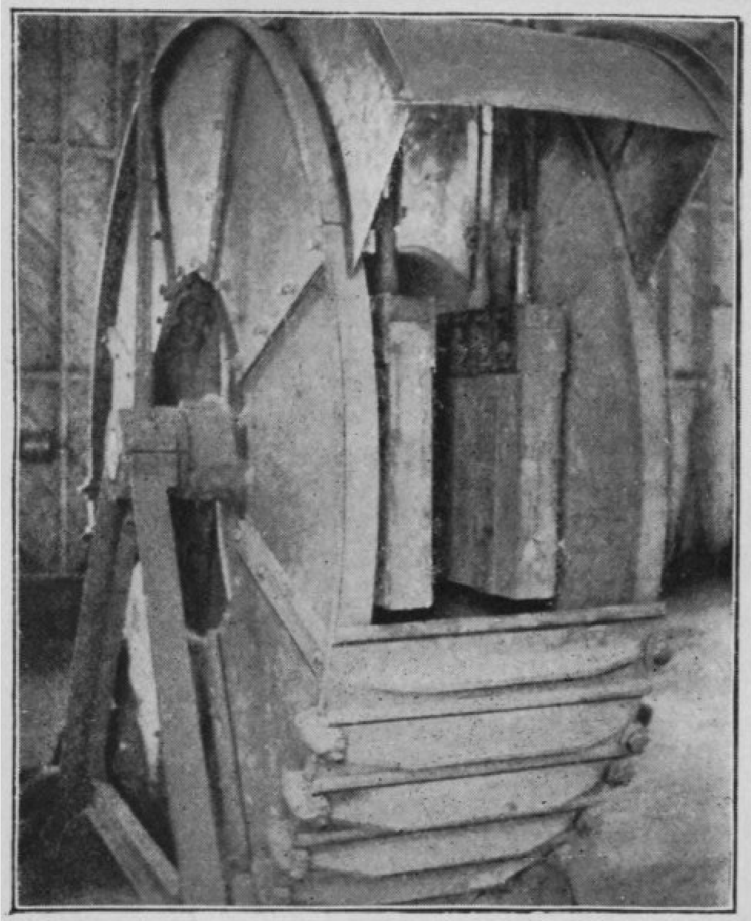
American priority was claimed by Willson, French priority by the friends of Moissan, German priority by Professor Borchers, of Aix-la-Chapelle. Fortunately for Willson, among those to whom he had sent specimens of carbide was Lord Kelvin, the famous English physicist, whose reply to Willson, stating that the substance received was calcium carbide, was dated October 3, 1892, two months before Moissan's first publication. Borchers's claims are too vague to waste space on. Willson's priority is now generally recognized excepting in France. The German Government has acknowledged it, and has annulled the German patent granted to Bullier.

Commercial carbide is essentially an American discovery, and it was developed industrially by Willson's associates before industrial action began abroad. Messrs. Dickerson and Suckert, of New York, were the first to undertake the industrial liquefaction of acetylene. Dr. G. de Chalmot, chemist, and Mr. J. M. Morehead, electrician, worked up the details of the furnace process in the early days at Spray, North Carolina, and the purity and the yield from a given weight of material of their carbide have never been excelled, though cheaper working furnaces are now in use.

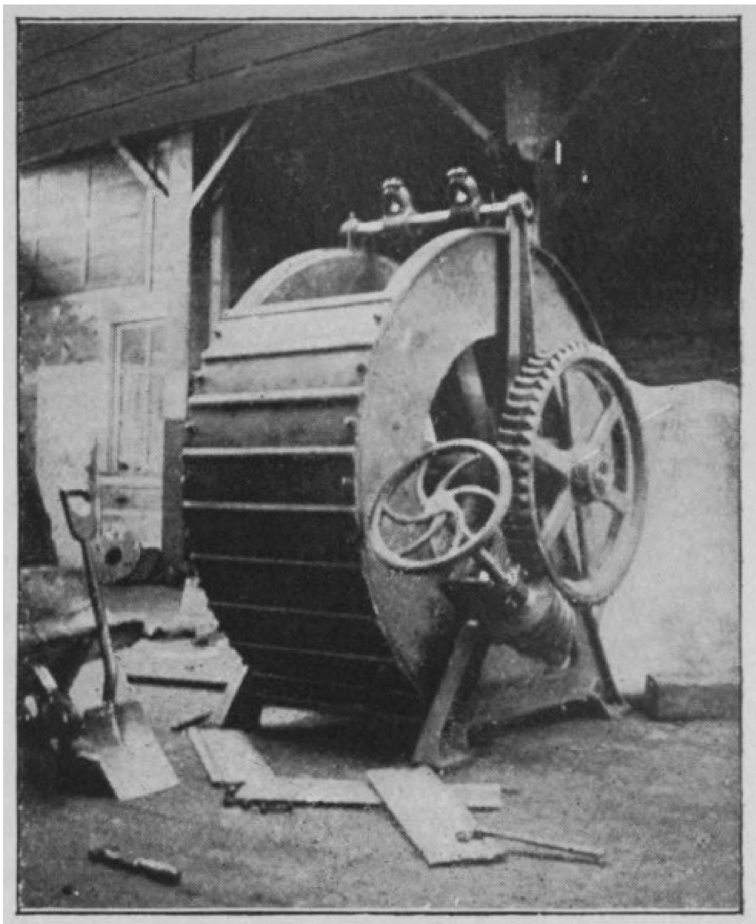
Carbides of other metals can be made in the electric furnace, but, owing to the cheapness of the new material, calcium carbide is the only one of these which has industrial value as a source of acetylene. One pound of pure carbide yields 5.89 cubic feet of acetylene.

Thus far carbide has been found industrially valuable for two other purposes. The one is for carbonizing steel; experiments in Germany show that iron or soft steel takes up carbon more readily when it is heated with carbide than when it is heated with coal dust or charcoal. Some steel works are now using carbide for this purpose. The other use of carbide is more important. It is found to be a valuable germicide. It is said to be the most effectual preventive of black rot, and to destroy the *Phylloxera*, the two worst enemies of the grape. The action of the carbide as a germicide depends on its decomposition by the moisture of the soil, forming acetylene, which kills the *Phylloxera*. If the use of carbide on a large scale substantiates the claims made for it, this is a discovery of vast importance. The ravages caused by the *Phylloxera* in the vineyards of southern Europe, of Africa, and Australia must be ranked as great national calamities.

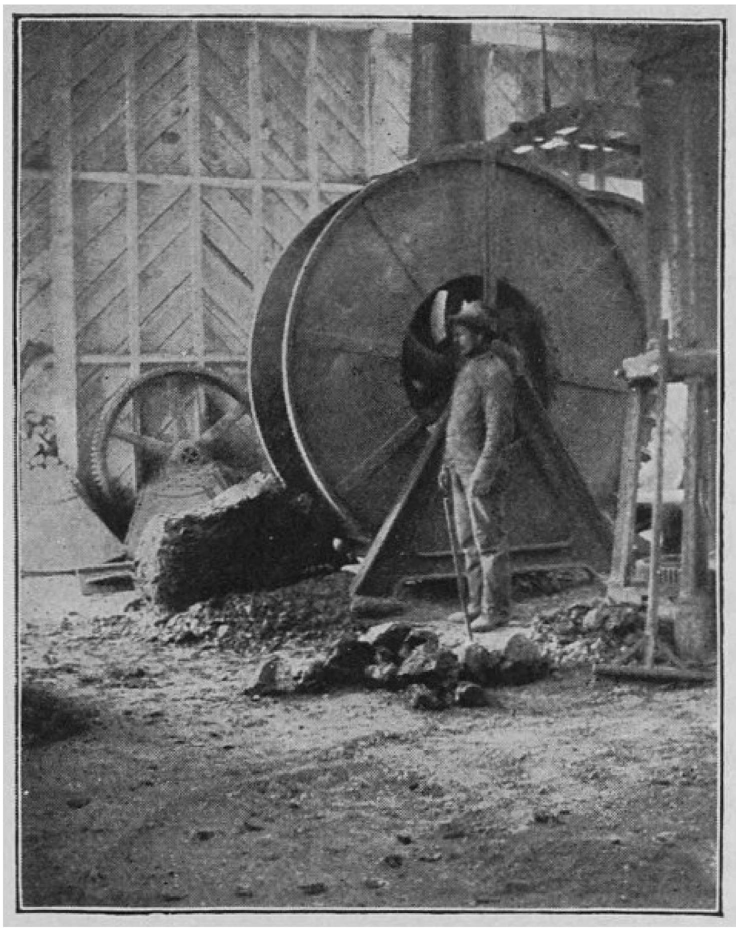
A temperature ranging from 2000° to 2500° C. (3600° to 4500° Fahrenheit) is required to make carbide. It is probable that this temperature can be economically attained only by the electric furnace using water power as the source of the electric current, and this is the only method used for making carbide, with the exception of the Walther process, which does not use electricity but [Pg 338] depends on the intense heat generated by burning acetylene under pressure. In electric furnaces the formation of carbide depends simply on the heat of the arc, which fuses the mixture of lime and coke. The latest improvements on the first very simple forms of furnace have secured continuity of work and economy of electric energy. In the United States carbide is made exclusively in the Horry furnace. This furnace consists of a huge short cylinder or hollow wheel, mounted to revolve slowly on a horizontal shaft. The periphery of the cylinder is closed by removable cast-iron slats. As the cylinder is partly revolved on its axis from time to time, the slats are taken off from one side and replaced on the other, thus leaving the top always open. The cylinder is filled on one side with the powdered mixture of coke and lime. Into the mixture two vertical carbon electrodes project downward through the open top of the cylinder. As the carbide is formed, the cylinder is revolved, lowering the mass from the electrodes. The fused carbide cools, hardens, and is broken off and removed as it rises on the other side of the slowly revolving cylinder; new material is constantly fed in to maintain the level around the electrodes. The process in the Horry furnace is continuous; the furnace can be run without arresting the current until repairs are necessary. It is said to combine the different theoretical improvements referred to, and to reduce the cost of production. The Horry furnace is in use at Niagara Falls and at Sault Ste. Marie. At St. Catherine's, Canada, Willson is using his own furnace. Abroad, the older types of furnace, the Willson, Bullier, and Héroult, are those chiefly in use.



Horry Furnace, showing Electrodes.[5]



Horry Furnace, showing Gearing.[5]



HORRY FURNACE, SHOWING CARBIDE JUST REMOVED.[5]

The actual ingot of good commercial carbide is nearly pure—ninety-six to ninety-nine per cent—but the ingot is surrounded by a crust of carbide mixed with unchanged material, containing forty to seventy per cent of carbide. Foreign makers break and blend ingot and crust to standard size, [Pg 339] the best makers guaranteeing their carbide ninety per cent pure, giving five cubic feet of acetylene per pound (pure carbide gives 5.89 cubic feet). Eight to nine pounds of carbide per horse power in twenty-four hours, averaging five cubic feet of acetylene, is considered satisfactory work. The Union Carbide Company, which controls the sale of carbide in the United States, is selling graded carbides under guarantee, the first grade being the nearly pure ingot, the lower grade the crust.

As the moisture of the air decomposes the carbide, it must be broken up as soon as made, and packed in air-tight tin cans, varying in size from one to four hundred pounds.

The present price of carbide abroad averages $96.80 in large lots, and $7.26 per hundredweight in small lots, packing included; in the United States, $70 per ton in large lots, and $4.50 per hundredweight in small lots, packing included. In 1898, 4,650 tons are said to have been made in the United States and Canada, and a much larger amount abroad. The output for 1899 is estimated at 12,000 tons for the United States, with a capacity in the new works in erection at Sault Ste. Marie and at Niagara Falls of 41,000 tons. The new works building in Europe, to be finished in 1899-1900, have a capacity for making 80,000 metric tons. These figures will justify [Pg 340] the statement made at the beginning of this article, that the new industry has found ample capital.

The statement is still current that acetylene attacks copper and brass, forming an explosive compound. This is not true. Exhaustive experiments by Moissan and by Gerdes, keeping these and other metals in contact with acetylene for months at a time, have shown that the metals were not affected. The conditions under which the explosive copper acetylide is made in laboratories can not well occur in generators or gas holders. It has been said that acetylene is very poisonous; the experiments of many observers, and especially those of Gréhant, do not confirm this statement. Gréhant experimented on dogs, causing them to breathe mixtures of acetylene, air, and oxygen, which always contained 20.8 per cent of oxygen, this being the percentage of oxygen in pure air. By this device he was able to discriminate between the poisoning caused by acetylene and suffocation caused by insufficient oxygen. A mixture containing twenty per cent acetylene inhaled for thirty-five minutes did not seem to trouble the animal. A sample of the dog's arterial blood contained ten per cent of acetylene. A dog which inhaled a mixture containing forty per cent of acetylene died suddenly after fifty-one minutes, having inhaled one hundred and twelve litres of the mixture; the arterial blood contained twenty per cent acetylene. Gréhant proved that acetylene simply dissolves in the blood plasma, while carbon monoxide forms a compound with the hæmoglobin of the blood. A dog breathing a similar mixture of air, oxygen, and illuminating gas containing only one per cent of carbon monoxide quickly showed convulsive movements, and died after ten minutes; its blood contained twenty-four per cent of carbon monoxide. Thus acetylene, while slightly poisonous, is less poisonous than coal gas, and vastly less than water gas, which contains a high percentage of carbon monoxide.

A pressure of thirty-nine atmospheres and three quarters at 20° C. converts acetylene into a liquid weighing one third as much as the same volume of water, while one cubic foot of the liquid when released from pressure gives five hundred cubic feet of gas.

Hitherto acetylene is used only as a source of heat or as a source of light; yet with very cheap carbide it would prove useful in many ways in chemical industry, and its use would have the most wide-spread effect on industry and agriculture. For instance, a method of making alcohol from acetylene is patented abroad, and by another patented process it is proposed to make sugar from acetylene. With the present prices of alcohol, sugar, and carbide, these processes have no commercial value.

Acetylene may be made from the carbide in gas works and delivered to the consumer through mains like ordinary illuminating gas; or it may be liquefied at a gas works and delivered to the consumer in the liquid form under pressure; or the consumer may purchase carbide and generate acetylene for his own consumption. All three of these methods are in use. [Pg 341]

To understand the attitude of insurance companies and of consumers toward liquid acetylene it will be well to examine its record for the last few years. Those interested in methods for liquefying acetylene, and for reducing the pressure of the liquid at the place of consumption so that the consumer actually uses it as a gas under a water pressure of six inches or less, may find processes described in detail in the Progressive Age, and in other technical journals. Suffice it to say that the methods in use in this country and abroad are simple and effective. The purified acetylene is delivered in strong steel cylinders, which may be placed in a special building or case and need not be handled by the consumer. It has been proved by the exhaustive experiments of the eminent French chemist Berthelot that liquefied acetylene in cylinders can not be exploded by blows or shocks to the closed cylinder. If it is exploded, however, by causing a spark within the cylinder, the explosive force is very great, being about equal to that of gun cotton.

The use of the liquefied acetylene is so simple and clean that the attention of inventors was first turned to this mode of supply. It may in future come again into prominence despite the present strong feeling against it, its use in many cities being prohibited. This feeling was caused by a number of explosions, accompanied by loss of life. Three of these explosions occurred in factories for liquefying acetylene; one in a factory where liquid acetylene regulators were made; several in buildings of consumers. In October, 1896, Pictet's works in Paris were wrecked by the explosion of a cylinder filled with liquid acetylene; evidence proved that the cylinder was held in a vise, and that the two workmen killed were at the ends of a wrench, closing or opening the valve, supposing the cylinder to be empty. The explosion was caused either by a spark from friction in turning the screw, or by the too sudden opening of the valve and releasing the pressure, causing a shock sufficient to decompose the liquid. In December, 1896, the works of G. Isaac, in Berlin, were destroyed by an explosion in the condenser where the cooled acetylene was liquefied by pressure; Isaac and three workmen were killed. Evidence showed that through carelessness warm water instead of cold water was in contact with the condenser, thus warming the liquid and increasing the pressure to a point which burst the condenser. In December, 1897, the works of the Dickerson & Suckert Acetylene Gas Liquefying and Distributing Company in Jersey City were destroyed by fire caused by the explosion of a cylinder filled through carelessness of workmen [Pg 342] with a mixture of air and liquid acetylene—i. e., with an explosive mixture—killing the superintendent and a workman. In the explosion at the regulator factory at New Haven, January, 1895, the valve of the cylinder, on which one of two workmen killed was working, broke; a large volume of acetylene escaped and ignited from a lighted candle. In all four cases the explosions were caused by ignorance or carelessness incident to the beginnings of a new industry, and could be avoided by experience and skill.

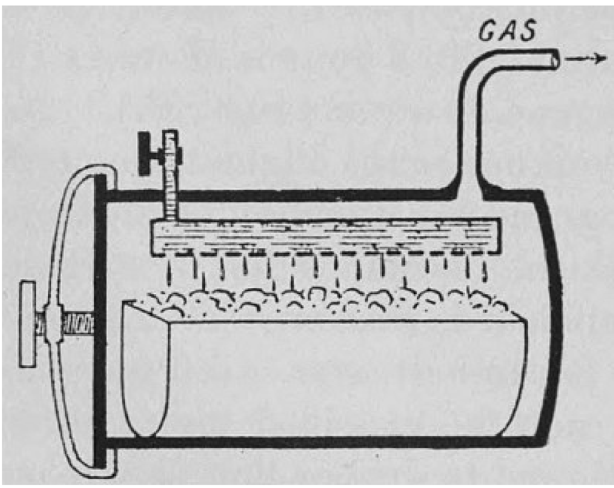
It should be stated that in the explosion at Paris all of the full acetylene cylinders were dug out of the ruins unhurt. The same was true at Berlin, where five full cylinders were blown against the wall of the building by the explosion of the condenser, but did not explode. At Jersey City sixty filled cylinders were exposed to the heat of the fire following the explosion; they were fitted with safety diaphragms of fusible metal; forty-eight remained intact, the acetylene burning off quietly as it escaped through the fused diaphragm, and twelve exploded, either on account of imperfection of the diaphragms or stoppage of the air passage leading from the diaphragm. The explosions of liquid acetylene in buildings of consumers have been due in every case to gross carelessness and ignorance on the part of the consumer.

Although one of the chief points in favor of the liquid acetylene is its portability, yet it can be shown that it is still easier to carry carbide to the consumer. One cubic metre of acetylene is compressed to two litres in liquid form; two litres of carbide weigh 4.44 kilogrammes, which will produce a cubic metre and a third of acetylene, reckoning three hundred litres to the kilogramme, which is the average guaranteed yield of carbide. The light tin carbide cans occupy less space and weigh less than the heavy steel cylinders, while the generation of the gas is simple and, with proper generators, perfectly safe. On the other hand, the generators must be cared for, must often be filled with fresh carbide, and from time to time must be cleaned. With the generator system acetylene is as safe as or safer than illuminating gas. Berthelot has shown that at pressures below two atmospheres a vessel filled with acetylene can not be exploded by the explosion of a cap of fulminating mercury within the vessel, nor by heating a wire which extends into the vessel to a white heat by an electric current. The reason is that the acetylene can not explode unless it is decomposed into its elements, carbon and hydrogen; to decompose it requires a certain amount of energy. While the energy of the glowing wire or of the exploding cap causes a local decomposition at the point of contact, it is not sufficient to spread the decomposition further. Acetylene forms an explosive mixture with air; so does illuminating gas. The odor of [Pg 343] acetylene is unpleasant; so is the odor of the water gas used generally in the United States, and the acetylene can be cheaply deodorized.

As the generator system, then, is the general one, the most important question to the consumer is what generator to buy, and it is a perplexing question. The carbide manufacture is so organized that it is everywhere under the control of powerful and responsible companies which sell a guaranteed product. The burners now in use are nearly all good. With generators it is different; the market is flooded with them at all prices, ranging in value from worse than useless to very good, as regards safety, economy, and quality of light. As the generator question is by far the most important and the least understood in the whole acetylene industry, it will be well to give a full account of the results of the experiments which have been made within the last two years on this question. The most exhaustive experiments are those of the English expert, Professor Lewes, and his results agree with those of other observers.

Lewes first determined the amount of heat developed by the decomposition of carbide by water, and the conditions which tend to lessen or increase the intensity of the reaction. The average result of the experiments as to the amount of heat was 446.6 calories for pure carbide, and a little less for commercial carbide (to state this differently, one pound of carbide, when decomposed by water, gives off heat enough to raise the temperature of 446.6 pounds of water 1° C., or to raise the temperature of one pound of water 446.6° C.). As the intensity of the heat developed determines the highest temperature attained during the decomposition, and is a function of the time needed to complete the action, and as the decomposition of carbide in contact with water is extremely rapid, it is evident that the temperature developed may be so high as to cause disaster. All the generators at present before the public may be classified under three heads: 1. Those in which water is allowed to drip or flow slowly on a mass of carbide, the evolution of the gas being regulated by the stopping of the water. 2. Those in which water in considerable volume is allowed to rise in contact with carbide, the evolution of the gas being regulated by the driving back of the water by the increase of pressure in the generating chamber. 3. Those in which the carbide is dropped or plunged into an excess of water.

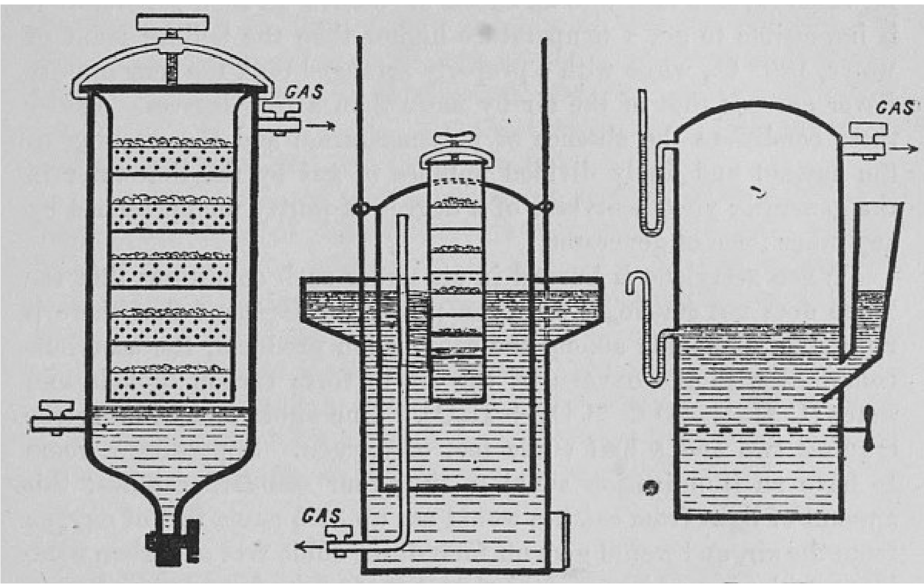
The conclusions deduced from a large number of experiments were that when, as in type 1, water is allowed to drip or flow in a fine stream upon a mass of carbide, the temperature rapidly rises until after eighteen to twenty-five minutes the maximum is reached, which varies from 400° to 700° C. (720° to 1120° Fahrenheit), and it is probable that in some of the mass the higher limit is always reached, as traces of tar are usually found in the residual lime, in some cases in sufficient [Pg 344] quantity to make the lime yellow and pasty, while vapors of benzene and other polymerization products pass off with the gas. Leaving the question of temperature in this type of generator, another important question is the length of time during which the generation of gas continues after the water supply is automatically cut off. It is found that gas is evolved with increasing slowness sometimes for an hour and three quarters after the water supply has ceased, the total volume of gas so evolved being large.



Type I.
Type of Generator.[6]

The experiments showed that in any automatic generator of this type the cut-off should be so arranged that one quarter of the total capacity of the gas holder is still available to store the slowly generating gas.

The second class of generators bring about contact either by water rising from below to the carbide suspended in the cage (II, *A*), or by a cage of carbide suspended in a movable bell which, as it falls, dips the carbide into water, withdrawing the carbide from the water as the excessive generation of gas lifts the bell (II, *B*). Lewes found that under certain conditions generators of the type II, *B* were far worse than those of type I.



Type II, *A*. **Type II, *B*.** **Type III.**

Types of Generators.[6]

The trials were made with a movable glass bell, with counterweights, containing a half-pound of carbide. The maximum temperatures reached in four trials were 703°, 734°, 754°, and 807° C. Excessive heating took place in every case; in the last mentioned the temperature was far above the point at which acetylene is decomposed into carbon and hydrogen, a thin black smoke being formed immediately around the carbide while tar vapor poured out. On removing the residue after cooling it was found to be coated with soot and loaded with tar. On several occasions the charge was removed from the generator just after the maximum temperature was reached, and was found to be at a bright red heat.

These experiments are of the greatest practical importance. At 600° acetylene begins to polymerize—i. e., to form more complex hydrocarbons, which are liquid, or solid, at ordinary temperatures. Probably in the generator acetylene is first given off so rapidly that the heat does not act on it, but as decomposition advances into the center of the mass of carbide, the acetylene [Pg 345] generated has to pass through the external layers, which, as shown, may be at high temperatures, above that at which acetylene decomposes; thus a considerable amount of gas is lost, and the tar formed may distill into the generator and tubes, clogging the tubes. A more serious evil is the deterioration in the illuminating quality of the gas. Samples of the gas were taken as the maximum temperature was approached, and analyzed with this average result: Acetylene, seventy per cent; other hydrocarbons, eleven per cent; hydrogen, nineteen per cent. This reduces the illuminating value from two hundred and forty to one hundred and twenty-six candles. The hydrocarbons consist largely of benzene, which requires three times as much air for complete combustion as acetylene does. The best possible acetylene burner smokes when the acetylene contains benzene.

At first sight these experiments would seem absolutely to condemn generators of class II, yet the fact remains that some excellent generators are of this type. Under certain conditions excessive overheating may be avoided. The rising bell shown in II, *B* should be discarded. Generators in which the water rises from below, and slowly attacks the carbide, can be made safe if the water is never driven back from the carbide, and the carbide is in separated layers as in II, *A*. Under these conditions the water is always in excess at the point where it attacks the carbide, so that the evaporation, by rendering heat latent, keeps the temperature down, the temperature of the [Pg 346] melting point of tin, 228° C., being rarely reached in good generators where these conditions are met.

Undoubtedly the best generators, and the only ones which from a scientific point of view should be employed, are those of class III, in which carbide falls into an excess of water. In such generators it is impossible to get a temperature higher than the boiling point of water, 100° C., while with a properly arranged tank the temperature never exceeds that of the air by more than a few degrees. Under these conditions the absence of polymerization and the washing of the nascent and finely divided bubbles of gas by the limewater in the generator yield acetylene of a degree of purity unapproached by any other form of generator.

When acetylene is burned in air under such conditions that the flame does not smoke, it has been proved by Gréhant that there is no carbon monoxide among the combustion products; the acetylene combines with the oxygen of the air to form carbon dioxide and water ($C_2H_2 + 5O = 2CO_2 + H_2O$). One cubic foot of acetylene requires two and a half cubic feet of oxygen. Supposing a room to have an illumination equal to sixty-four standard candles; this amount of light from candles would use up 38.5 cubic feet of oxygen from the air, and would give off forty-three cubic feet of carbon dioxide; petroleum requires, in cubic feet, twenty-five of oxygen, and gives off forty of carbon dioxide; gas burned with a flat flame requires about twenty-five oxygen and gives nineteen carbon dioxide—with an Argand flame a little less, while with the Welsbach burner gas requires only three oxygen, and gives off 1.8 carbon dioxide; acetylene requires five oxygen and yields four carbon dioxide. So that, light for light, acetylene fouls the air less than any ordinary illuminant excepting the Welsbach gas burner. (With incandescent electric light there is no combustion and no fouling of the air.)

Under the best conditions five cubic feet of acetylene give a light of two hundred and forty candles for one hour, or we may speak of acetylene as a two-hundred-and-forty-candle gas. Yet this statement, though strictly true, may be misleading. When ordinary illuminating gas is tested with the photometer, it is burned from a standard flat-flame burner, burning five cubic feet per hour. Now the amount of light given by such a gas flame is no greater than is pleasant to the eye; it is true that if we burn five cubic feet of acetylene from a suitable flat-flame burner, a light of two hundred and forty candles is given, but it is unfair to take this ratio as representing the actual relative illuminating value of the two lights, because we neither need a light of two hundred and forty candles, nor is such an amount of light issuing from one burner endurable to the eye. One-foot or one-half foot acetylene burners are used for domestic lighting; light from the [Pg 347]
best one-foot burners averages thirty-two to thirty-five candles per cubic foot. With acetylene, as with every other illuminating gas, the smaller the burner and consumption, the less light per cubic foot of gas is obtained. Another important point is that while these figures represent the best practical illumination obtained from acetylene by the burners hitherto in use, the standard flat-flame burner does not give the best gaslight; with a good Welsbach burner a cubic foot of illuminating gas will give a seventeen-candle light as an average. The comparison, to be fair, should be between acetylene and the Welsbach light.

The reader will ask whether it is not possible to burn acetylene with other forms of burner, or to use it with Welsbach mantles. Successful acetylene burners of the Argand or of the regenerative type have not yet been introduced; but in Germany a new acetylene burner with Welsbach mantle promises good results. Experiments in England with an acetylene Bunsen burner and Welsbach mantle gave a light of ninety candles per cubic foot of acetylene used. It remains to be seen whether it is necessary to modify the composition of the mantles because of the intense heat of the acetylene Bunsen flame, which gives a temperature of 2100° to 2400° C. (3812° to 4397° Fahrenheit).

It would extend this article to undue length to speak of the various uses of acetylene as an enricher of other gases, but a mixture of acetylene and Pintsch oil gas now in use on all the Prussian state railways deserves mention, as it is a success, and ten thousand tons of carbide will be used this year for lighting cars by this system. Lewes's new invention of a very cheap methane water gas which is enriched by acetylene, carried to the consumer through mains, and burned in ordinary burners, is also promising.

Insurance and police regulations vary for every country. As a rule, restrictions are put on the use of liquid acetylene, and on the amount of carbide to be kept in storage. Generators must stand in separate buildings, which, in towns, must be fireproof.

The Willson patents cover the manufacture of crystalline carbide in the United States, Canada, and the South American states; and, as all carbide made by the electric furnace is crystalline, no carbide can be made independently of these patents in these countries.

In conclusion, it may be predicted that within the next few years acetylene will prove a factor in giving us an improved and cheaper light. Whether this will be an acetylene-Welsbach light or whether the acetylene will be chiefly used as an enricher of cheaper gases the future will show.

THOUGHTS ABOUT UNIVERSITIES. [Pg 348]

By WILLIAM KEITH BROOKS,

PROFESSOR OF ZOÖLOGY IN THE JOHNS HOPKINS UNIVERSITY.

You are aware that the pedagogue is no longer treated with that deference and respect which he feels to be due to his love of learning. Past is all his fame. Past is the day when the village all declared how much he knew. Nowadays he is accustomed to be told by the rustics, who once gazed and wondered, that he is old-fashioned and out of place in our modern world; that he does not represent the nation; that the love he bears to learning is at fault; and that the university the people want must be universal like an omnibus, with a place for all, either for a single square or to the end.

He is also used to hearing from those successful people of whom all must speak with reverence—those who have demonstrated their superiority by laying their hands on everything they think worth the getting—that he is a mere "bookish theorist," and that they are much more able to show him the path to success than he to tell them anything to their advantage.

Unless he can minister to their comfort or entertainment, or make smooth the royal road to learning, or at the very least help to maintain the patent office, he is told to be content with such treatment as they think good enough for him, and to keep himself to his work of teaching the lower classes to be lowly and reverent to all their betters.

I have been much interested of late by two books on certain aspects of modern society. One treats of the dangers which threaten liberal culture and constitutional government, and all the best products of civilization, through the increasing prevalence of the belief that our institutions have been *devised* by a few for their own selfish ends. So long as men differ in natural endowments the ignorant and the incapable and the unsuccessful must outnumber those whose industry and energy and foresight insure success. As those who have little have always outnumbered those who have much of the desired fruits of civilization, this writer says that one of the great questions of the day is whether, in last resort, the world shall be governed by its ignorance or by its intelligence. He is alarmed by the diffusion of belief that our established institutions do not represent the people, and that they are hostile to the best interest of mankind, and by the prevalence of the opinion that the true way to reform the world and to secure rational progress is to intrust the organization and administration of government and of education and of all matters of public interest and importance to the majority. [Pg 349]

The danger so clearly pointed out is real, beyond question; but I can not agree with the author that it is exclusively or distinctively modern. If some in our day interpret the belief that the voice of the people is the voice of God, as conviction that the loudest voice is most divine; if they assert that the man with pure and lofty ideals of education and duty and loyalty is a public enemy; we must remember that so wise a man as Aristotle taught, in the day of Athenian democracy, that the man who is virtuous in undue measure is a moral monster, as justly repugnant to his neighbors as one pre-eminent in vice.

If the first book calls Aristotle to mind, one must often think of Jeremiah while reading the second, for its author is a dismal prophet, who holds that, formidable as unbridled democracy seems, it is helpless in the struggle with organized plutocracy, and that its efforts to shake off the restraints and limitations of social existence can end in nothing but a more crushing despotism, while submission may bring such rewards of merit for good behavior in the past and such prizes for good conduct in the future as seem to the givers to be good investments.

Both writers draw many of their illustrations from the history of our own country, and they hold that our great political contests are struggles between those who wish to maintain our institutions for the sake of what they can themselves make out of them, and those who seek to wreck the ship of state for very similar reasons.

Some hold that, these things being true, they can show the learned professor how he may win back, through the struggle between these two great classes of mankind, some of that confidence in his wisdom which his predecessors enjoyed. They tell him he may make his learning represent the people if he will extend his university until it becomes as universal as the kindergarten, and that he may at the same time increase his popularity with the select if he will devote more of his time and more of his energy to that branch of learning which was in olden times pursued in that secluded cloister called the campus, although it is better known to the polite society of our day through the banjo club, the football team, and the mask and wig club.

If he will cultivate these two fields, and, refraining from the theoretical pursuit of empty generalities, will enter upon a three months' campaign of education at some time when men's minds are stimulated by the heat of faction to welcome calm discussion of the principles of common honesty and good citizenship, he can not fail to win the respect and confidence of all.

When I wrote this last sentence I thought that it was all out of my own head, and I was proud of it; but as I laid down my pen in my satisfaction for a moment's rest, my eye fell upon this passage in the prospectus of a new university—one which is said, in the prospectus, to be not only universal, but cosmopolitan: "When a question arises which divides scholars, like the tariff, the causes and course of the Reformation, money, etc., the student will be referred to the ablest exponents of the opposing sides." [Pg 350]

No professor can plead ignorance of the way to enter this new career of usefulness. One can scarcely pick up a college catalogue or a magazine or a newspaper without learning how to make the university universal. One of the simplest plans, with which all are familiar, is to send to men with a reputation for learning a ruled form and a request that each will write, in the proper columns, the price, publisher, and title of the best book on his own subject—mathematics, astronomy, moral science, or whatever it may be—or, if he knows of no such book, that he will write one. An accompanying circular tells how these lists are to be scattered through the innumerable homes of our land, and how diplomas are to be distributed as prizes to those who, after purchasing the books, prepare and submit the most exhaustive permutations of their tables of contents.

Learned men who do not approve this plan are offered a choice from many others: six-week courses in law, medicine, and theology; summer schools for the promotion of science and the liberal arts; questions and answers in the educational column of some journal for the home; or a national university so universal that it shall supply lunches and learning for all out of the public chest, with no doorkeeper to examine passports.

The way to extend the university in this direction is so well understood that I will turn now to another part of our subject, for some may be less familiar with our opportunity to construct a royal road to learning for those who are entitled to use it.

A recent writer on education, who says American universities impose "upon young men in the nineteenth century a curriculum devised by dead-and-gone priests for the young men of the twelfth," calls upon the teachers of America to reconstruct their curriculum on psychological principles. I myself am no psychologist, and while I fail to see how this fact concerns the public, it has recently been pointed out in print, although no one has ever charged me with lack of reverence for the psychologist. In truth, he is to me what the good old family doctor is to many, for I am convinced that it would be hard to name one among all the educational ills that flesh is heir to that he would not be able to throw on the spot, with a good collar-and-elbow hold. I have a prodigious respect for those fine big words *curriculum* and *psychological principles*, and I welcome the plan for reconstructing the curriculum on psychological principles the more eagerly because it is extremely simple and not hard to understand, like some psychological utterances. In fact, it is so very simple and easy that it is sure of enthusiastic indorsement by innumerable children, for this reformer's plan is neither more nor less than the abolition of the pedagogue. [Pg 351]

"If," he says, "I was director general of education for all America" (which at the present moment he is not), "I would abolish colleges, but send American youths to travel for two years in Europe. In my opinion," he says, "a father who has sons and daughters of a proper age to go to college will do better by his children if he sends them for two years to travel in Europe than if he sends them for three years to an American or English university."

Admirable and simple as is this plan for ascending Parnassus in vestibuled trains of drawing-room cars, personally conducted by Grant Allen, this psychologist seems to me to err in thinking it new, for it was in high favor in England during the reign of that merry monarch who was always so furious at the sight of books that his queen, who loved reading, had to practice it in secret in her closet.

Euphranor having asked, in the reign of George II, "Who are these learned men that of late years have demolished the whole fabric which lawgivers, philosophers, and divines have been erecting for so many ages? Lysicles, hearing these words, smiled and said he believed Euphranor had figured to himself philosophers in square caps and long gowns; but, thanks to these happy times, the reign of pedantry was over. Our philosophers, said he, are of a different kind from those awkward students. They are the best-bred men of the age, men of the world, men of pleasure, men of fashion, and fine gentlemen. I will undertake a lad of fourteen bred in the modern way shall make a better figure and be more considered in any drawing-room or assembly of polite people than one at four-and-twenty who hath lain by a long time at school and college. He will say better things in a better manner, and be more liked by good judges. I say, when a man observes and considers all this, he will be apt to ascribe it to the force of truth and the merits of our cause, which, had it been supported by the revenues and establishments of the Church and universities, you may guess what a figure it would make by the figure it makes without them. People begin to open their eyes. It is not impossible but the revenues that in ignorant times were applied to a wrong use may hereafter, in a more enlightened age, be applied to a better."

"The money that went to found the Leland Stanford or the Johns Hopkins University," says the modern reformer, "would have been immeasurably better spent in bringing St. Marks at Venice and the Uffizi at Florence into the lives of innumerable young Americans. Here, then, is the opportunity for a wiser Cornell." [Pg 352]

A few years ago an acquaintance of my own, himself an accomplished psychologist, brought with him to Washington a young man, a native of north Greenland, that he might take into his life the best substitute for St. Marks at Venice that this country affords. While limited in range, the results were as definite as one could wish, for two of the most refined delights of our wonderful civilization—rum and horses—were at once taken into the life of Eskimo Joe with all the fresh enthusiasm of youth. In his boyish impetuosity he could not see why a hired horse should not have the fleetness of Santa Claus's reindeer and the endurance of wild dogs; and as few horses survived the first lesson, the psychologist soon reconstructed the curriculum, for Joe's progress in rum and oysters was most gratifying. You who have attended my lectures in anthropology will remember that Nature has bestowed on the Eskimos two endowments which are not elsewhere found united, although they are exhibited separately in high perfection by the anaconda and the camel. Joe was able to load himself with food and drink like a pirate ship victualed for a long cruise, and he became so proficient in three months that a two-year course seemed unnecessary, so he was shipped off to Labrador at the first opportunity, and was left there to carry St. Marks at Venice into the homes of Greenland as best he might. It is clear that our psychological reformer's plan is not new, but he says our curriculum is some thousand years behind the times, and he asks, "Will somebody one day have the wisdom to perceive that the education which sufficed for the mediæval England of the Plantagenets is not absolutely adapted to the America of the nineteenth century?" I myself know so little of the curriculum of that day that this charge may, for all I know, be well founded, and if so it were a grievous fault. For all I know the dead-and-gone priests of the twelfth century may have read Homer in the original Greek, and carried on their studies in trigonometry and navigation with the aid of logarithms and the nautical almanac, although it has come in my way to know something of their method of teaching zoölogy, for my studies have led me to examine a text-book on this subject, which was written early in the twelfth century for the education of the young Queen Adelaide, who was married to Henry I of England in 1121. The dedication is as follows:

"Philippi de Thann into the French language has translated the Bestiary, a book of science, for the honor of a jewel, who is a very handsome woman, Aliz is she named, a queen is she crowned, Queen she is of England, may her soul never have trouble! In Hebrew in truth Aliz means praise of God. I will compose a book, may God be with the commencement!" [Pg 353]

As a sample of the zoölogical curriculum of the twelfth century take this chapter:

"Onager by right is named the wild ass; of it the Physiologus says, in his speech, when March in his course has completed twenty-five days, then that day of the month he brays twelve times, and also in the night for this reason, that that season is the equinox, that is that night and day are of equal length; by the twelve times that it makes its braying and its crying, it shows that night and day have twelve hours in their circuit. The ass is grieved when he makes his cry, that the night and day have equal length; he likes better the length of the night than of the day. Now hear without doubt the signification of this. Onager signifies the devil in this life; and by March we understand all the time that we have; by the day we understand good people, by right, who will go in light; and by night we understand those who were Neros; and by hours we understand the number of people. And when the devil perceives that his people decrease, as do the hours which are in the night, after the vernal equinox which we have in March, then he begins to cry, to deplore greatly, as the ass does which brays and crys."

One need not go back to the middle ages for a measure of progress, for all who remember the American college of thirty years ago know there has been notable improvement in this short time, and they also know that every change has not been an improvement. All who are concerned with education see many defects, and wish to do what they can to remedy them, and to increase the efficiency and usefulness of our whole educational system in all its branches from the lowest to the highest, although I believe they still find much wisdom in the advice of the prophet of old, "that we make a stand upon the ancient way, and then look about us and discover what is the straight and right way, and so walk in it."

Many who are now before the public as reformers seem to me to fall into error through belief that our educational system has been *devised* by some one, either in the twelfth century or at some other time, and that they may therefore hope to devise a better. All who know that it is a highly complex and delicate organism which has grown up imperceptibly and naturally in accordance with many needs, fulfilling many different purposes and acting in many diversified and far-reaching ways, know also that while reform always has been and always will be needed, organic change is quite another matter. They know, too, that a disposition to pull it to pieces in [Pg 354] the interest of some theory or speculation must inevitably end in disaster, for they must agree with Bacon that "it were good, therefore, that men in their innovations would follow the example of time itself, which indeed innovateth greatly, but quietly, and by degrees scarce to be perceived."

The complaint that learning is no longer treated with due deference is not exclusively modern, for it was enumerated long ago among the things that are not new under the sun; and he who for his own pleasure or distinction devotes himself to work in fields that yield nothing but the interest of the exploration should look to his own pleasure for his reward, since learning is no more exalted by turning it into an aristocratic and exclusive pleasure ground than by making it a shop for profit. While no weak and foolish brother of the laboratory should be permitted to think that he belongs to a favored class or has any claims to support or respect except for service rendered, it is the duty of our graduates to teach the world, by the example of their lives, what the work of the university is.

Lyceum lectures and summer schools and systematic courses of reading are good things, and the common school and the home are the foundation of all education. Travel is a most valuable adjunct, but those who are to profit by it must first know what they go out to see, "for else shall young men go hooded and look abroad little."

No school or college can improve its work by calling itself a university, although the prevalence of belief that its work is the work of a university may bring harm incalculable; for that university is universal, in the best sense of the word, where students are inspired with enthusiasm for truth by the example of those whose minds are "as a mirror or glass capable of the image of the universal world, and joyful to receive the impression thereof as the eye joyeth to receive light."

What nobler task can our graduate undertake than to teach the world that while the benefits which learning confers are its only claim to consideration, these benefits will cease so soon as they are made an end or aim? All men prize the fruit; but who else is there to tell them that the tree will soon be barren if they visit it only at the harvest, that they must dig about it and nourish it and cherish the flowers and green leaves? What better service can he render than to point out that the gifts of learning are like health, which comes to him who does not seek it, but flies farther and farther from him who would lure it back by physic or indulgence?

The two authors I referred to at the beginning can not both be right, and both may be partly wrong, for it is possible that neither plutocracy nor a democratic majority makes a state. No university need humble itself to seek the favor of either plutocracy or democracy if its graduates [Pg 355] can convince mankind, by their own lives, that its aim is not to gain deference or success or distinction or reward of any sort, but solely to propagate and diffuse among mankind "that enthusiasm for truth, that fanaticism of veracity, which is a greater possession than much learning, a nobler gift than the power of increasing knowledge."

IN THE LITTLE BROOK.

By DAVID STARR JORDAN.

Long ago, in the old Devonian times, when life was very leisurely, all the beasts and people that there were lived in the sea together. The air was dull and murky on the land. It was so light that it gave no support to the body, and so those that ventured about in it had to lie prone on the ground all the time wherever they went. So they preferred to stay in the water, where motion is much easier. Then, too, water is so much better to breathe than air, if one has gills fitted for it! He has only to open his mouth and the water rushes in. Then he has only to shut his mouth and the water rushes out backward, bathing his gills on the way. Thus, the air dissolved in the water purifies all the little drops of blood that run up and back through the slender tubes of which the gills are made.

But in those days, besides the gills, some of the beasts of the sea had also a sac in the throat above the stomach in which they could stow away air which they took from the atmosphere itself. This served them in good stead when they were in crowded places, in which the air dissolved in the water would fail them.

And those which were so provided used to venture farther and farther out of the water, pushing their way heavily on the ground. And those which could put forth most effort survived, until at last their descendants were able to maintain themselves on the land altogether. These gave rise to the races of reptiles and birds and mammals, the ancestors of all the land beasts that you know, as well as men and women and all the monkey people. But it was very long ago when this happened, and because these ancestors came finally out of the water they have no part in the story I am trying to tell to-day.

Those that remained in the water grew more and more contented with their condition. Because the medium in which they lived was as heavy as their bodies, they swam without much effort, and [Pg 356] effort not being needed, it was not put forth. As there was food enough in the water, they did not need to go on land. As they did not go on land, they did not use their lungs for breathing, the air sac gradually shrank away, or was used for some other purpose, and all the parts of the body became adjusted for life in water, as those of their cousins who left the sea became fitted for the life in air. Being now fishes for good, all the progress since then has made them with each succeeding century more and more decidedly fishy.

And because they are fishes they are contented to live in little brooks, which would not satisfy you and me at all. But our ancestors in the early days were more ambitious, and by struggle and effort won what seems to us a larger heritage.

So it happened one spring when the ice melted out from some little brook that flows down from somebody's hills somewhere toward some river that sets toward the Mississippi, the little fishes began to run.

And first of all came the lampreys, but they hardly count as fishes, for they have yet to learn the first principles of fishiness. A fish is a creature whose arms and legs are developed as fins, having cartilaginous rays spreading out fanlike to form an oar for swimming. But the lamprey has no trace of arm or leg, not even a bone or cartilage hidden under the skin. And its ancestors never had any limbs at all, for the earliest lamprey embryo shows no traces of them. If the ancestors ever had limbs, the descendants would never quite forget it. Some little trace would be kept by the clinging force of heredity, and at some time or another this rudiment would appear. And the lower jaw they lack too, for that is really another pair of limbs joined together in front—as it were, a pair of short hands clasped together and never unlocked.

But though the lampreys have no limbs and no jaws and are not fishes anyhow, they do not know the difference, and come up the brook in the spring, rushing up the rapids, swirling about in the eddies, just as if they were real fishes and owned the brook themselves. They are long, slender, and slippery, shaped like eels, without any scales and with only a little fin, and that along the back and tail, an outgrowth from the vertebral column. The vertebral column itself is limp and soft, the vertebræ only imperfectly formed and made of soft cartilage. In front the lamprey seems to be cut off short, but if we look carefully we see that the body ends in a round disk of a mouth, and that this disk is beset by rows of sharp teeth. A row of the sharpest of these is placed on the tongue, and two of these are above the gullet, for the tongue to scrape against them. And the rest are all blunt and are scattered over the surface of the mouth, which has no lips nor jaws, but is [Pg 357] surrounded by a belt of fringes. When the lamprey is hungry he puts his mouth against the side of some fish, exhausts the water between, and then the pressure of the outside water holds him there tightly. When this is done, the fish swims away and the lamprey rides with it, giving no thought to where he is going, but all the while scraping away the flesh with his rasplike teeth. When he has filed off enough fish flesh to satisfy his hunger he lets go, and goes off about his business. The fish, who does not know what hurt him, goes off to get well if he can. Usually he can not, for the water of the brook is full of the germs of little toadstool-like plants, and these fasten themselves on the fish's wounds and make them bigger and bigger, until at last the cavity of the abdomen is pierced and little creatures of many kinds, plant and animal, go in there and plunder all this fish's internal organs, to carry them away for their own purposes.

But when the lampreys come up the April brook it is not to feed on fishes, nor is it to feed at all. Nature is insistent that the race should be kept up, and every animal is compelled to attend to the needs of the species, even though it be at the sacrifice of all else. If she were not so, the earth and the seas would be depopulated, and this is a contingency toward which Nature has never looked.

The lampreys come up the stream to spawn, and while on this errand they fasten their round mouths to stones or clods of earth, that the current may not sweep them away. When so fastened they look like some strange dark plant clinging to the bottom of the brook. When the spawning season is over some of them still remain there, forgotten by Nature, who is now busied with other things, and they wear their lives away still clinging—a strange, weird piece of brook-bottom scenery which touched the fancy of Thoreau.

When the young are hatched they are transparent as jelly, blind and toothless, with a mouth that seems only a slit down the front end of the body. These little creatures slip down the brook unobserved, and hide themselves in the grass and lily pads till their teeth are grown and they go about rasping the bodies of their betters, grieving the fishes who do not know how to protect themselves.

The lamprey is not a fish at all, only a wicked imitation of one which can deceive nobody. But there are fishes which are unquestionably fish—fish from gills to tail, from head to fin, and of these the little sunfish may stand first. He comes up the brook in the spring, fresh as "coin just from the mint," finny arms and legs wide spread, his gills moving, his mouth opening and shutting rhythmically, his tail wide spread, and ready for any sudden motion for which his erratic little brain may give the order. The scales of the sunfish shine with all sorts of scarlet, blue, [Pg 358] green, purple, and golden colors. There is a black spot on his head which looks like an ear, and sometimes grows out in a long black flap, which makes the imitation still closer. There are many species of the sunfish, and there may be a half dozen of them in the same brook, but that makes no difference; for our purposes they are all as one. They lie poised in the water, with all fins spread, strutting like turkey-cocks, snapping at worms and little crustaceans and insects whose only business in the brook is that the fishes may eat them. When the time comes, the sunfish makes its nest in the fine gravel, building it with some care—for a fish. When the female has laid her eggs the male stands guard till the eggs are hatched. His sharp teeth and snappish ways, and the bigness of his appearance when the fins are all displayed, keep the little fishes away. Sometimes, in his zeal, he snaps at a hook baited with a worm. He then makes a fierce fight, and the boy who holds the rod is sure that he has a real fish this time. But when the sunfish is out of the water, strung on a willow rod, and dried in the sun, the boy sees that a very little fish can make a good deal of a fuss.

When the sunfish goes, then the catfish will follow—"a reckless, bullying set of rangers, with ever a lance at rest." The catfish belongs to an ancient type not yet fully made into a fish, and hence those whose paired fins are all properly fastened to the head, as his are not, hold him in well-merited scorn. He has no scales and no bright colors. His fins are small, and his head and mouth are large. Around his mouth are eight long "smellers," fleshy feelers, that he pushes out as he crawls along the bottom in search of anything that he may eat. As he may eat anything, he always finds it. His appetite is as impartial as that of a goat. Anything from a dead lamprey or a bunch of sunfish eggs to a piece of tomato can is grateful to him. In each of the fins which represent his arms is a long, sharp bone with a slimy surface and a serrated edge. These are fastened by a ball-and-socket joint, and whenever the fish is alarmed the bone is whirled over and set in place; then it sticks out stiffly on each side. There is another such bone in the fin on the back, and when all of these are set there is no fish that can swallow him. When he takes the hook, which he surely will do if there is any hook to be taken, he will swallow it greedily. As he is drawn out of the water he sets his three spines, and laughs to himself as the boy pricks his fingers trying to get the hook from his stomach. This the boy is sure to do, and because the boy of the Mississippi Valley is always fishing for catfish is the reason why his fingers are always sore. The catfish is careless of the present, and sure of the future. After he is strung on a birch branch and dried in the sun and [Pg 359] sprinkled with dust and has had his stomach dug out to recover the hook, if he falls into the brook he will swim away. He holds no malice, and is ready to bite again at the first thing in sight.

The catfish uses his lungs as an organ of hearing. The needless lung becomes a closed sac filled with air, and commonly known as the swim bladder. In the catfish (as in the suckers, chubs, and most brook fishes) the air bladder is large, and is connected by a slender tube, the remains of the trachea, to the œsophagus. At its front it fits closely to the vertebral column. The anterior vertebræ are much enlarged, twisted together, and through them passes a chain of bones which connect with the hidden cavity of the air. The air bladder therefore assists the ear of the catfish as the tympanum and its bones assist the ear of the higher animals. An ear of this sort can carry little range of variety in sound. It probably gives only the impression of jars or disturbances in the water.

The catfish lays her eggs on the bottom of the brook, without much care as to their location. She is not, however, indifferent to their fate, for when the little fishes are hatched she swims with them into shallow waters, brooding over them and watching them much as a hen does with her chickens. In shallow ponds the young catfishes make a black cloud along the shores, and the other fishes let them alone, for their spines are sharp as needles.

Up the brooks in the spring come the suckers, large and small—coarse, harmless, stupid fishes, who have only two instincts, the one to press to the head of the stream to lay their eggs, the other to nose over the bottom of the stream wherever they go, sucking into their puckered, toothless mouths every organic thing, from water moss to carrion, which they may happen to find. They have no other habits to speak of, and when they have laid their eggs in a sandy ripple they care no more for them, but let go of life's activity and drop down the current to the river whence they came. There are black suckers and white suckers, yellow ones, brown ones, and mottled, and there is more than one kind in every little brook, but one and all they are harmless dolts, the prey of all larger fishes, and so full of bones that even the small boy spits them out after he has cooked them.

Then come the minnows, of all forms and sizes, the female dull colored and practical, laying her eggs automatically when she finds quiet water, and thinking no more of them afterward. The male, feeble of muscle, but resplendent in color, with head and fins painted scarlet or purple, or silver white, or inky black, as may be most pleasing to his spouse. His mouth is small and without teeth, for he feeds on creatures smaller than fishes, and his head in the spring is covered with coarse warts, nuptial ornaments, which fall off as soon as the eggs are properly disposed of. In [Pg 360] the little brook which comes to my mind as I write two kinds of minnows come up the stream together before the others realize that it is verily spring. The one is small, dainty, translucent, and active, swimming free in the water near the surface and able to take care of itself when pursued by a sunfish or bass. Along the side of its body are two black stripes not quite parallel, and between and below them the silvery scales are flushed with fiery scarlet. The fins are all yellow, with scarlet at base, and as the male passes and repasses before the female all these colors, which she has not, grow brighter than ever.

The next is a larger fish, clumsy in form, hugging the bottom as he swims. The whole body of the male is covered with coarse white warts, and across each fin is a bar of black, white, and orange. This minnow feeds on mud, or rather on the little plants which grow in mud, and his intestines are lengthened out proportionally. In fact, they are so long that, to find room for them, they are wound spool-fashion about the air bladder in a way which happens to no other animal.

Of the other minnows, the one attracts his female by a big, jet-black head; another by the painted fins, which shine like white satin; another by his deep-blue sheen, which is washed all over with crimson. In fact, every conceivable arrangement of bright colors can be found, if we go the country over, as the adornment of some minnow when he mates in the spring. The only exception is green, for to the fishes, as to the birds, green is not a color. It only serves to cover one, while the purpose of real color is to be seen.

And there are fishes whose colors are so placed that they are hidden from above or below, but seen of their own kind which looks on them from the side.

The brightest fishes in the world, the "Johnny darters," are in our little brook. But if you look at them from above you will hardly see them, for they are dull olive on the back, with dark spots and dashes like the weeds under which they lie. The male is only a little fellow, not so long as your finger and slim for his size. He lies flat on the bottom, half hidden by a stone, around which his tail is twisted. He will stay there for hours, unseen by other fishes, except by his own kinsmen. But if you reach down to touch him with your finger he is no longer there. The tail straightens out, there is a flash of blue and scarlet, and a foot or two away he is resting quietly as before. On the bottom is his place, and he seems always at peace, but when he moves his actions are instantaneous and as swift as possible to a creature who lives in the water. On the bottom, among the stones, the female casts her spawn. Neither she nor the male pays any further attention to it, but in the breeding season the male is painted in colors as beautiful as those of the wood [Pg 361] warblers. When you go to the brook in the spring you will find him there, and if you catch him and turn him over on his side you will see the colors that he shows to his mate, and which her choice through ages has tended to develop in him. But do not hurt him. He can only breathe for a moment out of water. Put him back in the brook and let him paint its bottom the colors of a rainbow, a sunset, or a garden of roses. All that can be done with blue, crimson, and green pigments in fish ornamentation you will find in some brook in which the darters live. It is in the limestone brooks that flow into the Tennessee and Cumberland where they are found at their brightest, but the Ozark region comes in for a close second.

There will be sticklebacks in your brook, but the other fishes do not like them, for they are tough and dry of flesh, and their sharp spines make them hard to swallow and harder still to digest. They hide beneath the overhanging tufts of grass, and dart out swiftly at whatever passes by. They tear the fins of the minnows, rob the nests of the sunfish, drag out the eggs of the suckers, and are busy from morn to night at whatever mischief is possible in the brook.

The male dresses in jet-black when the breeding season is on, sometimes with a further ornament of copper-red or of scarlet. The sticklebacks build nests in which to hide their eggs, and over these the male stands guard, defending them with courage which would be dauntless in any animal more than two inches long. Very often he has to repel the attacks of the female herself, who, being relieved of all responsibility for her offspring, is prone to turn cannibal. Even the little dwellers of the brook have their own troubles and adversities and perversities.

Last of all comes the blob, or miller's thumb, who hides in darkness and picks up all that there is left. He is scaleless and slippery, large of head, plump of body, and with no end of appetite. He lurks under stones when the water is cold. He is gray and greenish, like the bottom in color. He robs the buried nests of eggs, swallows the young fishes, devours the dead ones, and checks the undue increase of all, not forgetting his own kind. When he has done his work and the fall has come and gone, and the winter and the spring return, the brook once more fills with fishes, and there are the same kinds, with the same actions, the same ways, and the same numbers, and one might think from year to year, as the sun is said to do, that these were the selfsame waters and the selfsame fishes mating over and over again and feeding on the selfsame food.

But this is not so. The old stage remains, or seems to remain, but every year come new actors, [Pg 362] and the lines which they repeat were "written for them centuries before they were born." But each generation which passes changes their lives just a little, just as the brook and the meadow itself is changing.

WHITE WHALES IN CONFINEMENT.

By FRED MATHER.

The dolphin family (*Delphinidæ*) contains nine genera, with only one species in each, but the most interesting one is the white whale (*Delphinapterus leucas* of Pallas, or *D. catodon* [Linn.] of Gill), because it is the only one that can be kept in confinement and its habits observed under semi-domestication. It has fallen to my lot to care for several of these animals in confinement, and to have a chance to note their peculiarities.

"The Great New York Aquarium," at Broadway and Thirty-fourth Street, New York city, was built by Messrs. Coup and Reiche, and opened in 1876. Mr. Butler was the superintendent. I supervised fish culture, and when not otherwise engaged made collections of fishes and invertebrates in Bermuda and in other parts. In 1877 I had charge of their branch aquarium at Coney Island. At both places we had many white whales at different times, for the management would keep whales penned up on the St. Lawrence River to replace those which died, and would never show more than two at a time, claiming that they were rare animals and only to be had at "enormous" expense. The aquarium was a private concern; admission fifty cents; and as the owners were W. C. Coup, a former circus proprietor and once the business manager of Barnum's Circus, and Henry Reiche, an animal dealer, who would sell you giraffes, elephants, or white mice, the attractions were duly exaggerated by the press agent, no matter what the facts might be. This is why we kept a reserve stock of white whales. It would never do to have the public know that they were common during the summer in the St. Lawrence, and when one was getting weak another would be sent down, and the public supposed that the same pair was on exhibition all the time.

This species is common in the North Atlantic, North Pacific, and Arctic Oceans. According to the late Prof. G. Brown Goode, "stragglers have been seen in the Frith of Forth, latitude 56°, while on the American coast several have been taken within the past decade [1880] on the north shore of Cape Cod. They are slightly abundant in New England waters, but in the St. Lawrence River and on the coast of Labrador are plentiful, and the object of a profitable fishery. They abound in the Bering and Okhotsk Seas, and ascend the Yukon River, Alaska, to a distance of seven hundred miles. The names in use are beluga and whitefish among whalers, porpoise, dauphin blanc, marsouin or marsoon in Canada, and keela luak with the Greenland Eskimos" (Fisheries Industries). [Pg 363]

The white whale grows to be sixteen feet long; we never had one over ten feet in length, but they were billed, showman fashion, to be much longer. An adult will yield from eighty to one hundred gallons of good whale oil, besides several gallons of more valuable oil from the head which is used on clocks and watches under the trade name of "porpoise-jaw oil," which is sent in a crude state to manufacturers on Cape Cod, who refine it and free it from all tendency to gum. The skins make a leather that is waterproof and stands more hard service than any other known leather. Large quantities of it are sent to England and made into "porpoise-hide boots" for sportsmen, and in Canada the hides are converted into mail bags. The flesh is eaten to some extent by the fishermen, fresh, salted, and smoked.

Zach. Coup said: "I have eaten the fresh steaks several times, and found the meat a fair substitute for beef when the choice was between fish and bacon as a continuous diet, down on the islands where these three things were the only possible variation in the line of animal food, and a very limited choice in the vegetable line, comprising dried beans and rice, for when I was with them there was a scarcity of potatoes for seed, and canned goods had not attained their present popularity, even if these poor fishermen had been able to buy them."

The fat, oily blubber is an overcoat, a nonconductor of heat, and is between the muscle and the skin, as is largely the case with the hog, and, like the latter animal, there is savory muscle which may be cut into succulent steaks below it.

At first the white whales were not in my care, but, being strange animals, were watched with curiosity. The whale tank was as nearly circular as a twenty-sided tank could be whose glass plates were four feet wide with iron standards between, making a pool of about thirty feet in diameter. The pool was of cement and tapered down to an outlet about three feet below the floor, for drainage, and on the floor the cement basin arose two and a half feet, while the panes of one-inch glass were six feet high, with the water line two feet below the top of the glass. This gave the spectators a view of the animals below water, and of their backs as they came up to blow. The white whale and the harbor porpoise (*Phocæna brachycion*), known as the herring-hog, etc., do not make as much of a "spout" as the larger whales do; they roll up and exhale either less strongly or with less water over the blow-hole than their larger relatives. They merely send a mist into the air which can not be seen at a distance of a thousand yards, while the "blowing" of the larger whales may be seen for miles. Half a century ago we boys were taught by the text-books that the whale—there was only one mentioned—drew in water through its mouth, strained out the jellyfishes and other life, and then ejected the water, after the manner of a fire engine, through the top of its head. That this nostril, equipped with the best water-tight valve ever [Pg 364] invented, enabled an air-breathing mammal to exhale and inhale, without getting much water into its lungs, we never suspected. If we thought about it at all we looked at the whale as a fish, having gills somewhere, and let it go at that. As our laws speak of "whale fisheries" and "seal fisheries" in connection with these great aquatic mammals, it would be just as correct to speak of all animals which frequent the water as "fishes," and legislate on the "muskrat fisheries," "mink fisheries," etc.; there is really no difference.

I have seen newspaper reports that about thirty years ago a white whale, brought there by a Mr. Cutting, lived in captivity in Boston for two years. Beyond the fact that one was brought there by a Mr. Cutting, and was on exhibition about that time, is all that I have been able to learn, and it is doubtful if it lived one year (see Fisheries Industries, section 1, page 19). One was exhibited at Barnum's old museum, at Broadway and Ann Street, New York, that is said to have lived nine months and was then burned up when that building burned, in March, 1868. As these animals only come into the St. Lawrence, where all live ones have been captured, in May and June, there is no reason to doubt that it did live in confinement for nine months, but none that have been exhibited since that time have survived more than half as long, and I have had personal knowledge of every one since Barnum's.

Coup's Broadway Aquarium opened on October 11, 1876—too late to get a white whale that year. But early next spring Mr. Coup sent his brother to the St. Lawrence River for specimens. This brother, "Zach.," had never seen a whale, but he had full instructions concerning their care from Professor Butler, who had charge of the one at Barnum's Museum. There was an air of mystery about the expedition, and in May "Zach." brought a solitary specimen and at once went for more. The town was billed, the daily press was worked in true circus fashion, the crowd came and expressed various opinions. Standing by the tank, I heard strange comments:

"Do you call that little thing a whale?" This to an attendant.

"Yes, sir, it's a white whale from the northern coast of Labrador, the only one ever captured or ever seen by the oldest whaleman. It was reported to have been seen near the entrance to Hudson Bay, and Mr. Coup fitted out an expedition and captured it at an expense of over one hundred thousand dollars." He had evidently been reading what the press agent had stuffed into the newspapers. [Pg 365]

The visitor took another look and remarked: "The papers said it was twenty feet long; I should think it might be six feet, but no more."

"Well," answered the attendant, "water is mitey deceivin', an' that whale is more'n three times as long as it looks. The fact is, the papers did report it to be longer than it is, for when we drew off the water to clean the tank yesterday we put a steel tape over the whale and it measured just nineteen feet eleven inches and a half."

Then a rural couple came, and she remarked: "Oh, I'm so glad we came here, and can tell the folks that we've seen a real live whale!"

"Lucy," said he, "this city is full of all kinds of cheats, an' I don't believe that thing is alive more'n Methuselah is; it's some indy-rubber contraption with clockwork in it that makes it go round and puff in that way."

After the season for hatching trout and salmon was over, in April, I was detailed to build a branch aquarium at Coney Island, with instructions to construct a whale tank the first thing, in order to be ready for the next arrivals. I employed a maker of beer vats, and he brought three-inch planks for the bottom, staves eight feet high, and iron for hoops. The tank was to be twenty-five feet in diameter, with a "chime" nine inches below the bottom, making the tank seven feet deep inside. It was to set with its top eighteen inches above the soil, which was to be the water line, giving the whales five feet and a half of water—little enough when we realize that a ten-foot animal has a diameter of nearly three feet. Heavy timbers were laid under the bottom of the tank, carefully leveled, for no weight can be borne by the staves in a tank of that size.

All this was planned, as well as the engine and pumps, and was well under way, when I received an order from Mr. Coup to go to Quebec and bring down two whales while Zach. went for more. Then I learned the secrets of the live white whale trade. The first whale had been kept back until it could be delivered at night, and its transportation was a mystery intended to arouse the curiosity of the public.

At the railroad station at Quebec two boxes were turned over to me. They were about fifteen feet long, four feet wide, and four feet deep. They were upholstered with "bladder wrack," a most soft [Pg 366] cushion, and in each box a white whale lay on these pneumatic cushions. A plug in the bottom of each box had let the water out while the boxes were being lifted by the rope handles on the sides, but when on the cars the plugs were replaced and water to the depth of a foot was poured in; this served to keep the under parts moist, while frequent sponging or the use of a dipper served to keep the skin from drying. The nostril, or "blow-hole," needed the most attention, for it has a valve which must not be allowed to get even partially dry, and a saturated sponge was kept suspended over this all the time during the journey by rail to New York.

The white whale is a very timid animal, and comes up the St. Lawrence in May and June, when the young are brought forth; it is believed that they then go to the river to avoid their enemies, among which is the "killer" or orca whale. Their food, according to Professor Goode, is "bottom fish, like flounders and halibut, cod, haddock, salmon, squids, and prawns." From my knowledge of this whale in confinement I am surprised at the above list, for those under my observation not only preferred live eels, but could not swallow one whose diameter was over one inch, and it was difficult to get quantities of eels as small as three quarters of an inch in diameter, especially when an adult whale would consume about twenty pounds in a day. When larger eels were placed in the tank they would be taken out dead in a day or two with their sides scratched and torn by the small teeth of the whale which had failed to swallow it. We tried other food, for eels are quite expensive in New York city, costing fifteen and eighteen cents per pound, but the whales refused small flatfish, flounders, etc., and the only other food they ate was small tomcods. They refused dead herrings and all fish that were cut in pieces.

The animals are captured at the small French fishing village of Rivière l'Ouelle, on Isle aux Coudres, seventy miles below Quebec, where life is as primitive as it was two hundred years ago in this, one of the oldest of Canadian settlements. Luke Tilden, one of our aquarium men, who went up with Zach. Coup, told of the capture of the whales, and the following is from notes taken by me as Luke told it: The men all fish and the women do a little gardening, but their harvest is the marsouin, a name common to the white whale and to the black porpoise. A fair white whale will weight eight hundred pounds and yield nearly one hundred gallons of oil worth fifty cents per gallon, so that when they trap twenty in a season it means prosperity to the colony; in 1874 they took one hundred, but the catch has fallen off since. "When we reached the island," said Luke, "we went straight to Father Alixe Pelletier and donated ten dollars to the Church for prayers for our success, and it was well invested. The good old man is the head of that colony and keeps [Pg 367] everything straight. In 1863 there was an epidemic of indifference to the Church, and the men went to the bad, got drunk, fought, fished on Sundays, and reviled the priest, withholding all dues to him. Then he said, 'God is angry with you, and to punish you will send no more marsouin until you repent.' They laughed at him, and for three years no marsouin came to them, and they were very poor. They went to the father on a Christmas day and implored him to intercede for them, and he did. The next spring there was a great catch of marsouin, and the men have remained faithful since.

"The tides here rise and fall some twenty feet, and the whales are trapped in an inclosure made of poles, the entrance to which is closed when a school enters. The pound is about a mile square, and is made of slim poles put two feet apart, space enough to let a whale through, but they will not attempt it. The tide falls and leaves them on the mud, quaking with fear. When we want live ones the boxes are made, padded with seaweed, shoved out over the mud, tipped on one side, and the whale rolled into it, where its struggles soon put it on an even keel, and then it gives up and does nothing but breathe as the boxes are taken on board a schooner for Quebec."

I was fortunate in getting the above story from Luke Tilden, for a few weeks afterward he died in the aquarium; and Zach. Coup would tell nothing that could be relied on, not even to the locality where the whales were caught.

The white whale is the only one of its tribe that can be captured in the manner related, because of its cowardly timidity. The harbor porpoise, or "herring-hog," would jump nets and break barricades or die. It would not bear the confinement of an aquarium, for it would leap out of the tanks or dash its brains out in trying to do so; but, once placed in a tank of either salt or fresh water, the white whale starts to circle it, always to the left, with the sun, and contentedly blows at intervals of from five to fifteen minutes, and seems as contented as a canary bird in its cage.

The whale does not always swim in circles to the left when free, and why it does so in confinement is a question. I merely assert the fact. Perhaps wiser men know why perfectly still water in a washbowl will rotate to the left with an accelerated motion when the plug is withdrawn, but I do not. As the motion to the left is invariable there must be a rule for it, but, granting that this motion has some relation to the motion of the earth, the question of how this affects the voluntary movements of an animal remains to be answered. I have watched over a dozen white whales in captivity, dumped into tanks from the most convenient side without regard to the direction of their heads, and every one turned and circled to the left. The question arises, [Pg 368] Why do they do this? At the new aquarium now at Battery Park, New York city, the big sturgeon always circles to the left except when feeding.

The two whales at Coney Island were good-sized ones, nearly ten feet long, and they raced around, side by side, and played for nearly two hours before they began to take the eels which had been in the tank several days, although the large mammals had been without food for at least seven days. On the way down I had noticed a difference in the sound of their breathing, that of the female being sharp and clear, while her mate seemed to have a hoarseness, and occasionally gave something like a cough. I called attention to this and told Mr. Coup that the animal had some lung trouble. He consulted a man who professed to know about these animals, and then reported his opinion that the cough was nothing to fear, "merely a little water in the blow-hole."

"This may be true," I replied; "I'm not a medical man, but I've heard many consumptives cough, and that whale imitates them. I doubt if it lives a month."

It lived just twenty-six days after its arrival at Coney Island. The last five days of its life it took no food, and its labored breathing was annoying to all who knew the cause of it. Then came a touching display of affection. The female slackened her pace day by day to accommodate it to that of her constantly weakening companion, and as the end neared she put her broad transverse tail under his and propelled him along. He stopped breathing at 10 A. M., but his mate kept up her efforts, occasionally making a swift run around the tank, as if to say, "Come, follow me," and then slowing up at his side, resumed the work of sculling him along, as before. Rude men expressed pity for the living one, and after my men had rigged a derrick and hoisted her mate from the pool she would rise higher out of water when she came up to blow, remembering that he had gone out over the top of the tank. An autopsy by local physicians, whose names have been forgotten, assisted by a medical student then in my employ, now Dr. J. R. Latham, 126 West Eleventh Street, New York city, disclosed the fact that the whale died of pneumonia.

A white whale which reached the Broadway aquarium about July 1st, after mine came, lived seven months, dying January 28, 1878. My whale was either diseased when captured or took a cold at Isle aux Coudres. The New York one was sound all summer, and I told Mr. Coup that it might live for years, but the artificial heat of the aquarium in winter was not what a subarctic animal could endure, and it succumbed as most of Peary's Eskimos did in New York last winter. The autopsy on this whale was performed by Dr. F. D. Weisse, professor of practical and surgical anatomy of the medical department of the University of the City of New York, assisted by Prof. J. W. I. Arnold, of the same university, and Dr. Liautard, superintendent of the Veterinary College. They agreed that pneumonia was the cause of death, induced by a change of temperature of the water in which the animal had been kept. The official measurements of this female specimen, whose organs were kept in the two institutions named, were: nine feet six inches from snout to tail tips; three feet between tips of caudal fins, with a body breadth of twenty inches and a head breadth of thirteen inches. The lungs, weighing twenty-two pounds, presented on dissection the appearance of having been affected with chronic catarrhal pneumonia. The liver weighed nineteen pounds. The four stomachs were all free from any trace of previous disease. [Pg 369]

In looking up the life history of the white whale when opportunity offered, during the last twenty years I have consulted many old whalemen, and they all say that whales of all kinds take their babies on their flukes and scull them along as my female sculled her dying and dead partner. This must be a fact, for the little one could never swim with its parent. But another question arises: Is this purely a female instinct to provide for its young, which was, in the case of my pair, developed into a desire to preserve a companion? or, in other words, would a male have done this, or would a female have done it if she were free and had other companions? Was it love for her mate, or a feeling of selfishness at her lonely position? My female was afterward sent to England in the old transportation box, and was nine days without food, for they will not swallow food in transit, and it lived four days in London, clearing more than enough to pay for the animal and all expenses.

When the free aquarium at Battery Park, New York city, was opened, December 10, 1896, there was talk of getting white whales the next spring, but there was no way to employ men to go for them at a stated salary, as they would have to pass a civil-service examination and become regularly appointed employees of the city. In this emergency Mr. Eugene G. Blackford came forward and advanced the money for the expedition, and it started early in May. On June 4th Professor Butler delivered a pair of them to the superintendent, Dr. Bean. I was aware of their coming, and was at the aquarium, and so was Dr. Latham. The male was lead-colored, was said to be a year and a half old, and was nine feet long. The female was of the usual cream-color, ten feet and a half long, and was said to be a year older than her mate. It is known that young and immature specimens are darker than adults, but I am skeptical about the ages, especially as there is a half year credited to each at the exact time the young are brought forth, and do not know on what the ages are based further than that the young are darker in color for a time. [Pg 370]

"How does the breathing of the big one sound to you?" the doctor asked.

"Like ours at Coney Island that died from lung trouble," I replied, "and I would not have brought that animal down unless it was the only one to be had during the season."

"I think I'll give her about ten days to live," replied the doctor.

As these were not my whales, I declined to talk of their prospects of life to several reporters who knew me, and the whale in question died of pneumonia on June 11th, just a week after its arrival in New York, and several days before the trained ear of Dr. Latham had allotted its span of life.

The male came to its death by an accident at 9 P. M. on June 24th, just twenty days after arrival. An eel got into its blow-hole and it drowned. According to an account published in the New York Sun of Monday, July 26, 1897, said to be obtained from Dr. Tarleton H. Bean, director of the aquarium, the whale "was as healthy a one as ever spouted until late on Friday afternoon, the 24th, when one of the keepers noticed that something was wrong. His attention was attracted by the loud wheezing that accompanied each blow that the whale made when he came up for air. The wheezing could be heard all over the aquarium. Dr. Bean was sent for. He was certain that the whale's lungs were all right. He cited a fact, known to the custodian and to all the keepers, that the mammal for the past month had remained under water a little longer after he came to the surface to blow. This convinced Dr. Bean that the whale's lungs were sound and that some other cause of illness must be found."

Then the whale coughed out a piece of an eel that it had bit in two, and as it came up to blow again there was another piece hanging from the blow-hole which could not shut, and so let water into the lungs. Dr. Bean ordered the water drawn off the tank in order to get at the animal, but a former superintendent, who had planned the tanks, had put in such small drainage pipes that by the time the water was drawn down so that the men could get at the whale it was dead.

I do not believe that a white whale lived two years in Boston, because this subarctic animal could not endure the extremes of Boston's temperatures without contracting lung disease in some form. Think of such an animal living through climatic conditions that an Eskimo can not stand,

and in a public institution where thousands of people are vitiating the air!

Animals which live wholly in water are more susceptible to changes of temperature than those which live on land. The white whale can be kept the year round in New York city if it can have a refrigerating plant to give it the temperature which it needs, and proper food. [Pg 371]

We bring polar bears to New York which suffer in summer, if not in our comparatively mild winters, and tropical animals which barely survive, but these land mammals are not so susceptible to climatic influences as are the fishes and the purely aquatic mammals, like the whales. These can never be kept long by the crude means which have been employed. From the purest air they have been changed to the more or less vitiated air where thousands of human beings are crowded and in a temperature which is unnatural. If we would keep them we must give them better chances for living than in open tanks in the summer temperature of New York.

UNUSUAL FORMS IN PLANTS.

By BYRON D. HALSTED.

The unexpected is apt to occur. Along with the regularity in living things, which we call "uniformity of Nature," there is so strong a tendency to vary that one almost expects to find a turn in the avenues of life sooner or later, and that gradual or sudden, as the case may be. We will not stop to discuss the open question of whether we are possessed by an inherent quality of variation, or as creatures of circumstances, subject to the controlling forces of our environment.

Yesterday while looking at a row of seedling peaches, all from the same lot of pits, one of the miniature trees was found to be bronze or copper colored throughout. This set me to thinking. Here was a "sport," as it is termed, and if I take good care of the abnormity, bud it into common stock, etc., the landscape architects and ornamental gardeners may thank me for the novelty that will please their wealthy patrons.

Leaving aside the abnormal as met with in the animal world, for much of it is more painful than otherwise to contemplate, let us glance at some of the unusual things occurring among plants.

One first thinks of some strange forms in leaf, and if the eyes are opened to them they may be met with upon every hand. The "four-leaf" clover is lucky perhaps only because the finder is sharper-eyed than others, and stands a brighter chance of seeing success as it crouches almost invisible in the wild grass, the tilled field, or wherever the eyes may be set to find it.

The child who brings me the oddities of vegetable forms is knowing in the normals of his class of curiosities, or else he would not see the novelties from the finding and exhibiting of which he gains so much pleasure. The person who is familiar with the striking beauty of the cardinal flower (*Lobelia cardinalis*) is the one who rejoices at the variations that may occur in the tints of the bright corolla. His delight would reach a high pitch should the conspicuous spikes be found upon dry ground, and not by the bank of some stream half hidden by the overhanging grass. But should the wandering plant display white flowers, then an albino of a most interesting kind has been met with, and some reason for it is sought in the unusual locality. Only a few days ago a white variation of the *Lobelia syphilitica*, cousin to the cardinal, was seen by the writer treasured in the Botanical Garden at Cambridge, Mass., and it called to mind the rage for pink water lilies, that twenty years ago were only met with wild in ponds at Plymouth, Mass. I asked an expert recently if there was any call for the pink or "Plymouth" lilies, and he informed me that the fad had died out with the transplanting and widespread culture of the pink "sports" of the nymphæa ponds. [Pg 372]

Abnormal colors in flowers are among the most common freaks in wild plants, and none are more frequent than the albinos. One could fill a page with instances of this sort. Some of our most common weeds, as the moth mullein (*Verbascum blattaria*), have a large percentage of the plants with white blossoms, and the patches of the white interspersed with the normal yellow-flowered plants in poorly kept meadows and neglected land has led the writer to gather seed of each to test the truth of the opinion that the white strain may be transmitted to the offspring, but the proof is not yet at hand.

The writer knows where there is a patch of the hound's tongue (*Echinospermum*) with a good sprinkling of plants producing white corollas instead of the normal deep maroon. The two colors make a good subject for students who are gaining an elementary knowledge of the stability of species, and the range of striking variations that must be allowed for them.

Next to the albinos the instances where the floral parts approach leaves in size and color are the most common. A few weeks ago while passing through a field once devoted to corn, but now overgrown with weeds, and therefore of special interest to a botanist, my eyes fell upon a daisy plant all the heads of which were with olive-green ray flowers instead of the ordinary pure white ones. These rays were smaller than the normal and quite inclined to roll, as shown in Fig. 1, and form quills, as seen in some of the fancy chrysanthemums. By the way, our common field daisy is a genuine chrysanthemum, and that which is produced in one species under the guiding, fostering hand of the skilled gardener was here shadowed forth in the field of waste land. [Pg 373]

Fig. 1.—Green and Normal Oxeye Daisy Heads.

A week or so later, while going through a similar field in an adjoining county to the one where the daisy freak was found, I came upon nearly the same thing as seen in the heads of the "black-eyed Susan," or cone flower (*Rudbeckia hirta* L.). Here were the two leading weedy daisies, the white and the yellow, the former coming to our fields from the East and across the sea, while the latter, as a native of our Western prairies, journeys to make a home here and help to compensate by its pestiferous presence for the vile weeds that have gone West with the advance of civilization. Both of these daisies revealed that tendency in them to vary in their floral structures that if made use of by the floriculturist might result in forms and colors as attractive and profitable as met with in their cousins the chrysanthemums of the Orient.

Perhaps the season which we have had, with its excess of moisture and superheat, has made the abnormal forms more abundant than usual. The even current of life has been met by counter streams, so to say, and the channels were broken down. In walking through a meadow in early June it was a common thing to find the spikes of the narrow-leaved plantain (*Plantago lanceolata* L.) branched and compounded into curious shapes. Some of the normal and malformed spikes are shown in Fig. 2.

Fig. 2.—Malformed Heads of Plantago Lanceolata.

As a tailpiece to this portion of the subject it is a pleasure to introduce a freak among the native orchards, as shown in Fig. 3. A word of explanation is needed of the normal form of the lady's slipper here shown. As found in the moist woods, the plant above ground consists of two leaves and a single pink and strange-looking blossom terminating the stalk. This is the rule, and it has been strictly adhered to, so far as the writer knows, for centuries with a single exception, and that exception is the one here presented. It is as remarkable as a double-headed dog, and as difficult of explanation as the twin thumb.

Fig. 3.—A Twin-Flowered Cypripedium Acaule (Ait.).

Perhaps the best way is to make no attempt to account for the freak, and leave the subject open for those who have a gift of insight into the secrets of the abnormal and the unexpected. Other species of cypripediums regularly bear more than one flower; this one may have done so in former ages, and here is the link that binds our pretty unifloral species to its remote and possibly extinct ancestor. On the other hand, a double-flowered form is possibly in embryo, and before the next century closes the *Cypripedium acaule* Ait. may need to have its description changed so as to embrace two flowers.

The influence of moisture, heat, and light is very great upon vegetation, and one only needs to observe the same species of plant as grown in a moist, shady place, as compared with the ones that are located in the full sun where the soil is dry. Size and shape of parts, and even their color and the surface, are different, and this all leads us up to the cultivated plants where variation is the rule and constancy the exception. [Pg 375]

Among wild plants where similar surroundings obtain for all members of the species the albino is noted, and any replacement of stamens by petals, as in the wild buttercup, is the rare exception. But the cultivated plants have led a charmed life, and we scarcely wonder that the plants in the bed of sweet peas or gladiolus, canna or dahlia, are as diverse in form and color as the pieces in a crazy-bedquilt. Man, with all his ingenuity and skill, has been at work molding the plant clay made plastic by generations of special culture.

In one sense the greenhouse, the garden, orchard, and even the cultivated field are all dealing with monstrosities. The well-filled horticultural hall at a State or county fair is a vast collection of unnatural curiosities—that is, they do not occur in Nature, but are truly the creations of the mind of man as worked out along lines of vegetable physiology and stimulated plant production. For dinner this very day the writer ate a slice of a modern watermelon. What a triumph of horticultural art was exhibited in that giant fruit, each seed of which was filled with the accumulated tendencies of a generation of high breeding! There was represented the influence of soil and selection, of crossing and of culture, until the wild melon, which none of us sees or cares to see, is gone and a special creation takes its place, with its great demands upon any one who would attempt to grow it to perfection.

The art of breeding might possibly have deprived it of seeds had there been some other convenient method for propagation, as is true of many of our tree fruits, the navel orange being a striking example. Along with the absence of seeds and the presence of fine flavor there is truly a monstrous form, in that one orange is within and at the "navel" end of the other. [Pg 376]

Should we glance at some of our garden vegetables, as, for example, the cabbages in their various races, every one will be struck with the strangeness, to say the least, of the forms produced. In contrast with the head of the true cabbage, where leaf is folded upon leaf until a mass of metamorphosed foliage as large as a half bushel is produced, there is the cauliflower, with the edible substance stored in a fleshy inflorescence that has lost its normal function and become truly monstrous. Were it not so tender and delicate a food we might be disposed to smile at the absurdity of the whole thing, or at the kohl-rabi, with its turniplike bulb in the stem just above the surface of the ground. It is certainly a plastic species that will give such diverse and fantastic forms—so far from the wild state, and for that reason so useful to man.

In the same manner a comparison of our orchard fruits with the forms from which they came would lead to the thought that man has made them to his liking, and not for service to the plant species. They are abnormal, judged by all standards in Nature; monstrous in size and in many cases have lost their essential structure as seed-producing organs.

Coming to the ornamental grounds, the disguises are largely swept away, and there is but little hope of judging what the original plants may have been from which have descended the favorites of the flower bed and the conservatory. Species have been split into a thousand and one varieties, each with its peculiarities and each with the potency for greater deviation. Where shall we cast the line and land an example? The rose show of June is only surpassed by the chrysanthemum exhibition in autumn. There must be the new sorts brought out each year, whether the fancy be for a special shade or color or a striking new shape of bud or form of bloom. Would you realize what a novelty means to those in the craft who watch a group of carnation growers as they hang over the exhibit of a "new" rival, and consider all the merits and defects of the candidate for a certificate?

All the beauties of the flower garden are so familiar to us that it is not expected that they will be considered unnatural. If the hydrangea makes a panicle larger than it can bear, man helps it out with a string or stake, for by overdoing it is not undone any more than is the coddled peach tree held up at fruiting time by a dozen poles, or the forced lily with a weak back supported upright by an artificial green stem at church on Easter morning.

But even here there are monstrosities in the true sense. The asparagus or sweet potato stem occasionally broadens out into a ribbon, and it passes as an abnormity. The same thing takes place in the flower cluster of cockscomb (*Celosia cristata*), and if it failed to produce a strange fan-shaped and highly colored and crested top the owner would complain that her seed had given her only an inferior pigweed, and therefore not come true to name. The attractiveness of the cockscomb resides in the strange habit the plant has of broadening the upper end of the flower stalk out into a form that is truly monstrous. And this brings me to speak of a form that attracted my attention during the present season, samples of which are shown in Fig. 4. [Pg 377]

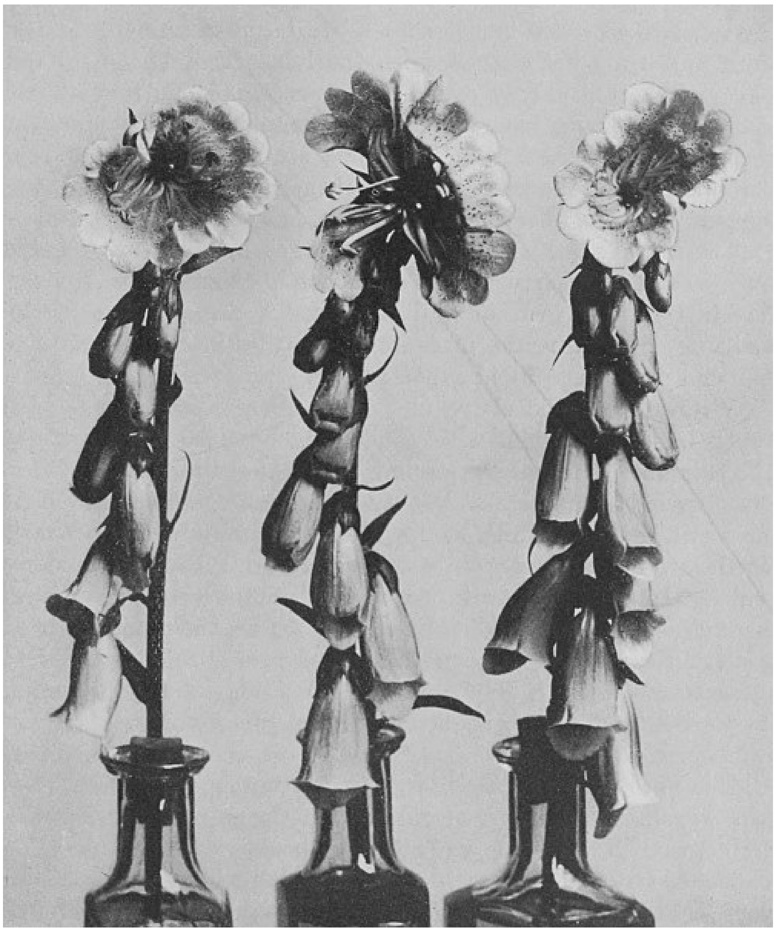


Fig. 4.—Monstrous Blossoms of Foxglove.

The striking feature of the specimens of foxglove (*Digitalis purpurea*) under consideration is the production of an enormous somewhat bell-shaped flower at the extremity of the long racemose inflorescence, and at a time when only a few of the lowermost blossoms upon the stem have opened. The normal digitalis flower has a large pendant purple corolla much spotted upon the middle lobe of the larger and lower lip. On the other hand, the truly monstrous flowers, two to three inches across, are borne terminally and are quite uniformly bell-shaped, with the lobes from twelve to fourteen and spotted evenly over all the surface. The four stamens of the normal flower have increased to twelve in three examined and to thirteen in another. These stamens are [Pg 378] normal in size and situated upon the corolla tube, except that there is no indication of their being in long and short pairs.

The single pistil is many times enlarged in the monstrous blossom—in one instance two thirds of an inch in diameter for the ovary. Within the outer ovarian wall there was a circle of five petaloid pistils, some showing the placentæ and ovules intermixed with the pink and purplish petaloid expansions.

Within the circle above mentioned there was a second pistil, tipped like the original with petal-like lobes instead of a stigma. The column was found so closely built up that the parts would not separate, and a cross-section was made through it, which showed that the pistil had a greenish central stalk around which the ovarian cavities were scattered quite irregularly, all bearing numerous ovules. In the flowers with twelve stamens there were four tips to the stigma, and the eight cavities were to be distinguished in the ovary, although they were not arranged in any regular order and not uniform in size. In short, the transections of these resembled the seed cavities seen in a slice of a large tomato of the "trophy" or "ponderosa" type.

The florists' catalogues advertise in a few instances this "*Digitalis monstrosa*," and it is presumed that the specimens from which the engraving was made were from a packet of this "strain" of seed. As but a small percentage of the plants in the bed examined were monstrous, letters were addressed to some German growers of the seed, with questions as to this commercial monstrosity. One reply contained the statement that the form known as "monstrosa" had been in the market about ten years, and that about fifty per cent of the plants produce the strange terminal flowers. Another correspondent recalls the form in question as having been catalogued for more than forty years, and that it is described in a work upon gardening published in 1859, in which it states that the seed of this variety must only be gathered from the capsules of the monstrous flowers in order to preserve the abnormity. Concerning this last my correspondent [Pg 379] said that it is all the same whether the seed is taken from the capsules of monstrous flowers or from the whole spike. Seed taken in this way will give from twenty-five to thirty-five per cent of the monstrous flowers, but the ratio varies from year to year.

There are some advantages to the floriculturist in the monstrous form as the first bloom in it is uppermost and very conspicuous, while in the normal form the blooms appear from below upward, and the drooping tip of the spike is the last to produce flowers. The case in hand is a remarkable deviation from the type in many ways, but most interesting of all is the fact that floriculturists have by selection developed a variety that, in a packet of a hundred seeds, is quite certain to give some plants of the type "monstrosa," which it bears as its trade name.

MALAY LITERATURE.

By R. CLYDE FORD.

The Malay has a literature peculiarly his own, and in it comes to light all that subtle appreciation of Nature which marks him as a *Naturmensch*, but not a savage. This lore of his race he carries mostly in his memory, for to reduce it to writing has been, until recently, a task at once laborious and scholarly, and the ordinary Malay, living in the ease of perpetual summer, is neither. Still, there are dog-eared old manuscripts which circulate from one village or *campong* to another, and these are often read aloud in the evenings to eager companies. And it makes a scene never to be forgotten, to see a dozen people seated in the shadows around some old man and to listen to the mellow cadences of his voice as he reads to them a tale of the olden time, of the great days of his race, before the foreigner's ships had scared the fish from the bays or turned them into noisy harbors; the sparkling stars peep through the ragged, whispering fronds of the palm trees, the yellow light of the *damar* torch shines on eager faces, crickets chirp in the grass, and from afar comes the booming of the sea borne on the soft breath of the night wind.

Malay literature, like most literatures, has had an ancient and a modern period. In the former we behold a primitive people dominated by Sanskrit life and civilization, and naturally enough the literature of this time is mostly translations of Sanskrit poems and romances, or at least productions inspired by such, and full of allusions to Hindu mythology. Probably to this early time may be traced such works as *Sri Rama*, a free translation of the *Ramayana*; the *Hikayat Pancha* [Pg 380] *Tantra*, an adaptation of the *Hitaspodêsa*; *Radin Mantri*, a history of the love affairs of a Javan royal prince; the *Shaïr Bidasari*, an epic; and several other such epics and romances.

One must not think that the language of these works is old-fashioned or obsolete, as Beowulf and Chaucer are to us, or the Niebelungen Lied in German. On the contrary, they are full of Arabic words and many other marks of recent composition; but it is the matter, the conditions of life described, the evident antiquity of the very feeling of the productions, that lead one to refer them to the early period.

There are also some works that are genuinely Malay in origin and inspiration, and probably of a date that would put them between the ancient and modern periods. Of such is *Hong Tuah*, a story of a prince of Malacca who was a kind of King Arthur of his day. This work exists in several manuscripts, some of which are in England, one in Leyden, and one or two in the East Indies, and the date of the oldest is not before 1172 of the Hegira. Considering the fact that the year 1317 of the Mohammedan era does not commence till May 12, 1899, we thus see that many of the manuscripts of Malay literature are of no great antiquity. Another of these intermediate works is the *Sejarat Malayu*, or Malay Annals, which narrates the history of the Malays of Malacca, and their heroic defense against the Portuguese in the year 1511. It is divided into chapters, and is about the only notable historical composition in the language.

The modern period is that period which marks the domination of Islam in the far East, the period in which the Malay mind has adjusted itself to a new faith and a new education. It is hard to tell when Mohammedanism first obtained a real foothold among the Malays, but probably not much before the fourteenth century. However, the conquest when once effected was complete, and to-day the people of Tanah Malayu are among the strictest followers of the Prophet.

In a certain sense this period of the literature has been fruitful, but not so fruitful as the former one. Originality has been checked and imagination deadened, and the result is seen in a loss of sprightliness and vivacity. Works of morals and philosophy and compilations of Mohammedan law, have flourished. Still, we find some prose works of this period which are commendable; they even have some of the spirit of the earlier writings by which, no doubt, they were inspired; among these may be mentioned the *Tadju Elsalathin*, or Crown of Kings, by a mendicant monk, and the *Hikayat Sultan Ibrahim*, a religious romance of some beauty and pathos.

Within the last seventy-five years the prose literature has received some notable additions [Pg 381]
through the writings of Abdulla bin Abdulkadir, a famous *moonshi* of Singapore, who attained to some distinction under the Straits Government, being sent once or twice on missions to native states. He was born in Malacca toward the close of the last century, of Arab-Malay parentage, and received the ordinary education of a Malay lad of good family. After Singapore was founded, in 1819, he moved thither, where he thenceforth spent most of his life. His most important works are the *Hikayat Abdulla*, an autobiography, the *Pelayaran Abdulla*, an account of his trip for the government to Kelantan, and a narrative of his pilgrimage to Mecca made in the year 1854.

Without a doubt Abdulla was the most cultured Malay who ever wrote. In his capacity as teacher he was often called upon to help missionaries with their translations of the Bible into Malay; though a devout Mohammedan, he was more than ordinarily liberal in belief, and quite willing to see the contest between Christianity and Islam go on fairly and on its merits. He once assisted a Mr. Thompsen, of Malacca, in translating portions of the Scriptures, but it was a thankless task, for the missionary was obstinate, and thought he knew more about the language than the *moonshi* himself. As a result, such wretched Malay got into the work that Abdulla felt called upon in his autobiography to set himself right before the world. This is what he says:

"... But let it be known to all gentlemen who read my autobiography that where there are wrong expressions or absurd Malay phrases in Mr. Thompsen's translation they must consider well the restraint put upon me, wherein I could neither add nor subtract a word without the concurrence of Mr. Thompsen. Now, because of all the circumstances mentioned here, let no gentleman rail at my character, for I was merely Mr. Thompsen's *moonshi* or instructor. I acknowledge I am not destitute of faults, but truly by God's grace I am able to distinguish between right and wrong in all that relates to the idiom of the Malay language, for I have made it my study. I did not attain it by hearing, nor by the way, nor in the bustle of the crowd."

But it is in poetry that we must look for whatever of originality and beauty there is in Malay literature, a fact not to be wondered at if we consider the softness and mellifluence of the language, which lends itself easily to the requirements of rhyme and rhythm. Two chief forms of poetry are recognized—the *pantun* and the *shaïr*.

The Pantun.—The *pantun* in Malay literature corresponds to the lyric verse of Western lands. It
consists of one or many quatrains, as the case may be, the lines usually from ten to twelve [Pg 382]
syllables in length. However, if worse comes to worst, the Malay poet with true poetic license suits himself in preference to others, and frequently employs as few as six or as many as thirteen syllables in a line. The length of a syllable is determined by tonic accent, but penult syllables not ending in a consonant are long, those ending in silent *i* are short. But here, too, the Malay often departs from theory, and his rhymes, instead of being always exact, are constructed for the eye and not for the ear; and as for the short lines, they have to be drawled out into a legitimate scansion. The lines are not written one below another as with us, but the second opposite the first, the third under the second and opposite the fourth, and so on.

The *pantun* is much employed in improvisation, the stanzas being recited alternately by the two taking part. To the Malayan mind the beauty of this kind of verse lies in the artistic perfection of each quatrain by which it is made to veil some charming metaphor, which in turn serves in the last two lines to point a moral or express some sentiment of love or friendship, depending on the allegory of the preceding. To illustrate:

Tinggih tinggih pokok lamburi
Sayang puchok-nia meniapa awan
Habis teloh puwas kuchari
Bagei punei menchari kawan.

Bulan trang bintang berchaya
Burong gagah bermakan padi
Teka tuan tiada perchaya
Bela dada, melihat hati.

The lamburi tree is tall, tall,
  Its branches sweep the sky;
My search is vain, and o'er is all,
  Like a mate-lorn dove am I.

Clear is the moon, with stars agleam,
  The raven wastes in the padi field;
O my beloved, when false I seem,
  Open my breast, my heart is revealed.

The waves are white on the Kataun shore,
  And day and night they beat;
The garden has white blossoms o'er,
  But only one do I think sweet.

Deeper yet the water grows,
  Nor the mountain rain is stilled;
My heart more longing knows,
  And its hope is unfulfilled.

In poetry of more pretentious style, and in improvisations also, each stanza contains a key-word or line which becomes the text, so to speak, of the next. As artificial and unnatural as this may seem, it is, nevertheless, an ingenious way of keeping the thread of one's discourse when other inspiration fails. The best results of Malay verse come from it. A beautiful example may be cited from the Asiatic Journal of 1825:

Cold is the wind, the rain falls fast;
I linger, though the hour is past.
Why come you not? Whence this delay?
Have I offended, say?

My heart is sad and sinking too;
O break it not—it loves but you!
Come, then, and end this long delay;
Why keep you thus away?

The wind is cold, fast falls the rain,
Yet weeping, chiding, I remain.
You come not still, you still delay—
O wherefore can you stay?

Adelbert von Chamisso, the German poet, who has another claim to fame, however—his scientific career was charmingly described in the Popular Science Monthly for December, 1890—includes in his published poems three songs, In Malay Form, for which he doubtless obtained inspiration during his voyage to the far East in 1815 to 1818. They are so faithful in spirit and style to their source that we can not forbear quoting one in translation. It is called The Basketmaker, and is in the form of a dialogue, each stanza having the usual "key" line:

The shower's gone by, the sun shines bright,
  The weather vanes now gayly swing;
We maidens here in merry plight
  Quick beg of you a song to sing.

The weather vanes now gayly swing,
  Through fire-red clouds the sun shines fair;
Right gay and quick to you I'll sing
  A song that's full of dread despair.

Through fire-red clouds the sun shines fair,
  A bird sings sweet and lures the bride;
Pray what concerns your dread despair
  To maidens fair and dear beside?

A bird sings sweet and lures the bride,
  A net for fishes there is spread;
A maiden fair and dear beside,
  A sprightly maiden would I wed.

A net for fishes there is spread,
  The moth's wings burn in bright flame hot;
A sprightly maiden wouldst thou wed,
  But thee the maiden chooseth not.

The Shaïr.—The *shaïr* is very different from the *pantun*; the latter is lyric, the former epic in its nature; the *shaïr* may be heroic or romantic, the *pantun* never. However, it employs the same measure as the *pantun*, but all the lines of each stanza rhyme, instead of by pairs, as in the quatrains of the lyric verse. It is to the *shaïr* that we must look for the really great works of Malay poetry, where some are bold enough to declare we may find passages of Homeric beauty. The most famous works of this nature are *Radin Mantri*, *Kin Tambouhan*, and *Bidasari*. The first two of these tell the story of the love of a prince of the royal house of Nigara for a maiden of his mother's court. It is a beautiful tale, abounding in parts of striking eloquence and pathos, and the characters are strong and well portrayed.

The *Bidasari* is the longest poem in the language, and typically Malayan. Its author is unknown, likewise the time and place of its composition. The only hint as to the writer is in the opening lines:

"... Listen to this story of the history of a king in a province of Kambayat. A fakir has turned the narrative into a poem."

And again at the conclusion, where it says:

"This poem is weak and faulty because my knowledge is imperfect. My heart was troubled—for that reason have I written it. I have not made it long, because I was sad; but I have finished it and thereby obtained many blessings."

Internal evidence, however, indicates that the poem is old, of a time long before the Europeans first came to the East, possibly before the Mohammedan conquest. It shows plainly the influence of Hindu theology, yet in the customs and scenes described, and the mode of life and the manner of thinking, it is essentially Malay, and so worthy, perhaps, of a somewhat extended notice.

"There was once a king, a sultan, handsome, learned, perfect; he was of the race of noble kings; he caused the land of merchants and strangers to be swallowed up. From what people of his time say of him he was a valorous prince who had never yet been thwarted. But to-morrow and the day after to-morrow are uncertain." Such is the beginning of Canto I, as given in the French translation by Louis de Backer. The king marries, but just as joy and happiness are to be his, a griffinlike *garuda* sweeps down upon his land and ravages it. Terrified, the monarch deserts his throne, takes his royal consort and flees for his life. On the flight the queen gives birth to a child, which, however, must be deserted, much to the mother's grief.

In Canto II a rich merchant is introduced—a man whose goods and treasures are immense, whose slaves numerous, prosperity constant, but who, alas! is childless. One morning as he and his wife are walking by the side of a stream they discover a boat drifting near them, and in it a child of such radiant beauty that they are moved to adopt it.

The lord of the region is Sultan Mengindra, whose queen is beautiful, but unhappy, through constant looking forward to the day when she shall be displaced by some woman more beautiful than she. At last she has a costly fan made, and sends out spies to offer it for sale in every village and town, but not to tell its price. If they discover a woman of rare beauty they are to return and notify her.

In course of time the spies come to the old merchant's home, and see Bidasari, the handsome adopted child. After some delay she is brought to court, where she has to undergo much studied ill treatment from the jealous queen. By a subterfuge the girl escapes and is then removed by the merchant to a secret place in the desert.

Canto III tells how Sultan Mengindra goes to hunt in the desert, and there finds a sleeping beauty whom he awakens and consoles with the music of a *pantun*.

In Canto IV the story returns to the King of Kambayat. He and his queen have succeeded in reaching a distant part of their kingdom, but the fate of the young princess whom they so shamefully deserted oppresses them. Finally, the king's son, stirred by his mother's tears, sets out to search for this sister whom he has never seen. In his search he meets with Bidasari's adopted brother, who detects the resemblance between the young prince and his sister. Together they go to obtain audience of the sultan and Bidasari, who is now queen.

Canto V. Convinced that the story of the prince is true, Sultan Mengindra dissuades him from returning, but bids his minister write a missive in letters of gold and dispatch it at once, with presents and jewels, to the King of Kambayat.

In Canto VI we have the last chapter. The King of Kambayat receives the letter, which, however, makes no mention of Bidasari, and at once accompanies the messengers to Sultan Mengindra's court. He makes his entry into the strange capital with becoming splendor, and is received with great honor. The queen now makes herself known to her father, who is moved to tears. Banquets and great tournaments follow, and happiness pervades the court. The king returns after a time to his own land, but continues as long as he lives to send gifts and goods to his daughter and her royal lord.

THE COLORS OF FLOWERS.

By HENRI COUPIN.

Much might be said, from an artistic and poetic point of view, concerning the colors of flowers. It is in the corolla that they reveal themselves in their most minute delicacy. The tints so widely diffused among animals, even those of butterflies, are coarse as compared with them, and the painter's palette is powerless to reproduce them. They run through the whole gamut of the solar spectrum, even to its most minute details. Some naturalists have striven to establish a classification of them, and it will be convenient to be acquainted with their efforts, though they are not decisive and are somewhat artificial, like all classifications. We give one of the most ingenious of them:

	Green.		
Cyanic series.	Greenish-blue.	Yellow-green.	Xanthic series.
	Blue.	Yellow.	
	Blue-violet.	Yellow-orange.	
	Violet.	Orange.	
	Violet-red.	Orange-red.	
	Red.		

The type of the cyanic series is blue, and that of the xanthic series yellow. The first is sometimes denominated the deoxidized series, and the second the oxidized, but these designations have hardly solid enough foundations to be preserved. De Candolle, who publishes the table in his Vegetable Physiology, appends some interesting remarks to it.

It will be noticed by the inspection of the table that nearly all the flowers susceptible of changes of color, as a rule, simply go up or down the scale of shades of the series to which they belong. Thus, in the xanthic series the flowers of the *Nyctago jalapa* may be yellow, yellow-orange, or red; those of *Rosa eglantina* yellow-orange or orange-red; those of nasturtium from yellow to orange; the flowers of *Ranunculus asiaticus* present all the colors of red up to green; those of the *Hieracium staticefolium*, and of some other yellow *Chicoraceæ* and of some *Leguminosæ* like the lotus, become greenish-yellow when dried, etc. In the cyanic series the flowers of many *Boraginaceæ*, especially of *Lithospermum purpureo-cæruleum*, vary from blue to violet-red; those of hortensia from rose to blue; the ligulate flowers of the asters from blue to red or violet; those of the hyacinths from blue to red, etc.

There are, however, a few apparent exceptions to this rule. Thus, although the hyacinths usually vary only in the blues, reds, or white, yellowish varieties, indicating an approach to the xanthic [Pg 387] series, are sometimes found in gardens. The auricula, which is originally yellow, passes to reddish-brown, to green, and to a sort of violet, but never reaches pure blue; and single petals occasionally give suggestions of both series in distinct parts of their surfaces.

Some surprise may be felt that white does not figure in De Candolle's table. This is because an absolutely white color does not seem to exist in any flower. The fact may be shown by placing some flowers supposed to be of the purest white, like the lily, the white campanula, or the wood anemone, on a leaf of clear white paper. It will be found that the white of the corolla is really washed with yellow, blue, or orange, according to what flower is taken. If the tint does not appear distinct, infusions of the corollas in alcohol will present tones unmistakably yellow or red, etc. White flowers are therefore flowers with tints appertaining to one of De Candolle's series, but albinized, as if they were etiolated. A small number of flowers begin white, and are subsequently colored under the action of light. The *Cheiranthus chameleo* passes from white to citron-yellow and a slightly violet-red; the *Ænothera tetraptera*, at first white, becomes rose and then almost red; the petals of the Indian tamarind are white the first day and yellow the second; and the corolla of the *Cobea scandens* comes out greenish-white and turns to violet the second day. The most remarkable plant in this respect is *Hibiscus mutabilis*, which Rumph calls the hourly flower, because it starts white, turns flesh-color toward noon, and becomes red at sunset.

In his recent work on Plants and their Cosmic Media, M. Costantin has some remarks concerning the precocity of various races and the tint of their flowers. Hoffmann made observations on this point for several years. He remarked, as the result of eight years' observation, that the common lilac with white flowers blooms on an average six days earlier than the normal form with purple flowers. This might be a curious anomaly with no bearing, but the more we advance in the study of Nature the more we perceive that all phenomena, even the most insignificant, deserve to be examined. Similar results have been observed in varieties of radish (*Raphanus raphanistrum*) and of saffron (*Crocus vernus*); in the former the white flowers expand on an average of sixteen days earlier than the yellow ones (twelve years of observation), and in the latter plant the difference is four days.

These changes of tint sometimes appear to depend on the temperature. Thus, the white lilac was obtained by horticulturists under the influence of a temperature of between 30° and 35° C. We can not, however, affirm that spontaneous races with white flowers originated in the same way as [Pg 388] the white lilac. It will be enough to point out a few facts that may contribute to the guidance of persons who are seeking to learn the origin of these colored varieties. The *Papava alpinum* has a very stable variety with yellow flowers, which, according to Focke, has been observed in the polar regions, while the white varieties have been seen in Switzerland. The cultivation of the same species at Giessen, Germany, has made it possible to obtain specimens with white flowers by metamorphosis from specimens with yellow flowers, but it is impossible to say whether or not heat is the agent that produces the changes in these cases. The experiments of MM. Schübela and Bonnier have shown that flowers become darker without changing their color in high regions and in those near the pole; but this phenomenon is one of light and not of color. Be their origin what it may, these white and colored forms have remarkable fixedness.

It will be observed that black does not figure in the table of the classification of colors given above. Absolute black, in fact, does not exist in any flower. If some parts appear black, it is only because their tint is excessively dark. The black of the petals of *Pelargonium triste* and of the bean is yellow, and that of the *Orchis nigra* is a brown. Apparent blacks are, moreover, extremely rare.

The gamut of the reds is much more varied than that of other colors. The reds of the xanthic series are generally more lively-hued, carnation or flame-colored; those of the cyanic series present tints more nearly approaching violet. These two reds may furthermore give rose-colors, but a little skill will divine their origin. The rose of the hydrangea inclines to blue, while that of the rose tends rather toward yellow. Blue colors are the most variable, and readily pass to violet and red, but most frequently to white. The most tenacious hues are those of yellow, and we might affirm that the bright and glistening yellow of the buttercup may be said never to change. The paler yellows change more easily, but rarely pass to anything but white. Green flowers, not being readily distinguished from the foliage around them, need not be specially mentioned. They are believed to be much rarer than they really are.

Horticulturists are able, by cultivation, selection, and hybridization, to cause the colors of flowers to vary in considerable proportions. Not much is known of the laws of these variations, chiefly because gardeners who might tell botanists of them if they would have not the scientific spirit. We cite here what MM. Decaisne and Naudin[7] say respecting the variations of the color of flowers:

"Change in this respect is effected in two ways: sometimes there is a simple discoloration, drawing the red, yellow, or blue tints of the corolla toward a more or less pure white; sometimes there is a radical substitution of one color for another. Flowers in which red or blue are the dominant tints are most subject to turn white, but the change may also be observed on some flowers that are naturally yellow, such as the disk of the daisy, the dahlia, and the chrysanthemum when those flowers suffer ligular transformation. Nothing, on the other hand, is more common in our gardens than white varieties of pink or of red roses, lilac, scarlet runners, larkspur, purple digitalis, Canterbury bells, etc.—in fact, nearly all plants with lilac, rose, red, purple, blue, or violet flowers. There are some flowers, however, in these categories the coloration of which is very persistent, and rarely fades perceptibly—as may be seen in the purple petunias, the hue of which does not lose its vivacity even when it is crossed with the white variety.

"The radical substitution of one color for another, whether over the whole corolla or only on some of its parts, in the form of spots, stripes, or variegations, is also of frequent occurrence, and is one of the sorts of modifications which horticulturists have used with great advantage. A considerable number of 'fancy' plants derive almost all their importance from the facility with which the liveliest colors replace one another, blend, and intermix in a thousand ways and in relative proportions of which nothing is fixed, so that we can not find in these collections, when they are well chosen, two plants out of a hundred that are exactly alike in the tone and distribution of their colors. These multicolored varieties, all the offspring of cultivation, are generally perpetuated true by cuttings, while the seedlings compensate for the uncertainty of what they will produce by the certainty that they will give rise to new combinations of colors. This is not the case with single-colored varieties, which, unless they are crossed with others, tend to perpetuate themselves through their seedlings. The yellow, white, and purple varieties of the four-o'clock, for example, when they are pure, reproduce themselves constantly; when crossed with one another they give rise to intermediately colored flowers, and more frequently to variegated ones."

Mr. Hughes Gibb observed, in the mild winter of 1897-'98, that flowers blooming out of season were liable not to have the same color as regularly blooming ones.

The cactus dahlia, usually red, has put out flowers almost orange and with exterior florets sometimes nearly yellow. On the other hand, these dahlias have often shown a marked tendency to return to the simpler form.

A species of nasturtium, habitually of a bright scarlet-red, has given in the cold frame late flowers of a bright yellow, a red band near the center of the petals remaining the only vestige of the normal color. In both cases the change of color began on the edges of the petals. The flower of the myosotis, normally bright blue, has become almost clear rose, without the slightest trace of blue; and a pure blue phlox has shown a tendency toward greenish-yellow.—*Translated for the Popular Science Monthly from La Nature.*

FOLKLORE OF THE ALLEGHANIES.

BY FRANCES ALBERT DOUGHTY.

The West Virginia mountaineer lives very close to Nature, and viewed from many standpoints the relation is characterized by pleasing amenities: juicy berries refresh him along the road; nuts drop into his path; "sang" (ginseng), which makes one of his sources of revenue, reveals itself to his eye as he follows the cows to pasture; a cool brook springs up to quench his thirst when weary of following the plow; pine knots are always within reach to make light as well as warmth; mud and stones easily combine in his hand to shape a daub chimney; and a trough dug out of an old tree furnishes a receptacle that is as good for dough at one end as for a baby at the other.

Often, however, this close relation to Nature assumes a war attitude, fierce and uncompromising. If hungry wolves no longer howl furiously at the back fence after nightfall, or gnaw at the log pens which secure the stock, and if panthers are seldom bold enough to spring at a horse's flanks as a man rides along in the daytime, bears are still numerous enough to devour a large number of sheep every year in spite of precautions, and they have a pronounced taste for sweet young corn. The living wrested from the soil in the short and changeable summer months must cover the winter's need as well; it is generally so scant and uncertain that the mountaineer feels a chronic discouragement toward agriculture as a pursuit and resource. He must depend on it, and yet as far back as he or his father can remember there has always been some reason why "a good crop" could not be made that year. The West Virginian lives in a large and thinly settled game preserve, but the fleet deer usually contrives to escape the hunter's chill wait in the autumnal dawn, the coy wild turkey is overshy of his lure, and the wary trout requires a very patient rod. In the long winter deep snows cover the fences, groups or "bunches" of cows and sheep often perish in the drifts, and the human prisoners in their cabins, huddling around the wood fires, are nearly [Pg 391] always, as they express it, "short of" some article which would be considered a necessity in the average city home.

The varying, defiant, and incalculable moods and phases of Nature bring so many chances into the humble lot of the mountaineer that it is not surprising he should interpret her phenomena as having a distinctly personal import. Anciently, around Olympus the talk was of "omens," "auguries," and "fate"; dwellers along the chain of the Alleghanies to-day talk of "signs," "spells," and "luck," and these words held their significance for hundreds of years in the ancestral stock of the first settlers in the region, most of the folklore being directly traceable to a Scotch-Irish strain of blood. The mountain pattern taken far from cities probably differs little either mentally or physically from that of the colonial mountaineers. Even with the railroad traversing a limited area, and the influx of summer visitors during three months of the year, the only perceptible change wrought in the natives is a little sharpening of their wits from the barter of fruit and furs at the hotels in the extensive mineral-spring section. The Alleghany mountaineer, ignorant, narrow-minded, honest, brave, and hospitable, remains what he was when the eagle soared from the inaccessible eyrie above his head to be chosen as the tutelary genius of the unconquerable young republic. The chief distinction in the temperament of the sexes is that the men are frank and talkative, the women shy and uncommunicative. Beings approaching the legendary fauns and satyrs, clad in the skins of wild animals, are sometimes discovered by the solitary horseman in the wild mountain fastnesses; they gaze at him as an apparition from a strange world, never having seen a village or heard a railroad whistle.

There is a curious and persistent survival of the belief in witchcraft through this mineral-spring belt in West Virginia. To draw out the natives on this mysterious subject they must be approached sympathetically; if twitted with their credulity they will shut up like clams, for with all the simplicity of the unlettered their intuition often arrives at a correct understanding of the estimate placed upon them by more fortunate persons. When satisfied that he is not expected to pose as a "freak," but is met on the equal plane of human intercourse, the mountain story-teller seems to enjoy recounting the traditions and beliefs of his people and their forefathers. Leaving himself a loophole of escape, he is very likely to finish his yarn with—

"'Tain't that I believe them things myself. I know they ain't nawthin' but superstition; but I kin qualify that right round here, not many miles away, there's people that believes in witches."

In a little cottage on a much-traveled thoroughfare one woman admitted to me with bated breath, [Pg 392] as though not quite sure her tormentor was dead, that she had been bewitched. Her account was given in these words:

"I kep' seein' an old woman with a cow's hoof in her hand; sometimes she was by my side an' sometimes she was there on the wall. At last she come up close to me, an' she was goin' to clap the cow's hoof over my mouth, but I slapped at her right hard an' she went away. She ain't never come again. Yes, I *know* I was bewitched."

A cow's hoof is a frequent accessory, and animals that are brought into the magic circle are always of a domestic character, completely subservient to the power of the witch.

It is noticeable that the exercise of witchcraft is generally ascribed to women; and that of witch mastery, the superior attribute, to men.

The form of a judicial process found favor with the Puritan temperament in old Salem, although by a grim mockery the verdict was decided in advance. The independent mountaineer likes to take the law in his own hands, as the following story illustrates:

"A farmer believed a woman was bewitching his stock. He drew a picture of her and set it up as a target; then he sunk a piece of silver in his bullet with an awl, *that being the charm for shooting a witch*. He aimed to shoot the picture through the heart, but fired a little too low. On that very day the woman herself fell flat on the ground, and a deep, awful hole was found in her side. From that minute she suffered extreme agony, and died in a week."

The narrator had heard this grewsome tale from his grandmother, who said that she had seen the hole.

One of the oldest inhabitants of Monroe County is responsible for the ensuing chronicle; he dates it in the "forties" of the present century:

"'Tain't so very long ago there was a woman livin' near the Sweet Springs who used to be always seen with a cap and bonnet on; nobody ever saw her without the cap. She was a hard, grim-lookin' monster. If anybody was watchin' to see her ontie her cap strings, somehow they never could see any more until the clean cap was on—now that's *so*, there ain't any mistake about that! When she come over here from Botetourt County the report followed her that she lived pretty close to a man whose chillun went to school, an' a calf had been in the habit of attackin' 'em an' bitin' em. The father concealed himself one day and was watchin' to catch the calf. On that occasion it come out an' attacked the chillun on a bridge across a little stream o' water. He ran [Pg 393] and caught the calf and cut off his ears with a knife. They always believed that *the old witch had turned herself into that calf*, and so when she turned back into a woman she wore the cap to hide that she didn't have any ears. There was three sisters of 'em; it was reported they was all witches, possessed of some uncommon art. John and Harriet had two little pet pullets they thought a good deal of. The cap-woman wanted 'em; they just fluttered an' fluttered till they died. Her name was Nancy L——. Well, she wanted the carpenter to make her a piece of furniture out of an old dirty plank she had, an' he wouldn't do it. He said it was gritty and it would ruin his tools. Then she got mad and said, 'I'll make you suffer in the flesh for that!' One day soon after that he was at his hog pen feedin' the hogs, when suddenly he was struck down perfectly helpless, so he couldn't speak. He thought it was paralytic or rheumatism. In those days there was an old doctor in Staunton, Augusta County, who had a kind o' process to steam people and boil 'em in a big kettle, for rheumatism. He put sump'n fireproof, a paste or ointment, all over 'em, like the fireproof you put on buildings, an' boiled 'em an hour or two hours, as the case might be. The carpenter went to consult him, an' he put him in a kettle that was big enough for him either to stand or sit down in it; a collar was fitted tight round his neck so the hot water couldn't get into his face and eyes. The boilin' didn't seem to do him any good. When he got home he halted about for twelve months or more. First he felt a pain in his hip, and then he felt a pain by the side of his knee as if it was gradually workin' down; then one day there was sump'n jaggin' in the calf of his leg. He put his leg up on a bench and an old gentleman seen sump'n stickin' out. He took a pair of nippers an' ketched holt an' pulled out a big shirtin' needle. Hugh kept the needle as long as he lived, and he believed Nancy the old witch shot him with it. He halted on that leg the balance of his days. *I've seen the needle*; it's God's truth!"

A spice of profanity seems to have the virtue of embalming a witch story in the mountain memory. A rustic maiden who lives with her family on one of the loneliest hilltops in the Alleghanies, only to be reached on foot or horseback, makes this contribution to the folklore of the region:

"An old lady not far off had three daughters, and she was going to learn 'em to be witches. They had to sit on the hearth by the fire and take off their shoes and grease their heels so as to go up the chimney, and they were not allowed to speak. The mother was to go first and the girls were to follow. The old lady and the two foremost ones had all got up safe, but the last girl, when she was [Pg 394] in a narrow place in the chimney, said, 'This is a d—d tight squeeze!' With that she fell back and was burned up."

The value of silence and self-control appears to be the only touch of morality in the witch logic. Manifestations of the black art frequently take place by or over running water. These characteristics are observed in another story from the same maid of the mountain:

"Two witches were going to rob a store in the night, and they took a young man with them as a partner. They put the greased witch cap on his head so he could go through the keyhole. They all started out, and presently they came to a river. They saw some calves in a field, and caught three of 'em; they mounted the two that were heifers and the boy got on the steer calf. They charged him of all things not to speak on the journey. The witches jumped the river on their calves without makin' a sound, but just as he was jumping across he cried out, 'That was a d—d good jump for a steer calf!' Well, they all went on, and when they got to the store they passed through the keyhole one after another, the young man too. They took all the money they wanted, but when the time came to leave he couldn't get out of the keyhole, because he had spoken, and the spell was broken. He was found in the store the next morning, and had to take all the punishment."

It is interesting to note as an offset to all these diabolic attributes and potencies that a firm faith exists in a beneficent Power back of them which under given conditions will prevail over evil. "God is always stronger than the devil" is the mountain way of expressing this dependence, and there are charlatans who take advantage of it by going about as "witch masters." One of these died a few years ago, and another farther back, an Irishman named "Mosey," is quoted yet for his successes as "master of all the witches and all the devils."

When the cows had been eating mushrooms and their milk became too bitter to make good butter, Mosey was sent for at once to "cure the witchcraft" and "take off the spell." He took his regular beat through his part of the mountain country once in a while. An old man who oscillates between the "White" and the "Sweet," selling canes, remembers him well. He tells of one woman's experience who "filed a complaint" that her cow wouldn't give much milk, and that the milk wouldn't "gether" for butter.

"'Woman,' says Mosey, 'your cow's bewitched, and badly bewitched!'

"'Can you do anything for her, Mosey, and what will you charge?'

"'Yes, I can cure her if you'll pay me five dollars and give me five pounds of butter to take home with me to burn in the fire to cap the climax and burn out the spell.' [Pg 395]

"Then he want through his enchantments over the cow, and took the money and the butter home with him. One day when he had been drinking a little I asked him if he really burned all that butter. 'Divil a grain of it did I burn; I ate it with my pertaties.' It was on that same trip when Mosey was curin' the cow that a man who lived near by sent for him. 'I feel mighty quare, Mosey,' says he, 'an' I can't describe exactly how I do feel!' 'You're bewitched, sir,' says he, 'and badly bewitched!' (he always used those words). 'Faith, an' I'll try and cure ye! Have ye got any blue yarn about the house?' The man's wife went to look for some, and she came back with a hank of blue yarn. Mosey wound off enough of it to make a cord about the size of his finger; they twisted it together, he pretending to put some enchantments on it, and then he told the sick man to fasten it round his waist next to his skin. 'Don't you lose it on peril of your life,' says he, 'or you're a dead man!' 'Peggy, get a needle and sew it on me!' he says to his wife, an' she done it. He gradually got well—may be he'd a got well anyway. I can't vouch for that."

When asked if such things were still happening, the cane-seller replied:

"Not three weeks ago a woman thought her cow was bewitched because her butter wouldn't gather, and she het an old horseshoe hot and dropped it in the churn of milk. When she churned again the butter on that occasion gathered, and *it was the same milk* that was in the churn to burn the witch. You can put that down for June, '93."

The Potts Creek neighborhood is said to be a center for the witch superstition. It is also a favorite place for "bush meetings," to which the natives come from a distance in their wagons with picnic dinners of salt-risen corn pone and sliced bacon, and there they listen approvingly to fervid exhortations that are based on orthodox Baptist and Methodist doctrines. The West Virginia mountaineer is profoundly religious in temperament, and considers that he has scriptural ground for a belief in witchcraft.

Prof. H. E. Armstrong has described how, by taking incidents from suitable story books, children aged respectively seven and a half, ten, and twelve and a half years were set to work to test the physical facts mentioned, and how, by the systematic use of the balance, measuring instruments, and simple apparatus, or even household utensils, a true spirit of scientific research was engendered. Evidence of the good effect was exhibited in the notebooks made by the children, which demonstrate clearly how well the juvenile investigators have mastered the scientific method of observation.

ORIGIN OF ANCIENT HINDU ASTRONOMY. [Pg 396]

By the Count GOBLET D'ALVIELLA.

It is manifest that India is indebted for some of its astronomy to the Greeks. Not that it had not astronomy and astronomers from an epoch anterior to the invasion of Alexander. It had, in fact, been necessary to make observations of the heavens in order to fix a calendar that would enable the sacrifices of the Vedic ritual in connection with the return of the seasons and the revolutions of the stars to be celebrated at the right dates. Further, the belief in astrology, or the influence exercised by the movements of the planets on physical phenomena and all the events of human life, would lead, in India as elsewhere, to the observation and anticipation of everything relating to the conjunction and opposition of the heavenly bodies.

The Rig-Veda has allusions to the phases and stations of the moon. The stations (*nakshatras*) consisted, according to a tradition preserved by the Brahmans, of twenty-seven constellations (afterward twenty-eight) which the moon was supposed to traverse successively in the course of its sidereal revolution. A lunar zodiac and a primary division of time into months were thus obtained. The moon, moreover, bears in the Veda the name of month-maker (*mâsakrit*). Each station was assigned a uniform length of 13° 20' on the ecliptic, and a denomination, generally derived from mythology. The month, in turn, took its name from the constellation that had the honor of harboring the moon. Manon and the Djyotisha (a special treatise included among the Védângas, or commentaries on the Vedas) tell us that the year was composed of twelve months, the month of thirty days, the day of thirty hours, the hour of forty-eight minutes, all strictly sexagesimal subdivisions, like our own measures of time. The Djyotisha also teaches the art of constructing a clepsydra, or water-clock.

The adjustment of the solar year to correspond with the lunar year and of the two with the civil year dates from this period. The month was still composed of thirty days, but the solar years were grouped into quinquennial periods, in the middle and at the end of which the lunar month was doubled. Combining these quinquennial periods with the revolutions of the planet *Brihaspati* (Jupiter), which was calculated as occupying about twelve years, the Indian astronomers computed an astronomical cycle of sixty solar years. As the same cycle is found with the Chaldeans, where, according to Berosus, it was called the *Sossos*, we have to inquire how far Brahmanic astronomy was influenced by the systems which were originally formed in ancient [Pg 397] Chaldea. The presumption of such an influence furnishes a simpler and more probable hypothesis than the effort to trace the earliest astronomical ideas of the Hindus, as M. W. Brennand has recently suggested, to a period when the ancestors of the Aryans, the Semites, and the Chinese were wandering together over the plateaus of central Asia!

We know now, from the cuneiform inscriptions, that the Chaldeans had, at a period far anterior to the entrance of the Aryans into India, invented a double calendar, solar and lunar, with intercalary periods; discovered the proper motion of the planets; calculated the return of eclipses; and constituted a double metrical system, decimal and sexagesimal; and, as was done, too, in India, had divided the circumference into three hundred and sixty degrees of sixty minutes each. It is impossible to draw the lines exactly between the astronomical discoveries which the Hindus borrowed from abroad and those which they drew from their own resources prior to the invasion of the Greeks, but we need in no case go farther than Mesopotamia for the source of the borrowed data.

The ancient literature of India contains observations of the positions or conjunctions of some of the stars that carry us back to positive dates in the history of the sky. The astronomers Bailly, Colebrooke, and Bentley, and, more recently, M. Brennand, have found notes relative to astronomical phenomena that took place in the twelfth, fourteenth, fifteenth, and even the twenty-first centuries B. C. Max Müller, however, advises prudence and reserve in accepting these calculations, some of which may have been afterthoughts, and others offer only apparent agreements.

In any case, the advent of Buddhism, by depreciating the religious practices and astrological speculations of the Brahmans, contributed to bringing on a decline of astronomy at the very time it was taking its most vigorous stand among the Greeks. We learn from a passage in Strabo that the Pramnai regarded the Brahmans as boasters and mad because they were interested in physiology and astronomy. Now, there really exists an ancient Buddhist treatise in which the predictions by the Brahmans of eclipses of the sun and of the conjunctions and oppositions of the planets, and their discussions of the appearance of comets and meteors, are treated as despicable arts and lies.

It was just at this age that Hellenic culture was developed in northwest India. It held astronomy, and astrology too, in great esteem. The Milinda Panda mentions the royal astrologer as one of the principal functionaries of Menander. No doubt there were, among the Gavanas (Ionians) of Taxila and Euthydêmia, minds versed in the knowledge of the principal cosmological systems [Pg 398] formulated among the Greeks from Thales to Aristotle, and also acquainted with all the progress in the physical and mathematical sciences that had been achieved by the Alexandrian astronomers in the last centuries before Christ. To comprehend the extent of the influence of Hellenic science, we have only to inquire what Hindu astronomy had become again at the time of the restoration of the Brahmans in the sixth century A. D. Aryabhatta teaches the rotation of the earth around its axis; maintains that the moon, naturally dark, owes its light to the rays of the sun; formulates the true theory of eclipses; assigns an elliptical form to the planetary epicycles; and demonstrates the displacement of the equinoctial and solstitial points. Varâha-Mihira devotes himself especially to astrological labors, but also has the merit of having condensed into a vast encyclopædia the *Pantcha Siddhântikâ*, the principal astronomical treatises that were current in India. And Brahmazoupta is especially famous for his revision of an older treatise, the *Brahma Siddhânta*.

In the opinion of the most competent critics, these works, which are chiefly empirical methods of determining the positions of the stars, are inferior to those which the Alexandrians have left us. Yet, in matters relating to the measurement of arcs and to spherical trigonometry, they reveal a more advanced state of the science. It is impossible to determine at what period this new astronomical science was constituted in India. Some of its theories squarely betray their indebtedness to Greek science, as, for instance, that of the displacement of the equinoctial and solstitial points by a periodical vibration or tremor. We can also say as much of the solar zodiac, the names of the constellations of which strikingly resemble the Greek names in form as well as in significance, and the same of the names of the chief planets. Other expressions are found, notably in the works of Varâha-Mihira, which indicate, if not a borrowing, a contact, at least, with the works of the Greek astronomy, of which Mr. Burgess gives a fairly complete list in his Notes on Hindu Astronomy and the History of our Knowledge of it, in the Journal of the Royal Asiatic Society. Among these terms, some are Greek words which have been utilized in naming constellations or astronomical measures; others have retained the special significations which they had in the works of the Alexandrian astronomers. It would certainly be an exaggeration to insist that the adoption of a foreign term of necessity implies the borrowing of the idea which it expresses. It is, nevertheless, probable that the Sanskrit writers would not have made use of so many of these exotic denominations if the ideas they represent had already found their expression in the languages of India.

Further, among the fine Siddântas which Varâha-Mihira collected and condensed as including all [Pg 399] the astronomical science of his time, there are two, the *Romaka* and the *Pauliça*, the names of which suggest directly—the first the scientific culture of the Roman world, and the other Paulus, a celebrated Alexandrian astronomer of the third century A. D.[8]

We apparently find, likewise, the names of Manetho (fourth century A. D.) in *Manittha* or *Manimda*; of Spensippus in *Sporedjivadja*; and of Ptolemy in *Asoura Maya*, whom the *Sounya Siddhânta* designates as the founder of astronomy, and who another treatise says was born at Romakapouri, "the city of the Romans."

In this order of ideas the natives of India have never tried to deny their sources. The Gavanas, we read in the *Gargí Samhitâ*, are barbarians; but this science (astrology) has been constituted by them, and they must be revered as saints. M. Weber affirms that a treatise on astrology bearing their name, the *Gavana Çastra*, was reputed to have been written in the land of the Gavanas by the god Sourya in person, when, expelled from heaven by the resentment of his divine rivals, he came down and was born again in the city of the Romans.[9]

We find, further, that the Greek calendar appears to have survived Hellenic domination in northern India. General Cunningham, in 1862, read in the inscriptions of the Indo-Scythians the names of the Macedonian months Artemisios and Appellaios. Since then the names of two other months of that calendar—Panemos and Daisios—have been found in inscriptions in the Kharosthis character.

Another era of Grecian origin, that of the Seleucidæ, seems likewise to have furnished the Hindus their first historical computation.[10] It should be observed, in fact, that their most ancient era, that of the Mauryas, dates from the year 312 B. C., or the beginning of the era of the Seleucidæ. This had been adopted by the Grecian sovereigns of India, as is attested by a coin of Plato, struck in the year 166 B. C.

Beginning with the Indo-Scythians, India generally adopted the era of the Cakas, which began, not, as had been long supposed, with the expulsion of the Scythians, but with the coronation of their principal sovereign, Kanichka.[11] Nevertheless, the inscriptions offer still other historical computations, as, for instance, that of the Gouptas era, which began in the year 240 of the Çaka era, and that of Vikramâditya, which was made to begin retrospectively fifty-six years B. C. Hence arise complications of a nature to make the task of paleography and history no lighter. —*Translated for the Popular Science Monthly from Ciel et Terre (from the author's essays on Classical Influences on the Scientific and Literary Culture of India).* [Pg 400]

SKETCH OF WILLIAM KEITH BROOKS.

The old problem of Nature *versus* nurture that meets us in studying the life history of any organism becomes especially interesting in dealing with the biography of men of eminence. Are their achievements the inevitable expression of the natural forces innate in them at birth, or the product of environmental influences, or some resultant of these two factors? And how much may we in each case assign to one factor or to the other?

These difficult questions naturally suggest themselves in glancing at the life of the subject of this sketch. Like so many men who have won prominence in comparatively new countries, he seemed, in an environment that had no apparent relation to his future, to grow from innate tendencies toward something not suggested by the circumstances about him, even to grow in opposition to the molding influences of these, and to conquer them. Later, however, we find him surrounded by influences that made a particular mode of self-expression easy, if they may not be said to have forced such expression. It was then that the casual observer might say that the circumstances made the man; yet, looking backward, we can trace the initiative in the man that led him into the congenial environment. A selection of proper environment to express Nature has been rightly claimed as a potent factor in all organic life; nurture, then, comes as a secondary power to mold, or rather to translate, the inherent power.

William Keith Brooks, the second son of Oliver Allen Brooks and Eleanora Bradbury, daughter of the Rev. Phineas Kingsley, was born in Cleveland, Ohio, in 1848. In 1877 he married Amelia Katherine, daughter of Edward T. Schultz and Susan Rebecca, daughter of David L. Martin. He has two children.

Brooks grew up amid the stimulating influences of a relatively new country, where freedom of [Pg 401] development was not so sharply restricted but that all paths of life seemed equally open to one who would work. As a boy he was not one of those precocious naturalists of the common sort whose collecting instincts find expression in the hoarding of dead animals or plants rather than the neater postage stamp; names and authorities, classes and species, neatly arranged mummies, were not his delight. At first there seemed no sign that zoölogy would claim him as a most ardent admirer. Yet he was fond of live things and their ways, and introduced into his home that most delightful microcosm, the fresh-water aquarium (so much neglected in this country), in which he could observe at ease the habits and slow changes of living things when their native haunts were not accessible. Such early interest in the essential wonders of livingness rather than in man's artificial classification of phenomena was thus prophetic of much of his later originality of thought and view.

He has never forgotten how much he owes to the instruction of the earnest and broad-minded teachers in the public schools of Cleveland.

His college life began at Hobart, where two years left a deep impression from an acquaintance with Berkeley's thought, gained in browsing in the library, and long treasured up to produce fruit in philosophic views of maturer years. Then at Williams College, where the notable Natural History Society was sending out its expedition across South America, his love of Nature matured and specialized for two years longer, until he received the A. B. degree in 1870. It was Williams also that later, in 1893, bestowed upon him the LL. D. degree. For him the completion of college life was truly the "commencement" and not the finish of his intellectual training. His strong trend toward pure science and abstract mental life forced him onward into post-graduate work. But this required funds, and America was not Germany; the struggle for existence was not here so intense that one might not win bread in many walks of life without special training, and parents did not need to extend the larval period of support for offspring beyond the completion of college life to gain for them a place in any rank, social or intellectual. Now, a rapidly increasing need for the Ph. D. degree as entrance to professional life, necessitating several years of post-graduate study, often forces parents to take up their share in the increased burden. Then, however, few were agreed as to the advisability of prolonging an unpractical life devoted to study beyond what seemed the maximum limit of unproductive preparation for life—the day of graduation at college. Beyond that the young man must make his own way as best he might. The subject of this sketch [Pg 402] chose to work his way by his own unaided efforts into the fullest measure of academic training.

That was before the day of competition between universities, and there was no temptation to go here rather than there in order to live a semi-parasitic existence as scholar or fellowship holder.

First in his father's counting house, and then at a boy's school near Niagara, young Brooks bravely gained the means to pursue higher branches of natural history, and to devote himself to research. In the former position he realized how futile for him would be a life given to money-getting, and he palliated the uncongenial nature of that life by such abstract thought as seemed useful, one immediate result of which was the invention of a mechanical device for computing interest and discounts in sterling money, that had considerable circulation. This, though it scarcely indicated a stronger bias for mathematics than for Nature study, showed a latent possibility that was not to be developed. In the latter position, which brought him in close contact with the wonders of time action, so plainly read in one of Nature's books for the blind—Niagara Falls—he found food for thought, as well as a deep interest in the action of young minds. Here was much material for philosophical study of wood life too, as well as for growth of conceptions of the way to learn and to teach.

Free, after serving three years, to follow his genius, Agassiz's romantic venture at Pennikese drew this young naturalist, as it did so many of that epoch; and henceforth marine life, with its revelation of fundamental problems, fascinated him. Working on at Agassiz's museum, learning its collections by heart, absorbing from this center of American natural history and from its founder both stimulus and method, influenced deeply also by the unobtrusive teachings of McCrady and others who helped to make Cambridge the Mecca of naturalists, he was already an active contributor to the discussion of problems in the embryology of animals when he won his Ph. D. degree in 1875.

Quiet, diffident, slow to speak, leaving hasty action, too, for those of other constitution, with thoughtful brow and keen eye to look outward, as well as to regard inner thought, this young man with flowing beard was a noticeable person. At this time he was to be seen always accompanied by his faithful "Tige"; for, wiser than Ulysses, he shared all the hardships and joys of life with this loved companion.

Now he sought his true environment, and found it in the new university starting in 1876—the Johns Hopkins University. There he was appointed Fellow, an honor subsequently won by many who are well known to biological science, as W. T. Sedgwick, E. B. Wilson, K. Mitsukuri, A. F. W. [Pg 403] Schimper, H. H. Donaldson, H. L. Osborn, J. McKeen Cattell, H. H. Howell, A. T. Bruce, E. S. Lee, H. E. Nachtrieb, W. Noyes, J. Jastrow, E. B. Mall, H. V. Wilson, C. E. Hodge, S. Watase, and T. H. Morgan. Like C. O. Whitman, in 1879, he did not enter upon the privileges of that position, but as instructor and associate became at once a guiding element in the new growth. In the freedom from old traditions, from fixed conventions and routines offered by this new university, this peculiar original mind found its best environment, and while the opportunity doubtless did much for the man, the man certainly reacted most favorably for the welfare of the highest ideals of his new home.

We find him at once outspoken in emphasis of the philosophical aspect of animal morphology, contributing thoughts upon "inductive reasoning in morphological problems," upon "the relation between embryology and phylogeny," upon "the causes of serial and bilateral symmetry," and upon the "rhythmic nature" of the cleavage of an egg. Yet this period was also, and pre-eminently, one of acquisition of hard-earned and detailed facts. The development of Pulmonates and Lamellibranchs, of Crustacea and of Medusæ, as well as of the marvels of Salpa's life history, became absorbing studies.

This great field of the morphology of nonvertebrates could be properly worked only with access to the marine fauna, and at that date there were few facilities for seaside study in America. A true disciple of Louis Agassiz, Professor Brooks saw the need of a marine laboratory, and devoted himself, as Dohrn did at Naples, to the accomplishment of an end so necessary for the advance of natural science. Encouraged by the aid of a few citizens of Baltimore, in 1878 there was started an experiment—"The Chesapeake Zoölogical Laboratory," at Fort Wool, Va., with Professor Brooks as director. With the absolute devotion of its director to research as example, and with the liberal aid of the trustees of the Johns Hopkins University, this laboratory became a most important adjunct to the university and a virile center of zoölogical study. So great was its success as a factor in the advance of zoölogical knowledge that the trustees bravely continued to support it whenever financial disaster did not rob them of the last penny. For eight years in the Chesapeake, or in the remoter waters of North Carolina, the station flourished; then, in 1886, we find the director, with a few enthusiastic students, venturing in a small schooner to the but little known Bahama Island, Green Turtle Cay, there to enlarge their experiences with such delightful realization of naturalists' dreams of the tropics as Haeckel experienced in his Journey to Ceylon. Subsequent annual expeditions to Nassau, the Bemini Islands, and to various parts of Jamaica [Pg 404] served as marked eras in the lives of many young naturalists who will not soon forget the contact with life thus obtained.

From these sources and from his connection with the United States Fish Commission, as director of the Marine Station at Woods Holl, Mass., in 1888, Professor Brooks drew inspiration and fact for the work and thought by which he is so well known to the working naturalist. There are few great divisions of the animal kingdom that have not excited his special interest and claimed his long-sustained labor upon the problems they express. Like McCrady, deeply fascinated by the *Hydromedusæ* and their wonderful changes, many smaller papers, as well as the Memoir of the Boston Society of Natural History, entitled The Life History of the *Hydromedusæ* and the Origin of Alternation of Generations, testify to his success in unraveling plots that thickened with new discoveries.

An early interest in the mollusca, shown by his doctor's dissertation upon the embryology of the fresh-water mussels, printed in part in the Proceedings of the American Association, 1875, continued to be expressed in his contributions to many problems in the embryology of the fresh-water Pulmonates, of Gasteropods, of Lamellibranchs, and of the Squid. The Crustacea also rightly claimed a large share of the attention of a philosophic naturalist, bringing him face to face with the rigid formulations of law which these creatures present. The discovery of the very exceptional method of cleavage in the egg of the decapod Lucifer, and the demonstration of the existence of a free Nauplius stage there (published in the Philosophical Transactions of the Royal Society in 1882), marked a most important advance in the morphological interpretation of all Crustacea, and brought its author to the first rank as an authority upon this much-studied group. Studying and capturing at Beaufort those phantom-like sand burrowers, the Squilla, gained him an insight into and an interest in this strange division of Crustacea that enabled him to undertake that difficult task, the description of Stomatopods collected by the Challenger Expedition—a task completed in 1886. The report, published in such a magnificent series as only the British Government could have consummated, is noticeable for the author's clear, free illustration of the creatures described and classified. In it we find a classification of the numerous, weird, glassy larvæ, agreeing with the classification of the adults and marking the success of the solution of the problem—the reference of chance collections of various stages of many species to their proper places in the life history of each species.

When the fever for ancestral trees had spread among naturalists in a much more virulent form than that endemic in Wales, and when the Ascidians were brought into line as ancestral [Pg 405] vertebrates, it was no wonder to find Professor Brooks laboring upon these interesting creatures, but his work in this group started from a different point of view. As early as 1875, when studying in the laboratory of Alexander Agassiz, he contributed to the Boston Society of Natural History a description involving a most novel interpretation of the embryology of a remarkable Ascidian, Salpa. This form is known to many not naturalists as that beautiful animal chain which is sometimes so common in the clear waters of Newport Harbor as to be dipped up in every bucket of water, but more often not there at all. The female buds forth male branches and gives each an egg (which is fertilized to form a second generation of females). There is thus no alteration of sexual and non-sexual generations at all; and, with characteristic appreciation of a paradox, Professor Brooks subsequently emphasized the fact that the poet naturalist Chamisso, in discovering, in 1814, "Alternation of Generations" in Salpa, had discovered a phenomenon where it did not exist, though subsequently found common enough in many other animals. With the continuity of interest so marked in him, the life history of Salpa, as thus revealed, continued to be one of the living thoughts in Professor Brooks's mind for a long period of years, and, with the accumulation of material and results of researches afforded by his summer work, culminated in the monograph Salpa—a quarto of nearly four hundred pages and fifty odd plates—published in 1893, or after nearly twenty years of sustained interest in this complex problem. In this volume we find first a coherent view of the intricate life history of this animal illuminated by such metaphors as make the necessary technicalities both readable and thinkable. For instance, "A chain of Salpa may be compared to two chains of cars on two parallel tracks, placed so that the middle of each car on one track is opposite the ends of two cars of the other track, and each joined by two couplings to the car in front of it on its own track, and in the same way to the one behind it, and also to those diagonally in front of it and behind it on the other track." Again, in speaking of that startling process of egg development that makes the embryology of Salpa one of the apparently insoluble problems of this branch of inquiry, he says: "Stated in a word, the most remarkable peculiarity of the Salpa embryology is this: It is blocked out in follicular cells, which form layers and undergo foldings and other changes which result in an outline or model of all the general features in the organization of the embryo. While these processes are going on the development of the blastomeres is retarded, so that they are carried into their final position in the embryo while still in a rudimentary condition. Finally, when they reach the places they are to [Pg 406] occupy, they undergo rapid multiplication and growth and build up the tissues of the body, while the scaffolding of follicle cells is torn down and used up as food for the true embryonic cells. An imaginary illustration may help to make the subject clear. Suppose that while carpenters are building a house of wood the brick-makers pile clay on the boards as they are carried past, and shape the lumps of clay into bricks as they find them scattered through the building where they have been carried with the boards. Now, as the house of wood approaches completion, imagine the bricklayers build a brick house over the wooden framework and not from the bottom upward, but here and there wherever the bricks are to be found, and that as fast as parts of the brick house are finished the wooden one is torn down. To make the analogy complete we must imagine that all the structure which is removed is assimilated by the bricks, and is thus turned into the substance of new bricks to carry on the construction."

Following that descriptive portion of the work comes a most interesting interweaving of facts gathered in wide experience with a scientific imagination possible only to one who had lived and thought in close sympathetic contact with tropical marine life. It is an account of the present conditions of life along tropical shores and the probable steps that led to the evolution of the innumerable sedentary and creeping things from the ancestral forms that floated on the surface of the ocean before there were shores. Charming reading for the layman, and for the specialist a broadening poetic insight into life as it is and as it was when the world was young and the pelagic forbears of the vertebrates competed with their simpler associates in the annexation of the bottom as a vantage ground for the "benevolent assimilation" of later immigrants. The third portion of the work follows a most commendable plan: "Scientific controversy is so unprofitable that I shall try to make it as subordinate as possible, that the reader may devote all his attention to the life history of Salpa, without interruption at every point where my own observations confirm or contradict the statements of others." This section deals with the refutation of criticism of the author's interpretations, and endeavors to harmonize the discords that in this, as in all complex morphological research, make progress slow though surer.

The above brief references to the research work of the subject of this sketch would be too incomplete did we omit mention of his papers upon that very interesting and extremely ancient inhabitant of the Chesapeake, the Lingula, or of the beautifully illustrated memoir of the National Academy of Sciences, describing the crania of the Lucayan Indians, an unfortunate race of gentle beings discovered by the Spaniards and treated as part of the live stock of the New World and [Pg 407] soon annihilated, leaving but a few bones, and, as Professor Brooks tells us, our familiar and pleasant word "hammocks," as evidences of their having been.

Coming to maturity in the period of general acceptance of the Darwinian hypothesis of organic evolution, Professor Brooks was naturally deeply influenced, and no one who has read his works can doubt his allegiance to natural selection as a powerful factor in the formation of the present order of living things. In the American Naturalist for 1877 he published the first outlines of a provisional hypothesis of pangenesis that sought to "combine the hypotheses of Owen, Spencer, and Darwin in such a way as to escape the objections to which each is in itself liable, and at the same time to retain all that renders them valuable." In 1883 the same hypothesis—that variations are perpetuated chiefly through the male line by special gemmules, and that the female is essentially conservative—was elaborated in book form under the title of The Law of Heredity.

Thenceforth, in intervals of research work, Professor Brooks has contributed to various periodicals, notably the Popular Science Monthly, such essays upon kindred topics as spontaneously arose in his mind in connection with current work here and abroad. Some of these of a general philosophical interest have been incorporated with lectures, originally given to students in Baltimore, as The Foundations of Zoölogy, brought out this year by the Macmillan Company as Volume V of the Columbia University Biological Series. This, it will be noted, is dedicated "To Hobart College, where I learned to study, and, I hope, to profit by, but not blindly to follow, the writings of that great thinker on the principles of science, George Berkeley," and its keynote might be said to be difficult to hold, expressing the standpoint of one who says "The proof that there is no necessary antagonism between mechanical explanations of human life and belief in volition and duty and moral responsibility seems to me to be very simple and easy to understand."

Though thus active in pushing forward the limit of fact and theory in the domain of pure science, Professor Brooks has not shirked the duty that falls to every member of society, but has labored earnestly to build a sound basis for immediate practical application of zoölogical research. In 1876 he organized a summer zoölogical laboratory for teachers and others in Cleveland, with the co-operation of two other young Clevelanders—A. H. Tuttle, now Professor of Biology in the University of Virginia, and I. B. Comstock, Professor of Geology in the University of Arizona.

Identifying himself with the interests of the community in which he had cast his lot, he interested [Pg 408] himself in the establishment of such educational influences as that of a public aquarium, and it was through no fault of the sower that the seed laboriously sown fell upon stony ground. In the winter of 1880 he gave a course of lectures and of laboratory work for teachers in the schools of Baltimore.

Again, his early studies of the development of the oyster (for which he was awarded the medal of the Société d'Acclimatisation of Paris in 1883), his discovery that the American oyster could be reared like fish from artificially fertilized eggs, since he found it to have a different life history from its European fellow, led him to realize the greater possibilities that awaited our oyster industries when they should be based upon scientific fact. Living amid a population dependent to no small extent upon these industries, Professor Brooks threw himself with enthusiasm into the problem of warding off the ruin that comes to every enterprise expanding faster than its capital is replenished, and eagerly sought the means to magnify without deterioration so important a factor in the existence of the Commonwealth. As chairman of the Oyster Commission appointed by the General Assembly of Maryland in 1882, he drew up the long, detailed, and well-illustrated report, issued in 1884, which set forth the condition of the oyster beds in the Chesapeake Bay and their deterioration from overwork, and suggested a legislative remedy in the form of a bill designed to remove this industry from that primitive, barbaric stage in which our communal ownership of migrant birds and fish still remains, and to place it upon the secure basis of personal ownership underlying other live-stock business. But it is difficult to change the customs of centuries' standing, and prophets rarely see the fulfillment of their predictions. Many lectures and the issue of a popular book—The Oyster, 1891—were necessary labors assumed by Professor Brooks before the public mind was educated to some appreciation of the nature of the problem, and the fruits of his labors are yet to be matured and gathered.

But it is not so much by discovery of new facts or by aid to the community in which one may chance to live that a man exerts his best influence upon mankind; rather by his success in inspiring others to see whatever of good there may be in his point of view and method of attack upon old problems, that his followers may keep alive and enlarge what he stands for in the growth of civilization. As a teacher Professor Brooks has exerted a powerful influence by the stimulus of example in his whole-hearted devotion to research, by originality of suggestion, and by his clear intuition of the essential factors in morphological problems. Convinced that [Pg 409] naturalists, like poets, are born and not made—or, if so, then self-made—his teaching has been free from that too easily acquired hallucination that the forcible introduction of facts, and frequent extraction of words by means of examination, are a possible means to the making of zoölogists, or what you will to order, to be ticketed and branded as such after a fixed term of the above process. Those who are strong enough to grow in the open have found in him a genial sunshine, but those needing hothouse forcing have sometimes missed, perhaps, the care necessary to bring them to a marketable state.

Many who have followed his lectures will recall the clearness and simplicity with which complex and puzzling questions were presented to their minds; the skull of the bony fish soon lost its terrors, while the homologies of the limb bones were brought to the mind in a graphic way, sure to leave a deep impression. Directness and lucidity, with freedom from investment of unessentials, are characteristics of his teaching and prominent features in his too little known Handbook of Marine Zoölogy, which, despite technical faults, was so original and honest, so free from closet natural history, that it marked an era in the advance of biological instruction. It was a direct appeal to the concrete study of living animals at a time when zoölogy for students was still the learning of text-books, and text-books were too often in spirit but modernizations of Pliny or of Aldrovandus.

It is this removal of the impeding paraphernalia of custom-bound authority, and a direct, childlike communion with Nature in search of truth by one's unaided labor, that this man has to offer to those who come under his sway as teacher; with what success will be evident from the work of those who recently united to honor his fiftieth birthday with a portrait that might recall him to them as he taught them, and from the work of those who, in coming years, will enjoy the privilege of contact with his genius and be led to "seek admission to the temple of natural knowledge naked and not ashamed, like little children."

Forestry, Professor Fernow said in his paper at the American Association, is not, as it seems to be popularly believed, "Woodman, spare that tree," but "Woodman, cut those trees judiciously." The handling of a slowly maturing crop like forest trees requires especial consideration of a problem quite unlike any other that presents itself to the business man. The trees ripen slowly, a full century often being necessary to the complete development of growth. Obviously it would be inadvisable to cut down the product and then wait a hundred years for further income from the land; another system is necessary, where merely the interest is taken, in trees which are in a condition to cut, while the principal, the forest itself, remains always practically intact.

Editor's Table. [Pg 410]

PRIMITIVE MAN.

Two articles contributed to the April and May numbers of the Fortnightly Review by Mr. J. G. Frazer, the learned author of The Golden Bough, and more recently of a monumental edition of Pausanias, are worthy of the close attention of all who are interested in the early history of mankind. The articles are entitled The Origin of Totemism, and the object of the writer is to show that on this obscure subject a flood of light has been shed by the lately published researches of Messrs. Spencer and Gillen into the beliefs and practices of the native tribes of central Australia, those tribes being perhaps the best representatives now anywhere surviving of the most primitive condition of the human race. Mr. Baldwin Spencer, formerly a Fellow of Lincoln College, Oxford, is at present Professor of Biology in the University of Melbourne, while Mr. Gillen is a special magistrate in South Australia, charged with the protection of the aborigines. In their work, Mr. Frazer observes, "We possess for the first time a full and authentic account of thoroughly primitive savages living in the totem stage and practically unaffected by European influence. Its importance," he adds, "as a document of human history can, therefore, hardly be overestimated."

Evolution, it has often been remarked, and is again remarked by the writer of these articles, is an outcome of the struggle for life, and is rapid and vigorous or slow and feeble, according to the intensity of the struggle and the number and variety of the competing elements. Among the great land masses of our planet Australia is the smallest; and, owing to this circumstance, and also to its physical conformation, which renders large areas unfit for the maintenance of life, population has been much restricted and competition has been at a minimum. Hence the extremely backward and undeveloped condition of its native tribes, a condition which enables us, as Mr. Frazer observes, to detect humanity in the chrysalis stage, and mark the first blind gropings of our race after liberty and light.

The account given of these tribes contains indeed some very remarkable details. For example, "though they suffer much from cold at night under the frosty stars of the clear Australian heaven, the idea of using as garments the warm furs of the wild animals they kill and eat has never entered into their minds." They attribute the propagation of the human race wholly to the action of spirits, to whom they attribute a fecundating power, treating as wholly irrelevant to the matter any contact of the sexes. The idea of natural causation seems to be one which they have no power to grasp. They believe that various results are dependent on special antecedent conditions, but it is a pure matter of accident what they shall conceive the conditions in any case to be. Here we come to the origin of totemism. Heretofore totemism has been considered, broadly speaking, as the identification of themselves by some group of savages with a particular plant or animal or other manifestation of the powers of Nature, accompanied by a complete or partial *taboo*, so far as the group in question is concerned, of the animal or other object adopted as totem, and also by a rule prohibiting marriage within the group. What Messrs. Spencer and Gillen have succeeded [Pg 411] in doing has been to observe and detect the significance of certain practices of the Australian tribes which have never been observed, or at least never understood, before.

At a certain time of the year, it appears, each totemistic tribe goes through elaborate ceremonies of a purely magical character for the purpose of promoting the growth and multiplication of the particular animal or plant, if it be one useful for food, with which the tribe is identified, or of antagonizing its evil effects if it be of a hurtful character. As "there is scarcely an object, animate or inanimate, to be found in the country occupied by the natives which does not give its name to some totemic group of individuals," the general scheme of things is pretty well looked after in the various ceremonies that are practiced by the different groups. Attention is here drawn to the essential difference between religion and magic, religion being an attempt to propitiate or conciliate the higher powers, while magic undertakes to coerce them. "To the magician," as Mr. Frazer observes, "it is a matter of indifference whether the cosmic powers are conscious or unconscious, spiritual or material; for in either case he imagines that he can force them by his enchantments to do his bidding." The ceremonies of the native Australians, as we have said, are wholly magical. They have the same kind of faith in their incantations and other strange performances that the modern man of science has in the preparations he makes for a physical experiment. The difference is that imagination or the crudest kind of symbolism has suggested the methods of the savage, while a careful scrutiny and comparison of facts has dictated those of the man of science. The *proprium* of the savage mind is an utter insensibility to evidence, or rather a lack of all power of conceiving what evidence is, and therefore a total incapacity for feeling any need of it. The scientific man, on the other hand, feels that he needs it every hour and every moment.

It may be interesting to quote the description given by Mr. Frazer, after Messrs. Spencer and Gillen, of the ceremonies performed by the men whose totem is the "witchetty grub," a creature much prized as an article of diet by the natives.

"The men of the witchetty-grub totem repair to a shallow cave in a ravine where lies a large block of quartzite, surrounded by some small rounded stones. The large block represents the full-grown grub; the small stones stand for the eggs. On reaching the cave the head man of the totem group begins to sing, while he taps the large block with a wooden trough, such as is used for scooping the earth out of burrows. All the other men at the same time tap it with twigs of a particular gum tree, chanting the while. The burden of their song is an invitation to the insect to go and lay eggs. Next, the leader takes up one of the smaller stones, representing an egg, and strikes each man in the stomach with it, saying, 'You have eaten much food,' after which he butts at the man's stomach with his forehead.... Ceremonies of the same sort are performed at ten different places. When the round has been completed the party returns home. Here, at some distance from the camp, a long structure of boughs has been got ready; it is designed to represent the chrysalis from which the full-grown insect emerges. Into this structure the men, each with the sacred design of the totem painted in red ochre and pipe clay on his body, enter and sing of the grub in the various stages of its development. After chanting thus for a while they shuffle out of the mock chrysalis one by one, with a gliding motion, singing all the time about the emergence of the real insect out of the real chrysalis, of which their own performance is clearly an imitation." [Pg 412]

The Emu men have their own ceremonies, equally elaborate and quite as well adapted to promote the multiplication of emus as those of the witchetty-grub men to produce an abundance of witchetty grubs. The earnestness which is thrown into these ceremonies is beyond all question; and it seems to be clear that each totemic group in turn takes up its own burden of social responsibility: each has its duty to the tribe as a whole, and performs it to the best of its ability. Through their united efforts, as they firmly believe, the various processes of Nature are maintained in satisfactory activity; the succulent grub comes forth in due season and in reasonable quantity; the emu, the kangaroo, the bandicoot, and other useful animals keep up their numbers and continue to furnish food for the community; the hakea flower and the manna of the mulga tree grow in normal abundance; the winds blow; the streams flow; the clouds yield rain and the sun goes on shining by day and the stars by night, with, on the whole, an admirable regularity. A more satisfactory system it would really be difficult to conceive. How absurd, not to say profane, it would be for any one to suggest that ceremonies which were so abundantly justified by results might without danger be omitted! Skepticism is indeed very much out of place in certain stages of human development.

The interesting feature, however, as Mr. Frazer holds, in the descriptions given by the two Australian writers we have named is the proof they afford that totemism, instead of being an irrational, unexplainable aberration of the nascent intellect of man, was really a scheme for securing the greatest possible multiplicity of benefits for the savage community. The whole tribe was divided into groups, and each group undertook to look after some function of Nature and keep it up to the mark. Here was a notable step in the direction of division of labor. How it came about that the particular animal or plant which was the totem of a group became wholly or partially *taboo* to the group is not very easily explained; but it seems not impossible that some sense of tribal duty, gradually developed, kept those who were credited with providing any particular food element from being themselves greedy consumers of it. So far as that article was concerned they may have felt themselves as sustaining somewhat the character of hosts or entertainers of the tribe, and it may thus have become the custom that they should either not partake at all of that special thing, or partake of it only sparingly. If so, we find the foundations already laid both of politeness and of morality. It is an interesting question how far the notions which have been described have died out of modern civilized society. That they are wholly extinct it would be rash to affirm. There are many traces, indeed, of the surviving influence of symbolism, and here and there lingering tendencies toward a belief in magic are easily discoverable. Perhaps the wisest of us may learn to understand ourselves a little better by studying the operations of the human mind in its very earliest stages, before reason had yet shaken itself free from the random suggestions of sense.

THE BOSTON PUBLIC LIBRARY AND SCIENCE.

Apropos of the recent notable issue, by the Boston Public Library, of a comprehensive Bibliography of the Anthropology and Ethnology of Europe, to accompany Professor Ripley's Races of Europe, the twofold and diversely opposed interests of a great institution of this sort are called to mind. On the one hand are its manifold obligations to the great mass of the public, to the average reader, to the ubiquitous novel and fiction consumer, to private clubs, and to school children. A field of activity and value in popular education is involved, scarcely secondary to that of the public schools, appealing to the general reader, the taxpayer, and, above all, to the well-wisher for democratic political institutions and representative government in the future. In stimulating work of this character in Boston, in bringing the Public Library into deserved prominence among the educational institutions of the community, Mr. Herbert Putnam achieved great and deserved success during his administration, winning commendation upon all sides.

The second aspect of public library duty is revealed by the recent undertaking at Boston above mentioned. It concerns the relations of great libraries to science, to original research, not to the average reader, but to the specialist. Instead of the purchase of twenty copies of David Harum, or perhaps of A Bloodthirsty and Self-laudatory History of the Recent Spanish War, by One who killed fifty men with his own hand, to meet a sudden demand on the part of readers, the expenditure of perhaps an equal sum of money for some rare and costly work in a foreign language, intelligible to but half a hundred men in the entire city, is involved. Such obligations do not of course rest upon libraries of secondary size and importance. Their path of duty is clearly marked out for them in the interests of the public, both on the score of financial ability and of demand as well. With the leading libraries of the country the case is different. Our universities are fast taking rank with the very best in Europe. Specialists in science and technology, the peers of those abroad, are plentiful on every hand. Oftentimes their private means are as limited as their appreciation and ambition are great. Without these rare books—the tools of their trade—they are powerless. In former days they were denied the opportunity for research, or else were obliged to spend months of study in Europe. We have the men and the minds here in America now; there is every indication that the books and apparatus are speedily becoming available as well.

This Bibliography of the Boston Public Library is a case in point. A collection of works relating to the physical history, the origins, migrations, and languages of the peoples of Europe is indicated upon its shelves, in all probability, we venture to predict, superior to any single one existing in Europe. This startling statement is based upon several considerations familiar to any specialist. Scientific book materials are of two classes. The first are the expensive and compendious volumes, generally to be found in great libraries, although oftentimes the paucity of their scientific collections is very surprising, especially in all that concerns the newer sciences of biology, anthropology, and the like. The second order of publications, often rarer and scientifically more valuable than the first, are the scattered monographs or pamphlets published in all manner of forms and by societies, oftentimes ephemeral and of all degrees of eminence. This second class of materials is generally richly represented in the collections of the various scientific societies, especially in the form of reprints presented by the authors. But the great and expensive tomes are seldom thus presented, and the societies can seldom afford to purchase them. Thus it comes about that these two classes of raw materials have to be separately hunted down, being rarely found together. For example, the library of the Société d'Anthropologie at Paris, judging by its printed catalogues, while abounding in scattered monographs and reprints, [Pg 414] contains very few of the expensive volumes. One must seek these, and if they be in English or German, very likely in vain, in the Bibliothèque Nationale.

The Public Library of the city of Boston has apparently tried an experiment in this direction, and is certainly to be congratulated upon the result. To a very rich collection of standard works has been added, by co-operation with a special investigator, a large part of the *flotsam* and *jetsam* which is of such extreme value to the student of original sources. The library has set a worthy example of encouragement to research; it has offered definite proof of the ability of our American institutions to rival their European contemporaries. And a peculiarly appropriate rounding-out to the successful career in the distinctively popular phases of administration of the institution of the late librarian, Mr. Herbert Putnam, is afforded in this work, the last at Boston officially, perhaps, to bear his signature and the stamp of his approval.

OUR RACE TROUBLES.

The article which we publish in the present number of the Monthly, under the title of The Race Problem in the United States, is a sequel to one which appeared in the May number entitled The Negro Question. Both writers have a special acquaintance with the subject, and are widely known as active workers for the elevation of the negro race—Mr. Booker T. Washington, the writer of the second article, being himself one of its most distinguished representatives. While both manifest abundant sympathy with the negro, and a deep sense of the pressing nature of the problems to which the presence of a large negro element in the population of certain of our States gives rise, they virtually acknowledge that it is extremely difficult in discussing the subject to do more than present a few broad general views. That there is a very bad condition of things in some of our Southern States no one will dispute. The crimes which have been committed by white men, in avenging real or supposed crimes committed by black men, stamp a character of utter savagery on the communities in which they have occurred, and in which they have remained unpunished. At the same time there is no doubt that the existence of so large a negro element in the South constitutes a serious obstacle to the moral and intellectual as well as to the economic development of that part of the country, and tends to keep alive a dangerous condition of public feeling. Our contributor, Dr. Curry, states significantly that he could give very impressive details on this point, were it not that it would furnish altogether too unpleasant reading.

What are we going to do about it? No doubt we have before us an illustration of the old adage, "The fathers have eaten sour grapes, and the children's teeth are set on edge." The South had its "peculiar institution" for some generations, and held to it with extraordinary tenacity—went to war rather than give it up. Now, by the simple force of events, the old patriarchal and slaveholding system is broken up, and there the former slaves and their descendants are—emancipated citizens who have their rights under the Constitution, and who therefore have to be reckoned with. They can not be deported against their will; they have the same right to live in the country that any white man has.

Manifestly there is but one honorable way of dealing with the blacks, and that is to treat them with absolute justice. Upon this point we are in entire agreement with Mr. Booker T. Washington. If a black man is excluded from the suffrage on account of his ignorance, let the equally ignorant [Pg 415] white man be equally excluded. We have great faith in the educative effect of justice, and a firm administration of law. It would at once raise the self-respect of the negro to know that what was law for the white man was law for him, and *vice versa*; and self-respect is a sure ground for further advance. In the matter of education, we hold that education for the colored race should be almost wholly of a practical kind. We go further, and say that the education given to white children everywhere might with great advantage be much more practical than it is. The proper education for any individual is that which will tend to make him more efficient, successful, and self-sufficing in the position which he is called to occupy. This principle, far from implying a stationary condition of the individual, is precisely the one which provides best for his advancement. It is the man who is thoroughly competent for the work he has at any given moment to do who passes beyond that work to something better. The misery of existing systems of education is that to so large extent they educate for a hypothetical position beyond that for which an immediate preparation is necessary. The result is that the schools unload upon the community year by year a levy of adventurous youths who at once begin to live by their wits in no very creditable sense, and who constitute a distinct menace to the stability of society.

We would therefore urge most earnestly upon all who take an interest in the education of the colored race to keep in view above all things the importance and necessity of fitting the negro to take an active part in the practical industries of the country, and above all in agriculture. An education directed mainly to this end would do far more to develop his intelligence than one of a more abstract and ambitious character and would furnish a far better foundation for success in life. Far from tying the negro down to manual occupations, it would prepare the way for his eventual participation in all occupations. But occupation for occupation, where is there one that can reasonably be rated higher than the intelligent and successful cultivation of the soil? If the negro problem can not be solved by common sense and common honesty it can not be solved at all. Before giving it up as insoluble we should make full proof of these homely specifics. We have long been proclaiming that the negro is a man and a brother; let us therefore treat him as such, and if we find out anything that is particularly good for his moral and intellectual improvement, let us try a little of it ourselves. It surely will not do us any harm.

Scientific Literature.

SPECIAL BOOKS.

The Lesson of Popular Government[12] is a fruit of thirty years' study, by Mr. *Bradford*, of certain peculiarities in the political workings of our institutions. The book is not for those who consider it patriotic to shut their eyes to whatever is going wrong, but for those whose regard for the Federal Constitution and the organization of our governments is only increased by the consciousness of the strain to which they are exposed, and who feel strongly that while the principles of the Government and the character of the people "are still sound and reliable, some modifications and readjustments of the machinery must take place, unless we are to drift through practical anarchy and increasing corruption to military despotism." For the sake of putting the subject in a clearer light, the three more prominent approaches to democratic government in modern times—those of England, France, and the United States—are studied comparatively in the former part of the work. The carrying on of governments in accordance with the expressed wish of the people is spoken of in the beginning as the appearance of a new force which has changed the whole face of society, and points to still greater changes in the future. How it has worked in the three countries in which it has been in operation for a little more than a century, and what it has done, are the questions which the author undertakes to answer. In England, popular government has taken the form, with a powerless hereditary sovereign commanding universal loyalty, of a ministry responsible to a Parliament, which is directly responsible to the people. In France, the executive is controlled by a legislative body chosen by universal suffrage, the majority of which is held together by party discipline. The virtue of this government is undergoing a supreme test in the Dreyfus case, the right issue of which would show a greater proportional advance in true liberty and the justification of popular government than has taken place in any other nation. In the United States, power is passing more and more into Congress, a body chosen separately from the President, whose members are actuated by personal, local, and partisan motives, and rarely rise to the conception of broad national views or look further than to the immediate present, while the nation at large and the Executive are without representation such as insures the co-operation of the ministry and Parliament in England. In all other respects than appointments to office, which must be made "in strict subordination to the demands of members of his party in both Houses of Congress," the recognized power of the Executive is confined within very narrow limits. In matters of legislation he has no voice whatever beyond general recommendations, such as are open to any citizen, and to which Congress pays little or no attention. In fact, that body resents anything like an expression of opinion from the President. The system is not encouraging to the filling of the office by men of the first rank, and men of that rank seldom reach it. The House of Representatives, meeting every two years a new body, suffers from its entire want of coherency and the absence of a qualified leader, and falls an easy prey to the lobbyist and the boss. So, while "there are still many, perhaps the majority, of men of good character in public life, the tendency is steadily downward." It has been customary in some quarters to charge the evils we suffer upon universal suffrage, but Mr. Bradford maintains that it is this which to-day is keeping up the character of the Government, and that but for the restraints imposed by it our political condition would be a great deal worse than it is. Further light is sought upon the situation, and further pictures are given of the conditions existing in comprehensive reviews of the State and municipal governments of the country. In considering proposed remedies the referendum is dismissed as tending to destroy personality and diffuse responsibility even more than is done now—the reverse of the concentration of executive power as the only really indispensable part of the Government, which should be sought. The enforcement of this principle of executive supremacy with immediate responsibility is the purpose of the book. Mr. Bradford would obtain this by giving the representatives of the administrative departments seats in the House, with power to suggest legislation, make explanations, and participate in debate. His final argument is that it can not be charged that democracy is a failure; but, "with a wholly new force introduced into the world, the proper machinery for its application has not yet been employed. In its nature it is reasonable, sound, and, on the whole, beneficent." Using the words of an English writer, "the failures of government in the United States are not the result of democracy, but of the craftiest combination of schemes to defeat the will of democracy ever devised in the world."

We have already published a fairly comprehensive review of *Richard Semon's In the Australian Bush*,[13] based upon the German original, by Prof. E. P. Evans, in the fifty-second volume of the Monthly (November, 1897). But little needs to be added to what Professor Evans has said of the book besides announcing the appearance of the English edition, the translation for which was written under the author's own superintendence, and the contents of which do not differ in any important particular from the German impression. Professor Semon went to Australia on a special zoölogical mission, and spent two years there. His purpose was the study of the wonderful Australian fauna, the oviparous mammals, marsupials, and ceratodus (lungfish). These animals represent forms which, with a few notable exceptions, have long since become extinct in other countries, where they have to be studied in such parts of their bony forms as happen to have been preserved in the rocks, while here they can be examined alive and in the flesh—"living fossils," as the author fittingly calls them, links between the present age and one of the geological periods of the past. His observations on these subjects are in course of publication in a special scientific work, not quite half of which has appeared. The present volume consists in the notes of travel and adventure, the dealing with men, the anthropological studies, and what we might call the *obiter* observations of the expedition. Almost simultaneously with Professor Semon's narrative we have from the same publishers another book, on *The Native Tribes of Central Australia*,[14] which deals more fully, exclusively, and perhaps more expertly with the anthropology of a part of the Australian continent. Of the authors, Mr. *Gillen* has spent the greater part of the past twenty years in the center of the continent, and as sub-protector of the aborigines has had exceptional opportunities of coming in contact with the Arunta tribe; and both of them have been made fully initiated members of that tribe. Though both about Australia, the two books do not cover the same ground. Australia is very large, and its physical conditions are such that the groups of tribes inhabiting the various regions have for a long period of time been isolated from one another and have followed different lines in development. Professor Semon's observations were made in the Burnett district of northeastern Queensland, while those recorded in the work of Spencer and Gillen were made in the very center of South Australia and of the continent. Consequently, in reading them we read really about different things. In addition to the investigation of various customs, such as those connected with initiation and magic, special [Pg 418] attention has been paid by Messrs. Spencer and Gillen to the totemic system and to matters connected with the social organization of the tribes; and here again the authors insist upon the differences between the groups of tribes, and that the customs of no one tribe or group can be taken as typical of Australia generally in any other sense than as broad outline. Both works deal with considerable fullness with the institution of marriage among the Australians, and the customs by which too close intermarriage is prevented. Among other subjects treated with especial fullness by Messrs. Spencer and Gillen are the totems, the bull-roarers, the Intichuma ceremonies (associated with the totems), the initiation ceremonies, customs relative to the knocking out of teeth, traditions, burial and mourning, spirit individuals, medicine men and magic, methods of obtaining wives, myths, clothing, weapons, implements, decorative art, and names. Professor Semon formed a moderate opinion of the capacity of the Australians. Though coarse and heavy, their faces are not bad looking and have expression. They are "no link between monkeys and men, but human creatures through and through," though of one of the lowest types. They have no pottery, no agriculture, no abstract ideas of any kind, can not count very far, but are clever in learning to write, read, and draw, are experts in signaling, and have their intellect and senses "brilliantly developed in all directions bearing on the hunt," with great dexterity in the use of weapons.

GENERAL NOTICES.

Miss *Mary H. Kingsley* has given in her *West African Studies*[15] a book marked by pungent wit and striking originality in its sketches of adventure and observation, and containing in the chapters devoted to ethnology results of her personal studies. She was already known by a record of her adventures of a young Englishwoman traveling alone through some of the worst regions of West Africa, embodied in her book Travels in West Africa, which was published in the latter part of 1898. The present book may be regarded, as its name implies, as the result and the embodiment of the afterthoughts of that hazardous journey. It includes, after descriptions in which the unconventional directness of expression is much to be remarked, an account of African characteristics and a description of fishing in West Africa, chapters of a soberer sort on fetich, schools of fetich, witchcraft, African medicine and the witch doctor, and historical and economical chapters on Early Trade, French Discovery, Commerce, the Crown Colony System and some of its incidents, The Clash of Cultures, and African Property. Miss Kingsley's criticisms of the present system of administration being regarded as rather destructive, she endeavors to set forth, in a chapter entitled An Alternative Plan, "some other way wherein the African colonies could be managed." Special attention is invited by the author to two articles in the appendix to the volume by M. le Comte C. N. de Cardi and Mr. John Harford. We are pleased to note the high appreciation which Miss Kingsley expresses of the anthropological work concerning west-coast tribes of our former contributor, Colonel A. B. Ellis—Sir A. B. Ellis when he died.

Mr. *Frederick Palmer's In the Klondyke*[16] is an unpretentious book and free from the appearance of sensationalism, but gives a clear and graphic account of the region and its ways and of the getting there at the breaking up of winter. The author was at Dyea late in February, having intended to go with a Government relief expedition which had found no occasion to [Pg 419] proceed farther. Being thus left out, he undertook, with dogs and sledges and two companions who proved congenial, the "untried journey" of six hundred miles over the ice fields of the Lewes Lakes and the ice packs of the Yukon River, which had been the contemplated route of the expedition. The start was made about the 18th of March, with little time to spare, because the Yukon was expected to become impassable by the 20th of April. The Chilkoot Pass was achieved in a day, and the rest of the journey was made "downhill with the current of the river at the rate of eight inches to the mile," in weather that became very variable, with now hard freezing and now slush in the middle of the day. The difficulties of the journey must have been formidable, with considerable suffering, besides a week in a hut with the measles, but no complaint further than the mention of the incidents appears in the author's story. On some of the days the thermometer ranged from 10° to 20° below zero at two o'clock in the morning, to 80° above at night, and the author "had one ear blistered by the frost and the other by the sun in the same day." The party arrived at Dawson just four days before the final break-up of the ice in the river. Accounts corresponding in temper and vividness with that of the journey are given of Dawson, the miners and mining, the history of the Klondyke mining enterprise, Klondyke types of character and adventure, the toils and trials and profit and losses of the "Pilgrims," the workings of the Government, and the return home to civilization—which does not appear, after all, to have offered transcendentally superior attractions to those who had experienced the pleasure of adventure.

The *History of Physics in its Elementary Branches*[17] has been prepared by Professor *Cajori* in the belief that some attention to the history of a science helps to make it attractive, and that the general view of the development of the human intellect gained in reading a history on the subject is in itself stimulating and liberalizing. The author has had in mind Professor Ostwald's characterization of the absence of the historical sense and the want of knowledge of the great researches upon which the edifice of science rests as a defect in the present method of teaching. The subject is treated by periods. In ancient times the Greeks, while displaying wonderful creative genius in metaphysics, literature, and art, being ignorant of the method of experimentation, achieved relatively little in natural science. The Roman scientific writers were contented to collect the researches of Greek professors. Except in a few instances the Arabs did not distinguish themselves in original research. Writers in the middle ages were only commentators, and knew nothing of personal investigation. The physicist of the renascence abandoned scholastic speculation and began to study Nature in the language of experiment. The seventeenth century was a period of great experimental as well as theoretical activity. In the eighteenth century speculation was less effectively restrained and guided by experiments. The nineteenth century "has overthrown the leading theories of the previous one hundred years, and has largely built anew on the older foundations laid during the seventeenth century." The evolution of physical laboratories, first for teachers and then for students, is the subject of the last chapter.

"The Great Commanders Series" of D. Appleton and Company is enriched by a biography of *General Sherman*,[18] whom the author, General *Manning F. Force*, styles "the most picturesque figure in our civil war." He was more than this; he was its scholar and statesman—a man distinguished by the possession of high military combined with the best civil qualities. Further, as General Force well says, "his character was absolutely pure and spotless." In his dealings with the Vigilance Committee in San Francisco he assumed a position which it required courage of a much higher order than a soldier's to maintain. While comfortably situated as an honored professor in the State Military Academy of Louisiana when the Legislature passed the Ordinance of Secession, he had no hesitation in deciding what to do. He at once gave in his resignation in a [Pg 420] letter that is a model of manliness, declaring his preference "to maintain allegiance to the Constitution of the United States as long as a fragment of it survives." His career as a general in the civil war is described at length. Through it all his foresight, seeking always to accomplish the most with the least expenditure and ultimate suffering, to which his strategy was adapted, is conspicuous. At this time and afterward his supreme thought appears to have been as to what would best conduce to the permanent good of the republic. To his military ability and self-effacing patriotism he added a far-seeing wisdom in council that could always be relied upon. "In his most unguarded words his principle was always clear, noble, and intensely patriotic, and his careless colloquial expressions often covered a practical wisdom and insight of a most striking kind."

In preparing their *Text-Book of Algebra*[19] the authors, assuming that mental discipline is of the first importance to every student of mathematics, have endeavored to present the elements of the science in a clear and logical form, while yet keeping the needs of beginners constantly in mind. Special attention is given to making clear the reason for every step taken; each principle is first illustrated by particular examples, and then rules and suggestions for performing the operation are laid down. The authors have endeavored to avoid apparent conciseness at the expense of clearness and accuracy, and have thereby made their volume somewhat larger than ordinary text-books. Features to which attention is called are the development of the fundamental operations with algebraic numbers and the concrete illustrations of these operations; the use of type forms in multiplication and division and in factoring; the application of factoring to the solution of equations; the solutions of equations based upon equivalent equations and equivalent systems of equations; the treatment of irrational equations; the discussions of general problems and the interpretation of positive, negative, zero, intermediate, and infinite solutions of problems; the treatment of inequalities and their applications; the outline of a discussion of irrational numbers; a brief introduction to imaginary and complex numbers; and the great number of graded examples and problems.

The material of the *Primary Arithmetic*, Number Studies for the Second, Third, and Fourth Grades, of *A. R. Hornbrook* (American Book Company), has been chosen with careful reference to the development of the number sense of little children, as noticed by the author and as reported by many other observers. A distinctive feature of the work is the use of diagrams called "number tables," as a concrete basis for the child's thinking while he is getting his first ideas of the facts of the addition and multiplication tables. In them the numbers up to one hundred are presented in columns of tens, and so handled as to exhibit to the child's conception the relations of the several digits. By their use he first learns the properties of ten, then of two, and so on of the others—not presented in regular order, but with a view of exhibiting special properties—and their relations to one another. The method is ingenious and appears useful.

The study on *Rhode Island and the Formation of the Union*, of the Columbia University Series in History, Economics, and Public Law (The Macmillan Company, New York), was undertaken by Mr. *Frank Greene Bates* in order to ascertain why Rhode Island so long delayed its ratification of the Federal Constitution. The delay seems to have been largely a matter of the assertion of State rights, in which Rhode Island appears at that time to have been but little, if any, behind South Carolina. Liberty "was the presiding genius of the spiritual life of the colony, and the principle of freedom of conscience was never lost sight of; and this could not otherwise than heighten the other characteristics of the colony—individualism." The course pursued was the natural outcome of the conditions of the times, the "outcropping of the undying love of the people of the State for democracy and liberty, and their jealousy of all authority outside their own boundaries." [Pg 421]

"No book up to recent date," says the author of *Pantheism, the Light and Hope of Modern Reason*, who signs his name *C. Amryc*, and gives no publisher's name, "has treated pantheism as consistently as it deserves to be treated"; and he adds that "it is no creed; it is a logic; it makes absolutely no demand upon 'belief'; what is not logical is rejected, what is logical to-day is accepted, no matter whether it was unlogical a thousand years ago or will be illogical a thousand years hence; we are only responsible for our times." As pantheism, if it is a true logic, must be applicable to all races, the author has not chosen his examples from one nation or tribe; and he believes that the views he expresses are also those of nine tenths of what is called modern science. Many topics are treated of, some of which would not at first thought be associated with an exposition of pantheism. The matter and manner of the book are various. Parts of it are fairly good reading; other parts strike us as different.

A book on *The Principles of Agriculture*, prepared by Prof. *L. H. Bailey* as a text-book for schools and rural societies, is published as a number of the Rural Science Series of the Macmillan Company ($1.25). In it agriculture is treated as a business, not a science, but as a business which is aided at every point by a knowledge of science. "It is on the science side that the experimenter is able to help the farmer. On the business side the farmer must rely upon himself, for the person who is not a good business man can not be a good farmer, however much he may know of science." The principle of the intelligent application of knowledge is illustrated in a remark of the author's about the treating of drainage. The learner is apt to begin at the wrong end of his problem. In the usual method the pupil or reader is first instructed in methods of laying drains. "But drainage is not the unit. The real unit is texture and moisture of soils—plowing, draining, green cropping, are methods of producing a given or desired result. The real subject-matter for first consideration, therefore, is amelioration of soil, rather than laying of drains." Professor Bailey aims throughout this book to get at "the real subject-matter for first consideration" in matters relating to soils, the plant and crops, and the animals and stock.

Ideals and Programmes (C. W. Bardeen, Syracuse, N. Y., 75 cents) is a collection of thoughtful and suggestive essays, by *Jean L. Gourdy*, on the practical side of school life and the teaching of children. The author's ideal seems to be that the teacher should have a plan for her work, preparing for it so as to have the whole course marked out on general lines for the entire school year. Thus, her occupation should be to qualify herself for doing the work right. These statements of general principles are followed by essays on reading and plans for teaching, correlation as "the headstone of the corner of successful teaching, geography, sand modeling, field lessons, kindergarten training, and discipline." The burden of the whole is by skillful adaptation to get the best possible out of every lesson, in which a liberal use of field work assists greatly, and above all to avoid the stiff, formal, juiceless lessons of the old style of teaching.

There have been several biographies of Faraday, most of them now out of print; but the life, work, methods, character, and aims of the man—who was "beyond all question the greatest scientific expositor of his time"—can not be kept too constantly or too long before the minds of students. Welcome, therefore, is the easily accessible and convenient volume *Michael Faraday: His Life and Work*, which has been prepared by Prof. *Sylvanus P. Thompson*, and is published by the Macmillan Company in their Century Science Series ($1.25). The work by which Faraday contributed so much to the advancement of knowledge is made prominent, and is illustrated largely, due regard being had to the limitations of the size of the book, with citations from his own journal and copies of his drawings.

In *American Indians*, a book second in order but first in date of publication of a series of "Ethno-Geographic Readers" (D. C. Heath & Co., Boston), Prof. *Frederick Starr* has succeeded in conveying a large amount of information about our aborigines in a very small space, and has [Pg 422] done it in a clear style and a very satisfactory manner. The book is intended as a reading book for boys and girls in school, to whose tastes and capacity it seems well adapted; but the author will be pleased if it also interests older readers, and hopes it may enlarge their sympathy with our native Americans. Besides the accounts of the tribal divisions, general customs, manner of life, houses, and institutions—which when they are counted up are found to be quite numerous—it has articles on the sign language, medicine men and secret societies, the mounds and their builders, George Catlin and his work, the cliff-dwellings and ruins of the Southwest, the tribes of the Northwest coast, matters of religious and mythological significance, the Aztecs, the Mayas, and the ruined cities of Yucatan and Central America.

The revision, for the fifth edition, of *H. Newell Martin's The Human Body* (Henry Holt & Co., New York, $1.20) was undertaken by Prof. *George Wills Fitz* with the idea of bringing the book into accord with the late developments of physiology, of simplifying the treatment of some parts while expanding that of others, and of giving additional illustrations. Every effort has been made to avoid injuring those features of the author's work which have contributed to making the book so favorably known. The changes in the first nine chapters are largely verbal; but considerable alterations and additions have been made in some of the succeeding chapters. The directions for demonstrations and experiments have been greatly enlarged and collected into an appendix. They include the new requirements in anatomy, physiology, and hygiene for admission to Harvard College and the Lawrence Scientific School.

We have already noticed some of *Lucy S. W. Wilson's* excellent Manuals on Nature Study, particularly the one intended for the guidance of teachers. We now have in the same line the *First Reader* of a series on *Nature Study in Elementary Schools* (New York: The Macmillan Company, 35 cents), a book composed of original matter and selections which has been prepared "with the desire of putting into the hands of little children literature which shall have for their minds the same interest and value that really good books have for grown-up people." But the author does not expect to accomplish this by merely giving the book to the child and leaving the reading to work out its own effect. Each of the lessons is intended to be preceded by a Nature lesson. During or after the reading a lesson should be given in the new words introduced, and afterward the lessons should be grasped for the sake of thought. The lessons, which have appropriate illustrations from Nature, present some novel features. Among them is an apparent intention in the original compositions to follow the child's method of thought.

The American Elementary Arithmetic (American Book Company) is intended by the author, Prof. *M. A. Bailey*, to cover the first five years' work (beginning apparently very young) in the study, and is the first of a two-book series. It is divided into two parts—for the primary and for the three succeeding grades. It contemplates the use of apparatus, consisting of paper, pasteboard, toy money, blocks, and splints. The attempt is made to give every subject twice: first in pictures, and second in the particular form of printed words. Mathematical conceptions are presented in the first chapter in the order in which they are supposed to arise in the child's consciousness—first, once or more, indefinitely; next, how many, by holding up fingers, laying down sticks, etc.; and then by words, and so on—all introductory work designed to develop step by step a mathematical vocabulary, and to form a habit of clear mathematical thinking. The laboratory plan is followed in the succeeding chapters.

In the *Language Lessons* of *J. G. Park* (American Book Company) an arrangement of the matter is aimed at which will draw upon the student for such effort as may be expected at a given stage of advancement, which will cause him to think first and then to express his thought with clearness and precision. In the succeeding parts are given exercises on language work, with special drills upon capitalization and punctuation, inductive lessons in grammar, and, finally, lessons so graded that a student may advance very readily from them into the higher work of grammar. The study is facilitated by the use of striking illustrations as the basis of lessons.

The *Semi-annual Report of Schimmel and Company* (Leipsic and New York), though primarily a business document, furnishes much information about the industries in essential oils and fine chemicals, and concerning progress in the departments of chemical science relating to these. The report for October, 1898, speaks of much research and many valuable studies as having been carried on during the preceding six months in the domain of the essential oils and their constitution, and of ample material for scientific reports as having been gathered.

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Fragments of Science.

The Gypsies and their Folk Tales.—In the introduction to his collection of Gypsy Folk Tales Mr. Francis H. Groome describes the wide dispersion of the gypsy race as extending, in Europe, from Finland to Sicily, and from the shores of the Bosporus to the Atlantic seaboard; in Asia, from Siberia to India, and from Asia Minor (possibly) to China; in Africa, from Egypt and Algeria to Darfúr and Kordofan; and in America, from Pictou in Canada to Rio Janeiro. Believing that the gypsies, originating in India, left that region at an unknown date very long ago, he traces their migrations in the past and shows that a part of the race is still very migratory, passing, among other routes, between Scotland and North America, and between Spain and Louisiana. Another [Pg 425] migration not mentioned in his book is the annual oscillation between north and south of the North American gypsy colony, which is growing healthily. The author finds it at present quite impossible to fix the arrival of the gypsies in southeastern Europe at a thousand years before Christ or a thousand years after. If the Komodromoi of the Byzantine writers were gypsies, then these people must have been a recognized and familiar element of the Balkan population about as early as the latter date. Gypsies pass for a very cunning people, and such they are to outsiders, so that Romany or gypsy guile is a very common expression. Centuries of suspicion and repression have taught them to arm themselves proof against confidence in strangers; but to those who become acquainted with them, as Mr. Groome professes to have done and George Borrow did, they present a character of simplicity and frankness. There is, as a gypsy woman once said to a writer in The Athenæum, "somethin' in the mind of a Gorgio that shuts the Romany's mouth and opens his eyes and ears." Gypsies are active transmitters of folklore, and have rich funds of stories; and many believe that the folklore stories of Europe are traceable to Indian sources, whence they may have been transmitted to Europe. Mr. Groome suggests how some of these stories may have originated by telling of a gypsy girl he knew who dashed off "what was almost a folk tale impromptu." She had been to a picnic in a four-in-hand with "a lot of real tiptop gentry," and "Reia," she said to me afterward, "I'll tell you the comicallest thing as ever was. We'd pulled up to put the brake on, and there was a *puro hotchiwitchi* (old hedgehog) come and looked at us through the hedge, looked at me hard. I could see he'd his eye upon me. And home he'd go, that old hedgehog, to his wife, and 'Missus,' he'd say, 'what d'ye think? I seen a little gypsy gal just now in a coach and four horses,' and 'Dabla,' she'd say, 'bless us, every one now keeps a carriage.'"

Educational Work of an Experiment Station.—The survey of the year's work of Cornell University Agricultural Experiment Station in its efforts to "help the farmer" by dealing with present-day problems includes mention of its investigations, related in bulletins published or to be published in reference to fruits, their insect and fungoid enemies, vegetables, flowers, sugar beets, potatoes, fertilizers, beans, the dairy, veterinary science, horticulture, and plant disease. Much of the work of the station can not be published, consisting as it does of correspondence, personal advice, attending meetings, making records, or the performance of special illustrative experiments at farmers' homes or in neighborhoods as object lessons. "It is a pity," the report says, "that every farmer in the State can not be personally touched at least once in his life by the methods and the inspiration of a good teacher." The itinerant schools which were held in the early days of the extension work are regarded as being most beneficial when the community has been awakened by simpler and more elementary means, while the larger part of the work can be done more economically than by them. Yet in particular places and cases they are of greatest value, and they are still held when suitable conditions prevail. Special dairy schools, largely of the nature of practical demonstrations, were held at various places. The report lays much stress on the importance of beginning the educational work with the children and upon the value of Nature study. More than sixteen thousand school children have requested and been supplied with information on the making of gardens.

Flies as Bearers of Disease.—In estimating the relative importance of flies and water supply in spreading disease, Dr. M. A. Veeder distinguishes between intestinal and malarial disorders. In the former the infection is a bacillus of some sort, the presence of which can be traced to contamination by excretions from a diseased bowel. In the latter the source of infection is peculiar to marshy or stagnant water, and independent of contamination from human sources. It is the author's belief that, with relatively unimportant exceptions, intestinal diseases are spread almost exclusively by flies and malarial diseases by water, and he supports it by citations from recent army experiences. Likewise, during the recent British campaign in Fashoda, which was [Pg 426] most carefully planned and took place in a climate that is exceptionally dry and hygienic, there was no abatement of typhoid fever. In the case of an outbreak of malignant dysentery described by the author in a previous paper, taken at its height, not a new case occurred after measures were adopted that made conveyance by flies impossible, although there had been fresh ones every day for some time previously. Another more recent "lively epidemic" of typhoid mentioned by the author was ended in a day by measures directed against conveyance by water. "When flies are responsible, there are little neighborhood epidemics, extending in short leaps from house to house, without reference to water supply or anything else in common. But when water is at fault the disease follows its use wherever it may go.... Epidemics spread by flies tend to follow the direction of prevailing warm winds, as though the fly, wandering outdoors after contact with the source of infection, had drifted with the wind, but nothing of the sort is perceptible in the case of water-borne disease."

Pottery Making and Lead Poisoning.—The report of Professors Thorpe and Oliver on the subject of the employment of compounds of lead in the manufacture of pottery, especially in its relation to the health of the work people, has just been issued as an English blue book. It appears that of the total male workers in the year 1898, 4.9 per cent became "leaded," while of the female workers the proportion was 12.4 per cent. It is stated that in the last six months many successful attempts have been made by the manufacturers to substitute a leadless glaze, and there seems no doubt that glazes of sufficient brilliancy, covering power, and durability are now within the reach of the manufacturer. The exclusion of women from certain parts of the work, except where leadless glazes are used, is advocated, and also various expedients for preventing the absorption of the lead by the skin, such as rubber gloves or "dipping" tongs. Their general conclusions are as follows: "That by far the greater amount of earthenware of the class already specified can be glazed without the use of lead in any form. It has been demonstrated, without the slightest doubt, that the ware so made is in no respects inferior to that coated with lead glaze. There seems no reason, therefore, why in the manufacture of this class of goods the operatives should still continue to be exposed to the evils which the use of lead glaze entails. There are, however, certain branches of the pottery industry in which it would be more difficult to dispense with the use of lead compounds. But there is no reason why, in these cases, the lead so employed should not be in the form of a fritted double silicate. Such a compound, if properly made, is but slightly attacked by even strong hydrochloric, acetic, or lactic acid. There can be little doubt that, if lead must be used, the employment of such a compound silicate—if its use could be insured—would greatly diminish the evil of lead poisoning. The use of raw lead as an ingredient of glazing material, or as an ingredient of colors which have to be subsequently fired, should be absolutely prohibited. As it would be very difficult to insure that an innocuous lead glaze shall be employed, we are of opinion that young persons and women should be excluded from employment as dippers, dippers' assistants, ware cleaners after dippers, and glost placers in factories where lead glaze is used, and that the adult male dippers, dippers' assistants, ware cleaners, and glost placers should be subjected to systematic medical inspection. In the 1893 report the medical members of the committee expressed the opinion that 'many old factories are wholly, or in part, unfit in a sanitary point of view for occupation,' and they suggested that 'there should be some authority to close them, or whatever part of them is condemned, on the same principle as dwellings are declared uninhabitable.' We share this opinion and we concur in the suggestion. Certain of the factories we have inspected are in the last stages of dilapidation, and it appears to us to be well-nigh impossible to introduce into them such rearrangements or additions as are required by the amended special rules."

The Longevity of Animals.—The following interesting table, showing the periods of maturity and the full term of life of various animals, was prepared by E. D. Bell and appeared in Nature for [Pg 427] March 23d. The table was made for the purpose of demonstrating a constant relation (in length) between these two periods of life, which the author expresses in the following formula, in which f. t. l. = full term of life, and p. m. the time required to arrive at maturity:

$$\text{f. t. l.} = \frac{10.5(\text{p. m.})}{\sqrt[3]{(\text{p. m.})}}, \text{ or } 10.5 \text{ x } (\text{p. m.})\frac{3}{8}$$

and which seems to be fairly well borne out by the table:

Animal.	OBSERVATIONS.				f. t. l. by
	Authority.	p. m.		f.t.l	formula.
		Mos.	Yr.	Yrs.	Years.
Dormouse	Ainslie Hollis.	3	.25	4-5	4.167
Guinea-pig	Flourens.	7	.583	6-7	7.33
Loprabbit:					
Buck	R. O. Edwards, p. m.	9	.75	8	8.67
Doe	R. O. Edwards, p. m.	8	.667	8	8.013
			Years.		
Cat	St. G. Mivart.		1	12	10.5
Cat	J. Jennings.		2	15	16.67
Goat	Pegler.		1.25	12	12.18
Fox	St. G. Mivart.		1.5	13-14	13.76
Cattle	Ainslie Hollis.		2	18	16.67
Large dogs	Dalziel, p. m.		2	15-20	16.67
Eng. thoroughbred horse	Ainslie Hollis.		4.5	30	28.62
Hog	James Long.		5	30	30.7
Hippopotamus	Chambers's Encyclopædia.		5	30	30.7
Lion	St. G. Mivart.		6	30-40	34.67
Eng. horse—hunter	Blaine.		6.25	35	35.63
Arab horse	Ainslie Hollis.		8	40	42.00
Camel	Flourens.		8	40	42.00
Man	Buffon, f. t. l.		25	90-100	89.77
Elephant	Darwin.		30	100	101.4
Elephant	C. F. Holder and Indian hunters.		35	120	112.35

The Manufacture of Firecrackers in China.—There were exported from China during the year ending June 30, 1897, 26,705,733 pounds of firecrackers, all from the province of Kwantung. The exports, however, represent only a small portion of the number manufactured, as the use of the cracker is universal all over China. They are used at weddings, births, funerals, at festivals, religious and civil, and in fact on all occasions out of the ordinary routine. The United States consul general at Shanghai gives the following account of the industry: There are no large factories; the crackers are made in small houses and in the shops where they are sold. In making them only the cheapest kind of straw paper is used for the body of the cracker. A little finer paper is used for the wrapper. A piece of straw paper, nine by thirty inches, will make twenty-one crackers an inch and a half long and a quarter inch in diameter. The powder is also of the cheapest grade, and is made in the locality where used. It costs about six cents per pound. For the fuse a paper (called "leather" in Shanghai) is used, which is imported from Japan, and is made from the inner lining of the bamboo. In other places a fine rice paper is used, generally stiffened slightly with buckwheat-flour paste, which the Chinese say adds to its inflammability. A strip of this paper one third of an inch wide by fourteen inches (a Chinese foot) long is laid on a table, and a very little powder put down the middle of it with a hollow bamboo stick. A quick twist of the paper makes the fuse ready for use. The straw paper is first rolled by hand around an iron rod, which varies in size according to the size of cracker to be made. To complete the rolling a rude machine is used. This consists of two uprights supporting an axis from which is suspended, by two arms, a heavy piece of wood, slightly convex on the lower side. There is just room between this swinging block and top of the table to place the cracker. As each layer of paper is put on by hand, the cracker is placed on the table and the suspended weight is drawn over the roll, thus tightening it until no more can be passed under the weight. For the smallest "whip" crackers, the workman uses for compression, instead of this machine, a heavy piece of wood fitted with a handle like that of a carpenter's plane. In filling crackers, two hundred to three hundred are tightly tied together in a bunch; red clay is spread over the end of the bunch, and forced into the end of each cracker with a punch. While the clay is being treated a little water is sprayed on it, which makes it pack closer. The powder is poured in at the other end of the cracker. With the aid of an awl the edge of the paper is turned in at the upper end of the cracker, and the fuse is inserted through this. The long ends of the fuses are braided together in such a way that the crackers lie in two parallel rows. The braid is doubled on itself, and a large, quick-firing fuse inserted, and the whole is bound with a fine thread. The bundle is wrapped in paper and in this shape is sent to the seacoast. A variety of cracker which is very popular in China is the "twice-sounding" cracker; it has two chambers, separated by a plug of clay, through which runs a connecting fuse. There is also a fuse extending from the powder in the lower chamber through the side of the cracker. When the cracker is to be fired, it is set on end and fire applied to the fuse. The powder exploding in the chamber throws the cracker high in the air, where the second charge is exploded by fire from the fuse extending through the plug between the two chambers. In the manufacture of these the clay is first packed in with a punch to form the separating plug. The lower chamber is then loaded with powder and closed by turning over the paper at the end. The upper chamber is loaded and closed with clay. A hole is punched in the side of the lower chamber with an awl, and the fuse inserted through this opening. [Pg 428]

An Enchanted Ravine.—During his archæological researches in the Uloa Valley, Honduras (Memoirs of Peabody Museum), Mr. George Byron Gordon made an excursion to the wonderful enchanted ravine, *Quebrada Encantada*, which was famous through all the country for its weather wisdom. It was situated in a deep valley, and, Mr. Gordon says, "sends forth a loud melodious sound which may be heard many miles away, and is regarded by the people of the region as an infallible sign of rain. In fact, it is a regular weather bureau, with this peculiarity, that it is always reliable; for the sound is so modulated as to indicate by its pitch whether the coming storm is to be heavy or light. The amount of promised rain is in exact proportion to the volume of the sound, and thus it proclaims to the accustomed ear with unerring precision the approach of a passing shower or heralds the terrific thunderstorm of the tropics; and this is no fiction, but a fact, which any one may demonstrate for himself by going and listening to it." Tradition says the ravine was the abode of a golden dragon, and that in former times "it was lined with golden pebbles and the sands at its margin were grains of gold, and it was the custom of the golden dragon to rise occasionally to the margin of the pool and receive the offerings that were made to him by the people. If they wanted rain, they would bring their offerings and lay them on the golden sand behind the pool or cast them on the water; then, while all the people chanted a prayer, the dragon would rise from the cave where he dwelt in the depths of the pool, and take the good things that were offered him, and there was never a drought or a famine in the land. Then, when the Spaniards came and the people were driven from their homes, the golden pebbles and grains of gold disappeared, and the golden dragon, retiring into the uttermost corner of his watery cavern, withdrew forever from the upper world. There he still lives, and, as formerly, controls the clouds and the winds that bring the rain. The spirits of the Indians, too, still hold their meetings of an occasional evening by their accustomed pool, now lost in the solitude of the forest, and it is the sound of their chanting that makes the voice of the ravine." The pool is formed by a cataract tumbling down the side of the mountain and making a final fall of fifty feet, and the sound of the tumbling of the waters forms the basis of the pretty legend.

The Work of the Field Columbian Museum.—Making only a selection from the numerous items of general interest in the Annual Report of the Director of the Field Columbian Museum, Chicago, for 1897-'98, we find mentioned the fall and spring courses of nine lectures each, as having been more largely attended than ever before, hundreds of persons having been turned away from some of them, and in one case nearly a thousand. The library contains 9,003 books and 9,630 pamphlets, and has had some valuable additions, particularly in the department of Americana. The additions to the collections include specimens from Egypt, Italy (ancient Etruscan and renaissance Venetian), Portuguese South Africa, Pacific islands, and Alaska, the department representing which now numbers more than ten thousand objects. Valuable contributions have been received from the expedition of the curator of the anthropological (physical) department to Arizona. The herbarium of the late Mr. M. S. Bebb, added to the botanical department, represents much of the flora of the Western States, and "about all" that of Illinois. Numerous other botanical collections and additions to the geological and zoölogical departments are mentioned. Field work was prosecuted by Mr. G. A. Dorsey among the Hopi Indians in Arizona, C. F. Millspaugh in the collection of North American forest trees, and O. C. Farrington in the Tertiary geology of South Dakota, Nebraska, and Wyoming. Other excursions were made among the zinc-lead deposits of southeast Missouri, to the Olympian Mountains of the Northwest, to "a point beyond which nothing unless provided with wings could go," etc., all resulting in collections of one kind or another. The museum was visited by 3,963 more persons than in the year before. [Pg 429]

A Year at Harvard Observatory.—The director of Harvard College Observatory reports the addition to the resources of the institution of twenty thousand dollars bequeathed by Charlotte Maria Haven, and twenty-five thousand dollars by Eliza Appleton Haven, without further restriction in the application of the income than that it shall be for direct purposes connected with astronomical science. In these bequests the legators fulfilled the wishes of their brother, Horace Appleton Haven, as expressed half a century ago. By the peculiar organization of the force of the observatory, with a single director to oversee all and a large force of assistants, each having a special work and many of them skillful only in that, an increased amount of work can be done for a given expenditure, and great advantages for co-operation are secured, but too much depends upon a single person—the director. In the examination of the spectra of stars photographed in the Draper, Bruce, and Bache telescopes by Mrs. Fleming, twelve new variable stars were discovered by means of their bright hydrogen lines, and the spectra of a considerable number of other stars were determined. Valuable results, obtained by other examiners, are mentioned. An instrument has been constructed by which prismatic spectra can be converted into normal spectra or any other desired change of scale can be effected. By photographs obtained of stars in the vicinity of the north pole material is believed to be furnished for an accurate determination of the constants of aberration, nutation, and precession. Sixteen circulars were issued during 1897-'98. When fifty of these circulars have been issued, a title-page and index are to be published for binding.

Putting Life in the School.—The discussion of the hygiene of instruction, said Dr. G. W. Fitz, in addresses which are published in the American Physical Education Review, brings us at once face to face with one of the gravest problems of our educational system—the depressing effect of school routine. In the search for a remedy "the school programme has been pronounced poor, and efforts have been made to enrich it. The work has been pronounced abstract and object lessons have been introduced; uninteresting and bright colors, varied shapes, pictures innumerable, have been rushed upon the child until he has been bewildered by the multiplicity of detail, and further exhausted by the demand for more discriminating attention. The fundamental difficulty has been that too much has been required of the child in the beginning, and the attempt at enrichment and greater variety has but increased the burden." Children begin learning to read before they have acquired experience and ideas to match the text; and "experience has shown over and over again that the child who begins to read at eight or even ten years of age is in no wise handicapped in his later intellectual progress. He has the inestimable advantage of intense interest, roused by his growing ability to unlock the secrets of books and papers after the fashion of his elders." Writing is taught before the child has acquired the art of fine co-ordination, and the effort demanded in the use of the pen "leads to a degree of nervous exhaustion unapproached by any other school work." In arithmetic the children "are unable to grasp the numerical relations involved, and the drill, which makes it a pure exercise of memory, is necessary. Much of the aversion to arithmetical problems found later is undoubtedly due to this disheartening primary [Pg 430] work. Here again the child who begins arithmetic at eight or ten years of age finds himself able to take it up quickly and has the liking for it that easy mastery always gives." Nature work, on the other hand, "offers wonderfully interesting and valuable material for awakening the intellectual activities of childhood, and while its material for study and description is unlimited, its demand upon the child may be perfectly adapted to his power of observation. We must remember that physical activity is the supreme factor in the development of the child." This means spontaneous play under favorable conditions, not "that nervously exhausting and deadening drill known as the Swedish gymnastics, which ... adds fatigue to fatigue, by taking the initiative away from the child and forcing him to pay constant attention to the orders of the teacher." As to discipline, "the child is self-disciplined when he is held to his work by the reflex attention of interest. This can always be secured when the work is adapted to his grasp, when he has the sense of power which comes with easy conquest, when he is not exhausted by the imposition of a sequence logical to the adult mind but meaningless to him, when his attention is not dulled by a demand for attention continued beyond a physiological limit."

Beautifying the Home Grounds.—The Horticultural Division of the Cornell University Agricultural Experiment Station has been making efforts during the past few years, under the auspices of the agricultural extension work, to improve the surroundings of rural houses, a part of which consists in the publication of bulletins giving hints as to how improved conditions and simple adornments may be obtained without great expense. One of these indicates as one of the means of making the home attractive and "keeping the boy on the farm" the brightening of the place with flowers. Assuming that the main planting of any place should be of trees and shrubs, the flowers are then used as decorations. They may be thrown in freely about the borders of the place, but not in beds in the center of the lawn. They show off better when seen against a background, which may be foliage, a building, a rock, or a fence. "Where to plant flowers is really more important than what to plant. In front of bushes, in the corner by the steps, against the foundation of the residence or outhouse, along a fence or walk—these are places for flowers. A single petunia plant against a background of foliage is worth a dozen similar plants in the center of the lawn.... The open-centered yard may be a picture; the promiscuously planted yard may be a nursery or a forest. A little color scattered in here and there puts a finish to the picture. A dash of color gives spirit and character to the brook or pond, to the ledge of rocks, to the old stump, or to the pile of rubbish." The flower garden, if there is one, should be at one side of the residence or at the rear, "for it is not allowable to spoil a good lawn even with flowers."

MINOR PARAGRAPHS.

Of the twelve genera and fifty species of known North American frogs and toads, Mr. William L. Sherwood says, in his paper in the Proceedings of the Linnæan Society, New York, that five genera and fifty species are found in the vicinity of New York city. Some of these are less secretive in habit than salamanders, and therefore much better known. As ponds and ditches have been drained, the aquatic forms have removed to greater distances from human dwellings, and only the more terrestrial toad and arboreal tree frogs have remained. All of our species have been described, but the author believes that the first mention of the cricket frog being found in this region is in a paper on salamanders, read by him in 1895. The breeding habits of these animals vary, but all lay their eggs in water or moist places. The purely amphibious and really aquatic species are three. Of the other eight species, one is burrowing, five tend to be terrestrial, inhabiting the woods and fields, and two are arboreal. The eggs are laid in gelatinous envelopes, which swell after leaving the adult. At the time of hatching the young tadpole has three pairs of [Pg 431] external gills, but no mouth or anal opening. Two small suckers, just back of where the mouth is to appear, enable it to cling to aquatic plants and prevent its dropping to the bottom of the pond and getting smothered in the mud. It soon develops into a tadpole, and proceeds to its development; but if prevented from coming to the surface of the water no metamorphosis takes place, and the changes are delayed by cold and dark.

At a meeting recently held in Berlin in behalf of a German antarctic exploration, Dr. von Drygalski, speaking of the scientific, practical, and national importance of the enterprise, said that from a geographical point of view the fundamental problem attached to the south polar region—the verification or disproof of a polar continent—is still unsolved. No less important questions likewise await solution with respect to the geological structure and character of the southern lands—so important in connection with a knowledge of volcanic action and the supposed former connection of South America and Australia—and with respect to the conditions of inland ice. Even the study of the floating ice broken away from the main mass may lead to important conclusions as to its mode of origin and the nature of the land from which it comes. Other problems to be investigated are the origin of the cold ocean currents that take their rise in the south, the conditions of the atmospheric pressure and temperature in that region, and the questions relating to terrestrial magnetism, which have a very important bearing on the practice of navigation. The present seems to be a particularly favorable period for the resumption of south polar research by reason of the unusual amount of drift ice which has within the last few years broken away from the main mass, and because, according to Supan, we are passing through a warmer temperature period.

Over and above the statistics and the bare record of facts the annual reports of the Perkins Institution and Massachusetts School for the Blind afford a continuous and growing interest to friends of suffering mankind in their stories of the development of mental life and illumination. Pupils come there blind and deaf, and apparently without any avenues of intelligent communication with the outer world, and are there brought to full consciousness and keenness of intellect that would be remarked even in many persons possessed of all their senses perfect from birth. The record began with Laura Bridgman, was continued with Helen Keller, and has been occupied for five or six years past with the wonderful mental growth of Elizabeth Robin, Edith M. Thomas, and Tommy Stringer. Before Dr. Howe began with Laura Bridgman, such things would have been deemed impossible and not to be thought of.

NOTES.

The Swiss Association for the Protection of Plants, which was formed in Geneva in 1883, has more than 900 members, and publishes 1,500 copies of its bulletin, which is sent, besides the members of the association, to the libraries of foreign Alpine clubs, the press, botanists, *curés*, and municipalities in countries harboring plants that require protection. Under its care, or the influence of its work, gardens have been created in various places and devoted especially to the cultivation of such plants as are most threatened with extinction. Of these are the Linnea Garden in the Valais, 5,500 feet above the sea; the Chanousia, founded five years ago by R. P. Chanoux, rector of the Hospice of St. Bernard, 6,800 feet; and the Rambertia, at the foot of the Rochers de Naye, 6,500 feet above the Lake of Geneva. Lectures are given under the auspices of the association, and no occasion for informing the public is lost. A neat chromo-poster calling attention to the association and its purpose has been prepared to be put up in railroad stations and hotels, to which is appended a motto emphasizing the importance of caring for rare plants.

The report of Heinrich Ries on the Kaolins and Fire Clays of Europe, published in the reports of the Geological Survey, is based largely on notes collected by the author during visits in 1897 to most of the important kaolin and clay deposits. To these such facts of importance concerning the clays as have already been published have been added. Some manufacturers have claimed that the foreign kaolins are superior to the American, but the evidence, Mr. Ries says, does not seem to bear out the statements. Notes are added respecting the clays and clay-working industries in
the States of Alabama, Arkansas, Indiana, Iowa, New York, and North Carolina.

According to the report of the *Commission Internationale des Glaciers* for 1897, thirty-nine out of fifty-six glaciers observed in Switzerland are retreating, five are at a standstill, and twelve are growing. Of the Italian glaciers, those of the Disgrazia and Bernina groups and the glaciers of Mont Canin in the Julian Alps show a marked retreat. Retreat seems to be almost universal in the Scandinavian glaciers. The report includes also information from the Caucasus, Altai, and Turkestan, and notes on a few glaciers in the United States and Mexico, concerning which we have not the particulars.

In a book on social types among the French people, M. Edmond Demolins tries to show that varieties of types are the products of constant causes which it is possible to analyze exactly, and the most fundamental principle of which is the nature of the place and of the occupation. Thus there is a social type derived from the pastoral occupation; another from the cultivation of fruit trees, among which the several classes determine as many modalities of the type; one is derived from petty gardening, and another from large farming; another from manufacturing, and another from transportation and commerce. Close analysis permits the detection of still more delicate shades of types of varieties in each of the categories named, whereby notable modifications are produced in the same region and the same work.

The brewing industry in Germany is credited with the following output of beer for the year 1897-'98: Germany proper, 8,055 breweries, exclusive of Bavaria, Würtemberg, Baden, and Alsace-

Lorraine, 916,000,000 gallons; Bavaria, 6,364 breweries, 351,000,000 gallons; Würtemberg, 6,285 breweries, 90,000,000 gallons; Baden, 946 breweries, 60,000,000 gallons; Alsace-Lorraine, 127 breweries, 21,230,000 gallons—a grand total of 1,438,230,000 gallons, from the taxation of which the Government received a revenue of $22,305,150.

Speaking in his society of the Relation of Britain to Folklore, retiring President Alfred Nutt urged that it was the privilege of that country to enshrine in its literature the ancient customary wisdom of many races, as the English system of law was itself largely derived from custom. The accidents of the geographical position and historical circumstances of Britain had made it the preserver of a great body of archaic tradition, which it was the function of the Folklore Society to study and interpret.

We have to record the deaths of Dr. William Hankel, Professor of Physics in the University of Leipsic; Prof. F. K. C. L. Büchner, author of the famous book, Force and Matter, at Darmstadt, Germany, May 1st; Dr. Francis W. MacNamara, State Examiner of Medical Stores at the India Office, London, formerly Professor of Chemistry in Calcutta Medical College, and later Chemical Examiner to the Government of India, March 5th, aged sixty-seven years; he was author of a number of books and papers on hygiene and medical chemistry; Jeremiah Head, engineer, President of the Mechanical Science Section of the British Association in 1893, and President of the British Institute of Mechanical Engineers in 1885-'86, March 10th, aged sixty-four years; who was instrumental in introducing into England important American improvements in the manufacture of iron and steel; Franz Ritter von Hanse, Austrian geologist, Intendant of the National Museum in Vienna, Director of the Imperial Geological Survey in 1866, and author of the Geological Map of Austria, Bosnia, and Montenegro, and of geological books, March 20th, aged seventy-seven years; Surveyor Major G. C. Wallich, March 31st, in his eighty-fourth year, and Count Abbé F. Castracan, of Rome, the two oldest Fellows of the Royal Microscopical Society; Dr. P. L. Ryke, of the University of Leyden, aged eighty-six years; Joseph Stevens, honorary curator of the museum at Reading, England, author of archæological and geological papers; Dr. C. Brogniart, entomologist, and author of a memoir On Fossil Insects of the Primary Period, at Paris; Charles L. Prince, author of papers on meteorology and astronomy, at Tunbridge Wells, England, April 22d; Dr. Wilhelm Jordan, Professor of Geometry and Geodesy at the Technical Institution, Hanover, April 17th, aged fifty-seven years; Sir William Roberts, of the Royal College of Physicians, author of lectures and papers on digestion, diet, uric acid, the opium habit in India, etc.; Prof. Karl Scheibler, chemist, at Berlin, aged seventy-two years; Dr. Josef Wastler, docent in geodesy at the Technical Institute in Graz; Dr. H. A. Wahlforso, Professor of Chemistry at Helsingfors, aged sixty years; and Philip Thomas Main, Fellow of St. John's College, Cambridge, England, author of a treatise on astronomy.

FOOTNOTES.

[1] From Alaska and the Klondike. With thirty-five full-page illustrations and three maps. By Prof. Angelo Heilprin. New York: D. Appleton and Company. Pp. 326. Price, $1.75.

[2] Prof. Israel Russell has made the interesting observation that orographic movement may now be taking place in the region of the middle Yukon, about the Lower Ramparts, with the uplifting of a mountain range athwart the river; on this supposition he seeks an explanation for the detail of the Yukon lowlands.

[3] Professor Russell, in discussing the flood-plain deposits of the Yukon about the mouth of the Porcupine River, says that "fresh-water shells were frequently observed in the finer deposits." Unfortunately, no statement is made of the types which they represent.

[4] Since writing the above intelligence has been received of the location of a rich pay streak on Gay Gulch.

[5] Note.—We are indebted to the courtesy of the Electrical World and Engineer for cuts showing the Horry furnace.

[6] Note.—We are indebted to the courtesy of the Progressive Age for cuts showing types of generators.

[7] Manuel de l'amateur des jardins.

[8] The Romaka Siddânta employs, as a measure of time, the *Guga* of 2,850 years or 1,040,953 days, giving a tropical year of 365 days, 5 hours, 55 minutes, and 12 seconds, which is exactly the figure proposed by Ptolemy and Hipparchus.—*Burgess, Journal of the Royal Asiatic Society.*

[9] The term Romakapouri does not necessarily imply the city of Rome; the name was probably extended to Alexandria and perhaps also to Byzantium. In other writings we find the name Gavanapouri, the city of the Greeks (or Ionians), applied to Alexandria.

[10] Till then, the Hindus hardly seem to have sought for a common measure of time except for astronomical or mythological purposes.

[11] M. Sylvain Levi has, however, lately reopened the question of the initial date of this era.

[12] The Lesson of Popular Government. By Gamaliel Bradford. New York: The Macmillan Company. Two volumes. Pp. 520 and 590. Price, $4.

[13] In the Australian Bush, and on the Coast of the Coral Sea. Being the Experiences and Observations of a Naturalist in Australia, New Guinea, and the Moluccas. New York: The Macmillan Company. Pp. 552. Price, $6.50.

[14] The Native Tribes of Central Australia. By Baldwin Spencer and F. J. Gillen. New York: The Macmillan Company. Pp. 671, with maps and plates. Price, $6.50.

[15] West African Studies. By Mary H. Kingsley. New York: The Macmillan Company. Pp. 633, with Map. Price, $5.

[16] In the Klondyke, including an Account of a Winter's Journey to Dawson. By Frederick Palmer. New York: Charles Scribner's Sons. Pp. 218, with plates. Price, $1.50.

[17] A History of Physics in its Elementary Branches, including the Evolution of Physical Laboratories. By Florian Cajori. New York: The Macmillan Company. Pp. 322. Price, $1.60.

[18] General Sherman. By General Manning F. Force. New York: D. Appleton and Company. Pp. 353.

[19] Text-Book of Algebra, with Exercises for Secondary Schools and Colleges. By George Egbert Fisher and Isaac J. Schwatt. Part I. Philadelphia: Fisher & Schwatt. Pp. 683. Price, $1.25.

Transcriber's Notes.

Obvious printer's errors have been repaired, other inconsistent spellings have been kept, including inconsistent use of hyphen (e.g. "widespread" and "wide-spread"), and proper names (e.g. "Siddânta" and "Siddhânta").

Some illustrations were relocated to correspond to their references in the text.

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