Title: Appletons' Popular Science Monthly, May, 1900

Author: Various
Editor: James McKeen Cattell

Release date: October 28, 2014 [EBook #47219]

Language: English

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Transcriber's note: Table of Contents added by Transcriber.

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THE
POPULAR SCIENCE
MONTHLY

EDITED BY

J. McKEEN CATTELL

VOL. LVII

MAY TO OCTOBER, 1900

NEW YORK AND LONDON

McCLURE, PHILLIPS AND COMPANY

1900

THE POPULAR SCIENCE MONTHLY

APPLETONS'
POPULAR SCIENCE
MONTHLY.

MAY, 1900.

THE COMING TOTAL ECLIPSE OF THE SUN.

By FRANK H. BIGELOW,
PROFESSOR OF METEOROLOGY, UNITED STATES WEATHER BUREAU.

The circumstance which renders the coming total eclipse of the sun, on May 28, 1900, of special significance to thousands of people who might otherwise entirely overlook the occasion is the fact that the path of the moon's shadow over the surface of the earth, or the track of the eclipse, is in such a convenient locality—namely, in our Southern States—as to render the places of visibility easily accessible. Instead of being obliged to go to the ends of the earth, at a heavy expenditure of time and money, all the while running the risk of not seeing the eclipsed sun on account of prevailing cloudiness, we are fortunate this time to have the show at home in our own country. While many foreigners will be induced to come to the United States to make observations, it is certain that more people will be in a position to see this eclipse with a minimum amount of trouble than has ever happened before in the history of eclipses, at least since the telescope was invented and careful records of the phenomenon preserved.

The track of May 28th enters the United States in southeastern Louisiana; passes over New Orleans, La., centrally; over Mobile, Ala., which is on its southern edge; over Montgomery, Ala., on the northern edge; over Columbus, Ga.; south of Atlanta, Ga., which lies about twenty-five miles to the north of it; near Macon, Milledgeville, and Augusta, Ga., Columbia, S. C., Charlotte, N. C.; over Raleigh, N. C., which is ten miles north of the central line; and over Norfolk, Va., fifteen miles north of the center. The track is about fifty miles wide in all parts, and the duration of the eclipse varies from one minute and twelve seconds near New Orleans to one minute and forty-four seconds near Norfolk, on the central line. These durations diminish from the maximum at the middle of the track to zero at the northern and southern limits of it, so that an observer must be stationed as near the central line as possible in order to see much of the eclipse. The population of several of the above-mentioned cities is at present as follows: New Orleans, 242,000; Mobile, 31,000; Montgomery, 22,000; Columbus, 20,000; Atlanta, 66,000; Raleigh, 13,000; and Norfolk, 35,000. It is evident that with very little exertion more than 500,000 people can see this eclipse. It is most fortunate that the track passes near so many cities, because, with their facilities for the accommodation of visitors, many will be induced to undertake excursions with the purpose of taking in this rare sight, and a little enterprise on the part of railroads and transportation companies might easily increase the numbers. If people will go to a parade, yacht race, or an exposition, and consider themselves paid for their expenses, then surely they will find in this great spectacle of Nature not only an object of wonder and beauty, but also one of peculiar instruction in many important branches of science. All educators who can induce their pupils to make such an expedition will implant a love of astronomy in many impressionable minds which will become a source of pleasure to them for the rest of their lives.

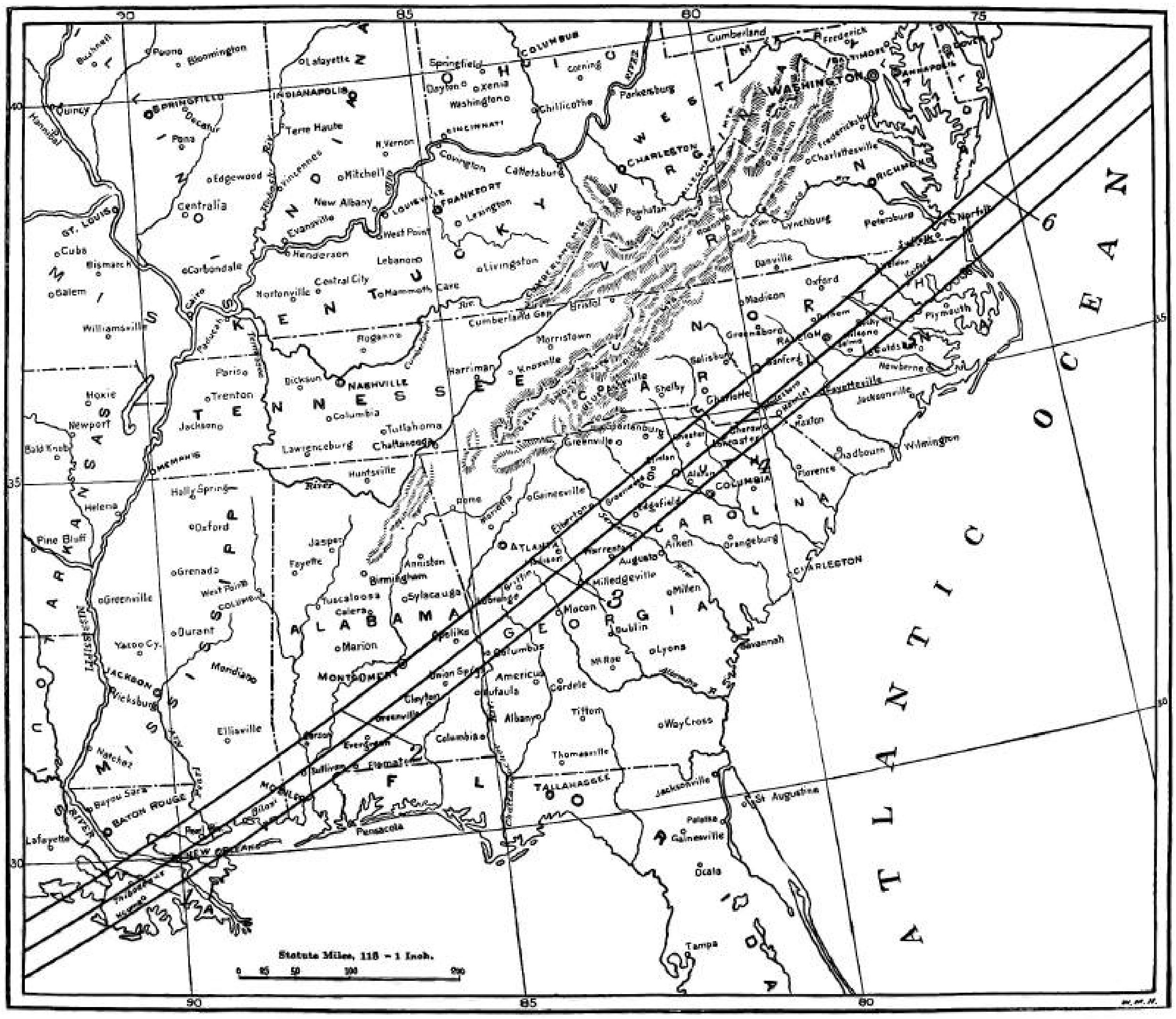

Chart I.—Track in the United States of the Total Eclipse of May 28, 1900. (By permission of the United States Weather Bureau.)

Out of about seventy eclipses of the sun which have occurred somewhere in the world within the nineteenth century, there have been only eight total eclipses of more or less duration visible on the North American continent. The others happened in places often remote from civilization, and sometimes in entirely inaccessible localities, as over the ocean areas. The difficulty of transporting heavy baggage to the remote parts of Asia, Africa, or South America is such as to preclude all but a few scientists from any effort to observe eclipses. The writer was much impressed with the formidable nature of undertaking to establish eclipse stations in places which are distant from centers of population by his own experience on the West African Eclipse Expedition, sent out by the United States Government, for the eclipse of December 22, 1889, to Cape Ledo, on the west coast of Angola, about seventy miles south of St. Paul de Loanda. Nearly eight months were consumed in the course of the preparations at home and in the voyage out and back. The expedition, it should be said, however, went to Cape Town, South Africa, and halted also at St. Helena, Ascension Island, and Barbados for magnetic and gravity observations, so that all this time should not be charged to the eclipse proper. We sailed in the old frigate Pensacola, the companion to Farragut’s flagship, the Hartford, with Captain Yates. In earlier days 3
Admiral Dewey commanded this ship, and the expedition was fitted out while he was in charge of the Bureau of Equipment at Washington. The same fine courtesy that has become so well known to his countrymen was at that time extended to all the members of the expedition.

The cloudiness along the track of the eclipse in the Southern States on the 28th of May, 1900, is evidently a matter of much importance not only for all astronomers, but for non-professional spectators. If it could be foretold, with the same precision as the astronomical data give the time and the place of the occurrence of the eclipse, that the day itself will be fair or cloudy, or that certain portions of the track will be clear while others will be obscured, it would be of great benefit. The cost of these scientific expeditions is very great, since it is necessary to transport many heavy and delicate pieces of apparatus into the field, including telescopes, spectroscopes, polariscopes, and photographic cameras, and set them up in exact position for the day of observation. The expedition to Cape Ledo, West Africa, in 1889, carried out a large amount of material, prepared it for work during the totality, and then entirely lost the sun during the critical moments by a temporary obscuring of the sky through local cloud formations. There had been some clouds at the station during the forenoons for several days preceding the eclipse, but the sky was usually clear and very favorable during the middle of the afternoons. The totality came on at three o’clock, and photographs of the sun were taken at first contact about 1.30 P. M.; clouds thickened, however, and totality was entirely lost, while the sun came out again for the last contact at 4.30 P. M. This was a very trying experience, and of course could not have been avoided by any possible precautions. Some astronomers have thought that the advance of the moon’s shadow is accompanied by a fall in temperature, and that cloudiness is more likely to be produced from this cause.

Soon after the West African eclipse Professor Todd, of Amherst College, proposed that more systematic observations be made for the probable state of the sky along eclipse tracks, with the view of at least selecting stations having the most favorable local conditions. The method was tried in Chili, April, 15, 1893, and in Japan, August 8, 1896, with some success. Heretofore the available meteorological records, which were originally taken for other general purposes, had been consulted, and some idea formed of the prevailing tendency to cloudy conditions. In accordance with the improved method, the United States Weather Bureau has been conducting special observations on the cloudiness occurring from May 15th to June 15th in each of the three 4
years 1897, 1898, and 1899, for the morning hours of the eclipse—between 8 A. M. and 9 A. M. A tabular form was sent through the local offices to such observers as were willing to act as volunteers in making these records, and their reports have been studied to discover how the cloudiness behaves along the eclipse track at that season of the year. Each of the three years gives substantially the same conclusion—namely, that there is a maximum of cloudiness near the Atlantic coast in Virginia, extending back into North Carolina, and also near the Gulf coast in Louisiana and in southern Mississippi, while there is a minimum of cloudiness in eastern Alabama and central Georgia. The following table will serve to make this plain:

The Prevailing Cloudiness of the Sky along the Eclipse Track.

State.	General sky.	Sky near the sun.
Virginia	40.3	38.0
North Carolina	32.4	29.9
South Carolina	26.4	24.9
Georgia	16.4	14.7
Alabama	18.2	17.7
Mississippi	30.8	29.2
Louisiana	32.9	27.7

The significance of these figures is shown by transferring them to a diagram, given on Chart II, which indicates the average cloudiness prevailing over the several States where they are crossed by the track. The marked depression in the middle portions, especially over Alabama and Georgia, indicates that the stations in these districts make a much better showing than those nearer the coast line. The reasons for this difference are probably many in number, but the chief feature is that the interior of this region, especially over the higher lands of the southern reaches of the Appalachian Mountains, which are from six hundred to one thousand feet above the sea level, is somewhat freer from the moisture flowing inland from the ocean at that season of the year. The table shows also two divisions, one for the "general sky," wherein the relative cloudiness was noted in every portion of the visible sky, and for the "sky near the sun," where the observation was confined to the immediate vicinity of the sun. The two records agree almost exactly, except that the sky near the sun averages a little lower than the general sky. This indicates that although the sun will be seen in the morning hour of May 28th, when it is only from thirty to forty degrees above the horizon, yet this is not an unfavorable circumstance. The low altitude, on the other hand, makes it easier for those at the instruments to enjoy a more comfortable 5
observing position than if it were nearer the zenith, where one must look directly upward. Of course, a storm of some kind may occur on that day to modify these general weather conditions and upset all calculations. While the cloud observations suggest that Georgia and Alabama have the best sites for the eclipse, it must be remembered that the duration is about one minute and twenty seconds in Alabama, and one minute and forty seconds in North Carolina. As a gain of twenty seconds in observing time will be considered by many of sufficient importance to take chances on the cloudiness, stations will be selected in North Carolina for that reason, although the probability for minimum cloudiness is twice as good in Georgia and Alabama. The table shows that the chances are only one to six against observers located in these States, while near the coast they are about two to six against them. On the whole, the general result is that observing in this region ought to be successful, because the favorable chances for good weather are above the average at that season of the year.

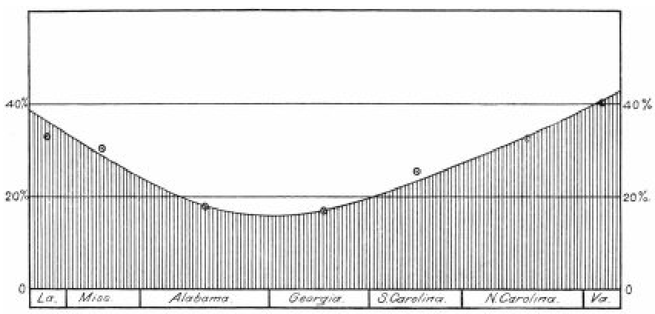

Chart II.—Probable State of the Sky along the Eclipse Track.
Average percentage of cloudiness in May and June.

On Chart I there are six lines drawn across the track: No. 1 near New Orleans, and No. 6 on the ocean to the east of Norfolk, Va. These represent the places for which the times of the duration are computed in the American Nautical Almanac, with the following results:

No.		h. m.			h. m.		m. s.
1.	At	1 30	Greenwich M. T.	=	7 27.	Local M. T. the duration is	1 12.6

2.	”	1 35	”	”	=	7 47.	”	”	”	”	”	1 19.6
3.	”	1 40	”	”	=	8 05.	”	”	”	”	”	1 26.0
4.	”	1 45	”	”	=	8 22.	”	”	”	”	”	1 31.7
5.	”	1 50	”	”	=	8 40.	”	”	”	”	”	1 37.0
6.	”	1 55	”	”	=	8 54.	”	”	”	”	”	1 41.9

6

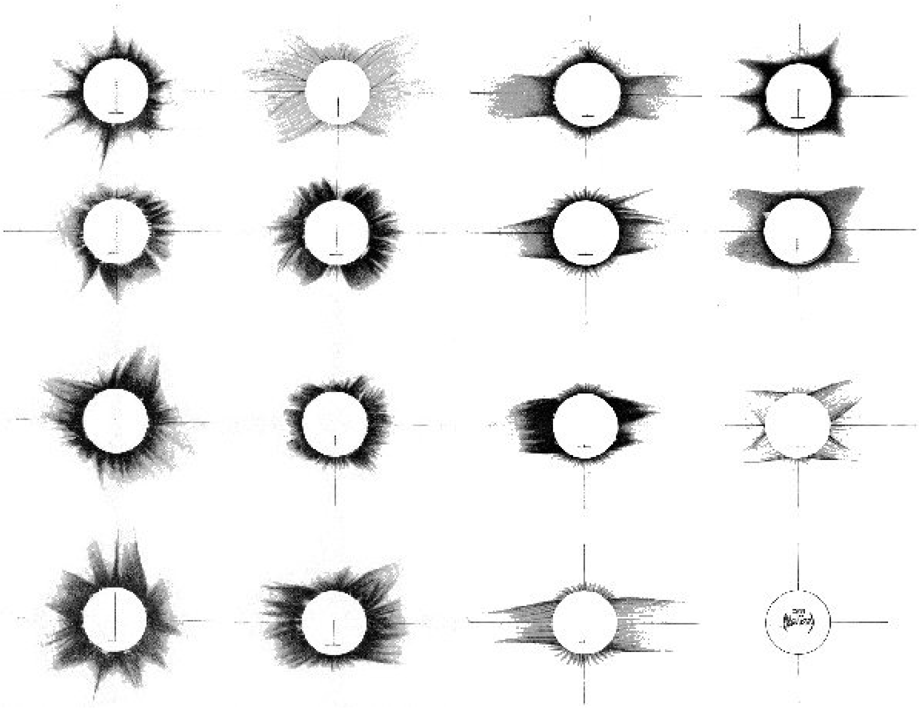

Chart III.—Fifteen Pictures of the Solar Corona, arranged in the Eleven Year Period, to show the Recurrence of Similar Types during this Period.

An observer at the intersection of these cross-lines with the central line will see the totality during the intervals given in the table. 8

The mode of the formation of the shadow cones of the moon, called the penumbra for the partial shadow and the umbra for the total shadow, are well illustrated in general works on astronomy, and good geometrical pictures of them can there be found, together with much useful information regarding the subject of eclipses. As we are here concerned chiefly with certain practical points about the eclipse of 1900, it will be well for the reader to consult such works for many details regarding the astronomical features attending an eclipse of the sun which must now be omitted.

There are many existing theories to account for the phenomenon of the sun’s bright appendage, called the corona, which is visible only during eclipses, on account of the absorbing effects of the earth’s atmosphere on its light. Is it electrical, or is it magnetic? Is it composed of fine stuff ejected from the sun, or of meteoric dust falling upon the sun? Is it merely an optical effect, as some suppose, or is it a portion of the newly discovered radiant matter streaming off to enormous distances into space? The answer to these questions is eagerly sought through observation, photography, and every other possible means, on the occasion of each total eclipse.

The efforts of astronomers have thus far secured a series of pictures of the solar corona, which, when compared together, show very distinctly that the corona, as well as the spots, the protuberances, and the faculæ, are going through a series of changes which seem to repeat themselves in the so-called eleven-year period. It has also been proven, with entire distinctness, that the earth’s magnetic field, as marked by the changes in the intensity of the magnetic elements, in the auroral displays, and the earth electric currents show variations which synchronize closely with those observed on the sun; also that the weather elements of pressure, temperature, precipitation, and storm intensity all harmonize with the solar and the earth’s magnetism in the same synchronism. All attempts of scientists to detect any variations in the sunshine which falls upon the tropics have been entirely futile; on the other hand, it has been shown that the magnetic forces having the characteristics just mentioned impinge upon the earth in a direction perpendicular to the plane of the earth’s orbit, just as if the sun, being a magnet, throws out a field of force to the surface of the earth, which, by its variation depending upon the internal workings of the sun, produces the changes just enumerated in the earth’s atmosphere and in its magnetic field, also throughout the planetary system, being, of course, strongest 9
near the sun. The belief is gradually growing among scientists that the earth, the sun, and the planets are all magnetic bodies, and have these bonds of connection between them in addition to the Newtonian gravitation. This is a most fascinating field of research, and, though full of difficulties, yet attracts the attention of many who are convinced that one of the most pressing duties of the hour is to clear up the problems connected with the transmission of energy from the sun to the earth in other forms than the ordinary or sunlight radiation. It is entirely probable that the secular variations of the weather changes from year to year, and even from month to month, are bound up with these solar forces, and that the solution of these questions will carry with them much information of practical use to civilized man.

The coronas of the past forty years are shown on Chart III, taken from the report of the eclipse of 1896 (August 9th), by A. Hansky. It arranges the coronas in the eleven-year period so far as the dates at which the eclipses occurred permit this to be done, and by comparing them in vertical lines the similarity is at once seen for the respective quarters of phases of the period. The forecast there given for 1900 is seen to resemble 1867, 1878, and 1889, but it differs in orientation from that on Chart IV, which was prepared by the author. The four coronas on the left in Chart III are taken at the sun-spot maximum, and the appearance is that of total confusion in the structure of the rays; the second and the fourth columns are for the sun's medium intensity at about halfway between the maximum and the minimum, and they show a system of polar rays taking on structural form, the second column being at a stage of diminishing and the fourth at one of increasing solar activity; the third column gives the corona when the spots are at a minimum of frequency and the sun is in a comparatively quiescent state, wherein the polar rifts are very distinct and the equatorial wings or extensions greatly developed.

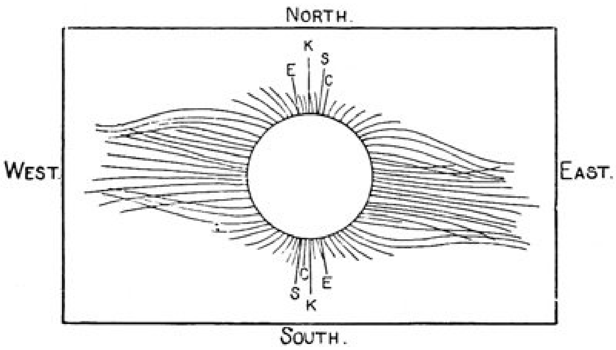

Chart IV.—Bigelow's Forecast of the Corona of May 28, 1900. E, earth's axis; K, axis of ecliptic; S, axis of sun; C, C, poles of the solar corona.

The successful observation of a solar corona depends upon three conditions: the selection of the instrument,
its proper mounting, and the photographic process, regarding each of which a few suggestions will be made. 10
The instruments are divided into two classes, for visual and for photographic work. But in either case the most 11
important feature is the focal length or the size of the telescope. Since the photographic image of the corona will not bear magnifying without dispersing the available light, and thus blurring out the details of the picture, which is the most important feature to retain to the utmost, one can not use a short telescope and at the same time a magnifying eyepiece to enlarge the image by projection on a screen or on a photographic plate. The only alternative in order to get an image of large diameter is to use a long-focus lens. The effect of a difference of focus upon the image of the corona is well shown on Chart V, which gives a small corona (1) taken with a four-foot lens (Barnard), (2) with a fifteen-foot lens (Pickering), and (3) with a forty-foot lens (Schaeberle). The diameter is proportional to the focal length, but the difference of effect upon the details is very important. In the small picture the details of the corona near the sun are completely lost in the general light, while the coronal extensions from the middle latitudes are seen at a great distance from the sun—as much as one million miles; at the same time the polar rifts are distinctly marked, so that the pole or central line from which they bend is readily located. On the second picture the details of the polar rays are better brought out, but the extensions are shortened. In the third the region near the sun's edge has many interesting details very clearly defined, while all the extensions are gone. It is evident that each lens has its advantage, according to the details sought, and they ought all to be employed in the eclipse. The reproductions on paper by no means do justice to the original negatives, which make the distinctions even more pronounced than shown on Chart V.

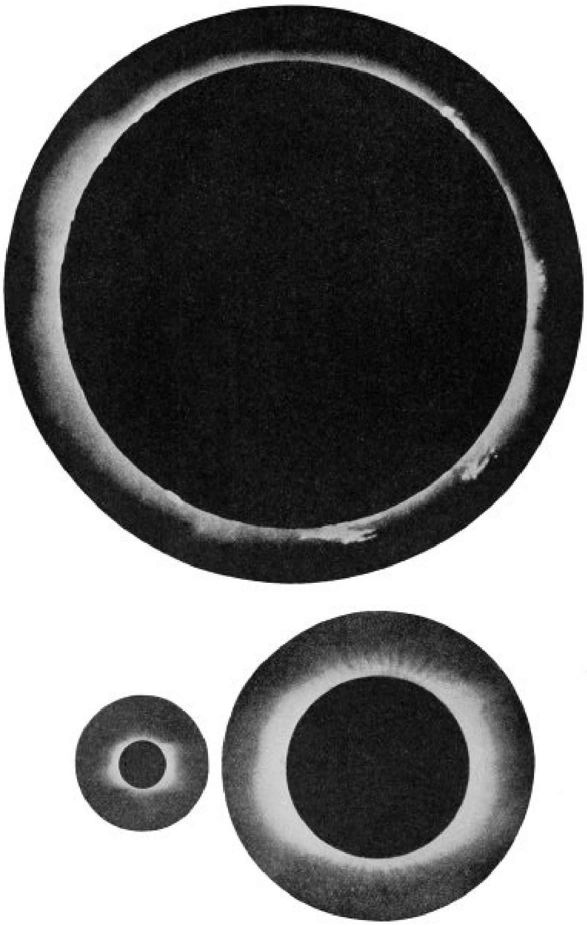

Chart V.—Relative Images of the Corona as taken with Telescopes ranging from Forty Feet to Four Feet in Focal Length.

Some amateur observers have telescopes but no mountings suitable for eclipse work, and many astronomical telescopes have good equatorial mountings at home which are yet unavailable in the field for lack of proper foundations and supports. The ordinary telescope balanced near the center, with the eye end subject to all sorts of motions which may happen through jarring and rough handling in the hurry of shifting photographic plates, makes a very poor eclipse apparatus. All telescopes of any length should be held firmly at each end, so as to be perfectly steady, since the least vibration ruins a coronal picture devoted to delicate photographic effects. There are two ways of accomplishing this, and only two. Dispensing with an equatorial mounting, the lens must be set permanently on a base, and light reflected from a mirror must be utilized, which shall be concentrated on a plate also placed on a fixed base. This is the method employed by Schaeberle in Chili, April 16, 1893, to obtain No. III of Chart V. There is no objection to it if an observer possesses a perfectly plane 12
mirror, which it is very difficult and also expensive to obtain; if the reflecting mirror should be imperfect it would distort the image of the corona. The second method, lacking a good mirror, is to mount the long-focus lens in a tube and point it directly at the sun. A forty-foot lens was thus mounted at Cape Ledo for December 22, 1889, and its action was very satisfactory. Of course, it was a cumbersome arrangement, and could not be employed by a small party. The foundation for the mounting of the forty-foot tube consisted of two casks filled with stones and cement, and set firmly in the ground. These made two good piers, since the narrowing tops of the casks held the bed plates of the telescope as in a vise. A triangle, whose base was parallel to the earth’s axis and having the telescope tube itself for the long side, was fitted with an extension rod for adjustment in altitude on the third side, and the whole was made to revolve on ball bearings. This triangular support was rotated by a side rod of adjustable length, whose end terminated in a sand piston working with a regulating valve. The sand flowed out steadily like an hour-glass, and dropped the tube, keeping it central on the sun. The image was made to follow accurately for twenty minutes without tremor, all the time holding the solar disk tangent to fixed lines. The principle of a revolving triangle and a short piston, taking the place of an expensive reflecting mirror with a delicate clockwork or one carrying a telescope balanced on its center but subject to jars and side motions, is an important assistance in field work on account of its ready adaptability to all sorts of observations. Since time is limited, it is necessary to provide all operations with automatic arrangements as far as possible, by using such an apparatus as that described. What can be applied successfully to a forty-foot lens can serve for shorter telescopes. In combination with spectroscopes, polariscopes, and special instruments for photographing, an immense amount of work can be compressed into the few seconds allowed by mounting them all on such a movable frame as the triangle. The old-fashioned method of putting one observer to one telescope ought to be abandoned. Of course, for a rising sun during the forenoon a modification in the moving support must be employed. This should be such as to cause the objective of the telescope to rise from the ground toward the meridian, and it must be accomplished by attaching a heavy weight which in sinking draws the tube upward.

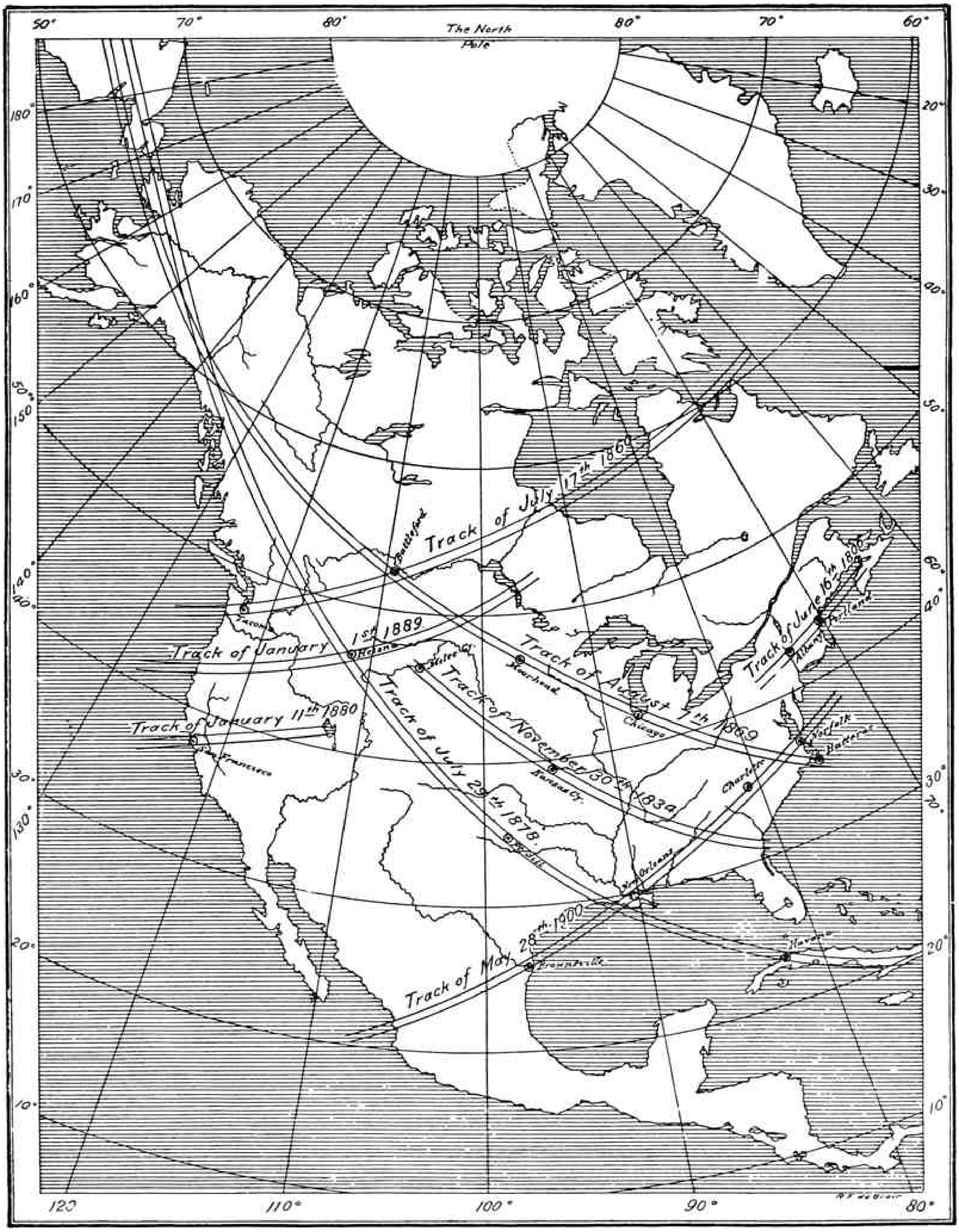

Chart VI.—Tracks of the Eight Total Eclipses of the Sun seen on the North American Continent during the Nineteenth Century.

Of the two kinds of photographic plates, the wet and the dry, the dry plates are much more convenient in the field, and are good for certain purposes. The objections to them are that the rough granulations of the gelatin film sometimes overpower the fine details of the corona itself; they burn out very near the disk by over-exposure 13
while the faint outer extensions are being taken. Wet plates having the requisite quickness are harder to prepare, but are smoother and hold the coronal rays better from the base to the outer edge, and there is always plenty of time to give the necessary exposure. The No. 26 Seed plate requires from 0.5 to 2.0 seconds only, 14
generally one second being about right; the wet plate will take the corona in eight seconds or less. The best time of exposure should be tested on a bright star of about the second magnitude, by trial before the eclipse. There is no rule about the photographic focus, except to discover it by a series of exposures at different distances near the supposed point. Eclipse work is a practical matter, and many rough-and-ready methods must necessarily be admitted. A good lens in a wooden light-tight tube, supported at each end, having the motion of the sun, the photographic focal plane carefully determined, the time exposures very short, and, finally, exceedingly slow development of the picture after the eclipse—these form the prime requisites. Expensive telescopes, clockwork on heavy iron piers, reflecting mirrors, and such like apparatus are not needed. Ingenuity in practical details, with great anxiety about the essential matter of the light itself, is what is needed for a

successful eclipse expedition.

Those persons who have no telescope for viewing the sun, or camera for photographing it, can yet see the corona to great advantage by means of a good opera glass, and indeed this is really the most satisfactory way to thoroughly enjoy the spectacle. The object may be sketched on paper at once or from memory, and this picture may well be of value to astronomy.

The tracks of the eight North American eclipses seen since 1800 are shown on Chart VI. It is noted that three have paths very similarly located, and that five run in directions about parallel to one another, but almost at right angles to the first group. This comprises the eclipse of November 30, 1834, duration two minutes; August 7, 1869, two minutes and three quarters; July 29, 1878, two minutes and a half, which stretch from Alaska southeastward in a fan-shape to the South Atlantic coast. The second group contains the tracks June 16, 1806, four minutes and a half; July 17, 1860, three minutes; January 11, 1880 thirty-two seconds; January 1, 1889, two minutes and a quarter; and May 28, 1900, two minutes. These tracks all trend from southwest to northeast, and cross the North American continent in different latitudes, that of May 28, 1900, being the most southerly and of rather short duration; lasting less than two minutes in the United States.

The path of the total eclipse of May 28, 1900, after leaving the United States, crosses the North Atlantic Ocean to Coimbra, Portugal, and continues over North Africa to its end at the Red Sea. Stations which are not situated on the path of the totality will see the sun partially eclipsed, in proportion to the distance of the locality from the central line to the northern or the southern limits. Thus New England, New York, the Ohio Valley, and [15] the southern Rocky Mountain districts will see the sun about nine tenths covered; the Lake Region, the lower Missouri Valley, and Southern California will see an eight-tenths eclipse; and the northern Rocky Mountain region about six tenths or seven tenths. The best way to view the partially eclipsed sun is to secure three strips [16] of thin colored glass, one and a half inch wide by five inches long—red, blue, and green; bind them over the eye end of a good opera glass, and adjust focus on the sun. This makes the light safe for the eyes and brings out the spherical aspect of the sun's ball. The time of the eclipse can be read by interpolating within the lines marked on Chart VII.

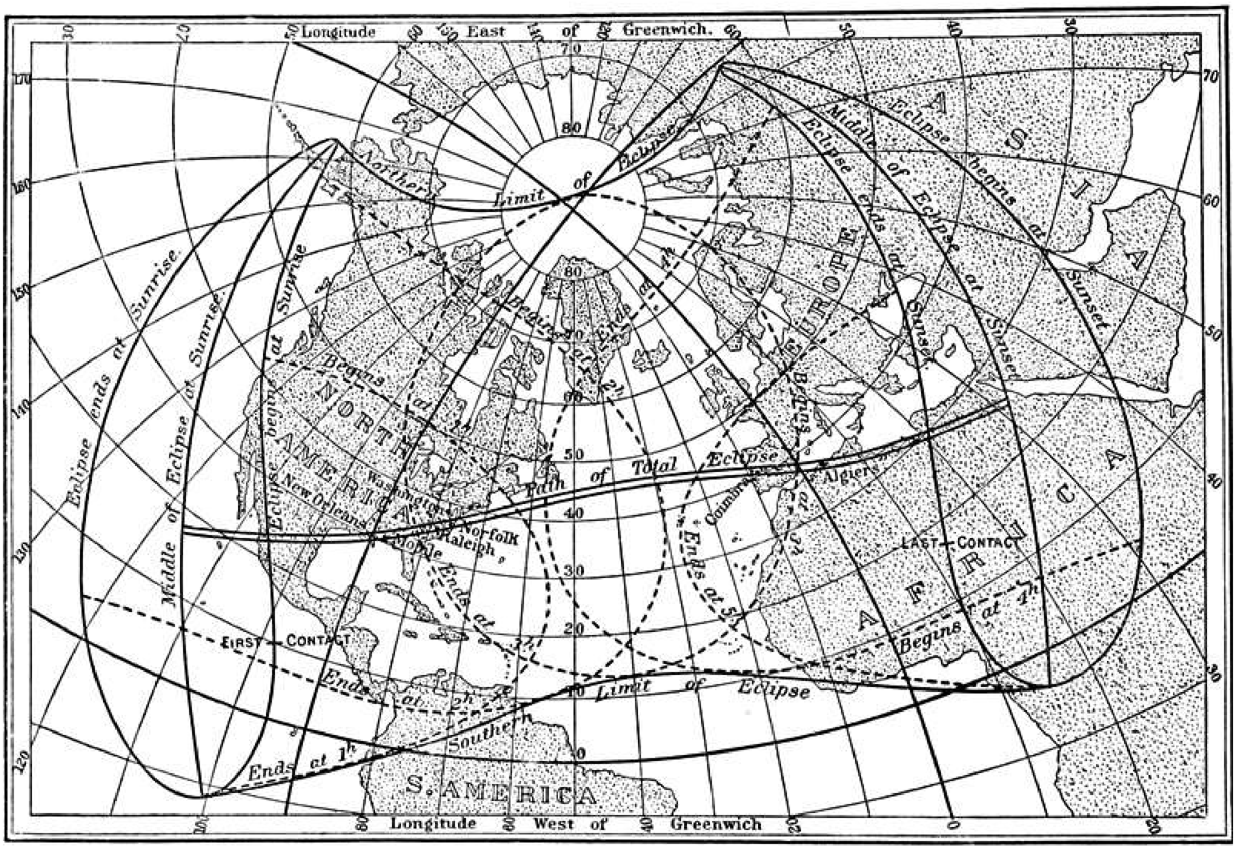

Chart VII.—The Path of the Total Eclipse of May 28, 1900, with Times of Beginning and Ending at Several Places and the Northern and Southern Limits of the Partial Eclipse.

No other eclipse track will occur in this country till June 8, 1918, when one of the first kind will pass from Oregon to Florida, two minutes in duration. Another will occur in New England, January 24, 1925. Eclipses seven minutes in duration will occur in India in 1955, and in Africa in 1973, the longest for a thousand years. The remoteness of the last two, both in time and place, put them out of reckoning for most of us, but those of 1918 and 1925 give additional zest to the approaching eclipse of May 28th, as affording further opportunity for confirming facts and noting differences based upon the observations now made.

THE MOST EXPENSIVE CITY IN THE WORLD.

By Hon. BIRD S. COLER,

COMPTROLLER OF THE CITY OF NEW YORK.

The annual expenses of the city of New York are larger than those of any other municipality in the world, and the financial transactions of a year represent the receipt and expenditure of more than $200,000,000, counting temporary loans, sinking funds, and bond issues. The gross budget of the city for 1899 was $20,000,000 greater than the expenses of the city of London, $18,000,000 in excess of the budget of Paris, and only $1,000,000 less than the combined expenditures of Boston, Chicago, and Philadelphia.

The expenses of New York last year for local purposes, exclusive of bond issues, amounted to $19.56 per capita of an estimated population of 3,500,000. The combined annual expenditures of the six largest States in the Union are less than those of the city of New York, and the financial transactions of the latter are equal in amount to one seventh of those of the national Government.

The credit of the city, it may be stated at the outset, is second only to that of the Federal Government, and the property owned by the municipality, if sold at market value, would pay the entire funded debt several times over.

The consolidation of ninety municipalities with the former city of New York was the culmination of a 17
sentiment so fixed upon an ideal that there had been little careful reckoning of the cost. The municipality, by taking in the extra territory and population, doubled its debt, added less than one fourth to its tangible assets, and increased the cost of local government $15,000,000 a year. This added cost is the price paid by the taxpayers for a sentiment and for haste and carelessness in the work of completing consolidation. The cost of government for the enlarged city was in 1899 approximately $15,000,000 more than the combined expenditures of the various municipalities for the last year of their separate existence. This increase was excessive and altogether unnecessary to the maintenance of thorough and progressive government.

The present charter of the city is supposed to provide a large measure of home rule, yet the salary of almost every officer and employee, from the mayor to the doormen of the police stations, is fixed by act of the State Legislature. The former cities of New York and Brooklyn had been so long regulated and governed from Albany that the commissioners who drafted the charter evidently overlooked the fact that a municipality might be trusted to regulate the pay of its own employees. To-day the pay of the school-teachers, policemen, firemen, heads of departments, and chiefs of bureaus is fixed at Albany, where the representatives of the city are in the minority. When the charter was prepared the commissioners agreed that taxation and salaries must be equalized. The members differed in their views on many questions, but they evidently agreed that the way to equalize salaries was to increase the lowest to equal the highest.

In extending the benefits of a great corporate government to the many suburban communities included in the consolidation a uniformed policeman, or five or ten of them, at fourteen hundred dollars a year took the place of a town marshal or constable at three hundred dollars a year, and high-priced trained firemen were substituted for unpaid volunteers. This method of equalizing salaries was extended to every section of the city and to every branch of the government. No attempt, apparently, was made to devise some system that would adjust salaries in various localities to local conditions and cost of living. The sentiment in favor of a great city was not disposed to quibble when the cost of maintaining the visible form of municipal government was increased fivefold in much of the outlying territory.

Aside from the extension of high-priced municipal service throughout the great area of the consolidated city, many useless offices were created and many salaries fixed at excessive figures. Authority was too much divided.
The borough system is expensive, and so far useless. The entire charter is a series of compromises, and every 18
compromise on a salary was at the maximum rate.

This method of arranging the expenses of the greater city increased the cost of government beyond the highest estimates of those who had advocated consolidation. The initial cost was further increased by reason of the fact that no precautions were taken to prevent the various municipalities to be united from increasing their bonded and contract indebtedness during the last year of their separate existence. The result of that oversight was that every municipality, the former city of New York included, issued bonds and entered upon contracts with somewhat reckless disregard of the future. In this way a heavy burden of unnecessary expense was added to the legitimate account charged against the consolidated city.

Greater New York began business in a condition of apparent bankruptcy, because the debts exceeded the constitutional limitation of ten per cent of the assessed value of taxable real estate. To overcome this and to meet the extra expense of government by the new system it was necessary to greatly increase the tax rate.

The financial condition of New York on January 1, 1900, was satisfactory except in the matter of current expenses. The gross accepted funded debt on that date was $358,104,307.11, against which there was a sinking fund of $105,435,871.70, leaving a net funded debt of $252,668,435.41. Considered in connection with the wealth of the city, this debt is not excessive. The city of Paris, with smaller available resources, has a debt in excess of $500,000,000. The gross expenditures of the city during 1899, exclusive of permanent improvements, paid for from the proceeds of bonds, were $93,520,082.03, and in 1900 the expenses will be some $3,000,000 less.

The total receipts of the city for the same period, from all sources and for all purposes, were approximately $108,000,000. The income was derived from three general sources, taxation yielding $84,000,000. The budget, which represents the money to be raised by taxation, was reduced $9,000,000 by income known as the general fund. The chief items of this were: Excise taxes, $3,600,000; school money from the State, $1,280,883.45; fees of various county and city offices, $246,576.65; interest on taxes and assessments, $979,185.35; and unexpended appropriations, $1,356,786.57.

Aside from the revenues classed as the general fund, New York has no income from any source that can be applied to current expenses for the reduction of taxation. The immensely valuable franchises heretofore granted to private corporations yield a revenue to the city that is insignificant, the total collected rarely exceeding 19
$300,000 a year.

The gradual reduction of the city debt, except as it is maintained or increased by additional bond issues, is amply provided for by a steadily increasing and protected sinking fund. The total receipts of this fund in 1899 were $15,601,492.50. The Croton water rents, amounting last year to $4,590,502.55, are applied to this fund, as well as the dock and slip rents of $2,362,421.14. Some of the other chief items of this fund are: Revenue from investments, $3,573,519.34; ferry rents, $370,776; market rents, $251,500; interest on deposits, $520,526; installments included in the budget, $2,633,110.

More, than $1,000,000 is derived annually from miscellaneous sources, including the sale of various odds and ends of property. The total interest charges on bonds in 1899 amounted to $11,275,822, leaving more than $4,000,000 of the sinking-fund income applicable to reduction of the funded debt.

Two features of the financial system of New York that increase expenditures can and should be changed. Taxes are now collected in the last quarter of the year upon an assessment made twelve months before. This compels the city to borrow large sums of money to meet current expenses. In 1899 the city borrowed, in anticipation of taxes, the sum of $48,027,450, on which the interest amounted to $755,704. If the taxes were collected during the first quarter of the year, the city would not only save this three quarters of a million dollars interest on temporary loans, but for six or seven months would have large cash balances in depository banks earning two per cent. This change would be worth approximately $1,500,000 a year to the treasury, but it must be made by degrees in order that taxes shall not be collected twice in a twelve-month.

Under the present constitutional restriction upon the borrowing capacity of the city, New York is placed in the contradictory position of getting richer and poorer at the same time and by the same process. The restriction of the debt limit to ten per cent of the taxable real estate is arbitrary, and makes no distinction of obligations. Every time the city acquires additional real estate for parks, docks, schoolhouses, or any other purpose its borrowing capacity and income from taxation are reduced, because the property acquired no longer yields a tax and it is not counted in the valuation upon which the debt limit is fixed. This is the most illogical and unbusinesslike feature of the present financial system.

The piers owned by the city are profitable investments, yielding a revenue in excess of interest and sinking 20
fund for the bonds issued; yet if we should acquire $100,000,000 of additional water front now owned by private parties the borrowing capacity of the municipality would be reduced $10,000,000, and the income would suffer the amount of taxes on the land acquired. There should be adopted a constitutional amendment that would separate debts incurred for revenue-yielding investments, such as docks and waterworks, from those created for general public improvements. The former should not be a charge against the borrowing capacity of the city.

The budget of the city for 1900 is $90,778,972.48, which will be reduced $9,000,000 by the general fund, leaving some $82,000,000 to be raised by taxation. The magnitude of this outlay for current expenses may be better understood by comparison with the expenditures of other large cities. The approximate current expenses of London last year were $73,000,000; of Paris, $75,000,000; of Berlin, $23,347,600; of Boston, $35,454,588; of Chicago, $32,034,008; of Philadelphia, $27,075,014.

In 1899 the State tax paid by the city of New York amounted to $6,275,659, or nearly seventy per cent of the whole; interest on bonds absorbed $11,275,822, leaving $75,813,644 as the actual cost of the current expenses of local government. The gross budget represented a per-capita tax of $24.62 on 3,500,000 inhabitants, of which $19.56 was for local expenses. Of this enormous expenditure more than $35,000,000 is paid out in salaries and wages to 37,000 officers and employees. The Police Department cost $12,000,000 a year, of which $10,700,000 is for salaries. New York has 6,400 policemen. Philadelphia has 2,600, and the annual cost of the department in that city is $3,100,000 a year—much lower in proportion than that of the metropolis.

The salaries and wages paid to all regular department employees, including policemen, firemen, street cleaners, and dock builders, are higher than those paid in any other city in the world, and almost without exception the rate has been fixed by act of the State Legislature, and not by the local authorities. In the matter of fixing the pay of officers and employees the city of New York has never known any degree of home rule.

The magnitude of the city in wealth and population has always operated against economy in local government. There has existed, apparently, an overwhelming popular sentiment in the city, as well as throughout the State, that such a great municipality should pay the maximum price for everything it might require. If this sentiment had been satisfied by the payment of high salaries and wages it might have been excusable from some points of view; but it was not, and the demand for more money from the public treasury 21
has extended to every class of expenditure.

The city of New York is a purchaser in the open market of supplies exceeding in value $5,000,000 a year. This figure applies only to articles purchased without competitive bidding. There is in the charter a provision that all purchases of supplies and labor in excess of $1,000 shall be made by open competitive bidding. This leaves a wide field for fraud and favoritism, and it is an easy matter to evade the spirit and letter of the law relating to competition. If a department requires material and supplies amounting to $10,000, or even $50,000, it is often possible to make the purchases in lots of less than $1,000 from day to day, and thereby obey the letter of the law while permitting the grossest frauds against the city treasury.

Under the system that has grown up, protected by this imperfect legal restriction and opinions and decisions to the effect that the city has no defense against excessive claims unless fraud and conspiracy can be proved, robbery of the public treasury has not only been legalized, it has been made respectable. The comptroller, who is by law the auditor of accounts, may be able to show that the city has been charged double or treble the market rate for supplies purchased, yet under the legal opinions and decisions that have prevailed for two years he is not permitted to interpose any defense to an action to recover unless he can prove that there was a conspiracy or agreement to defraud. In the very nature of things it is next to impossible to secure legal evidence of such agreements; therefore the city has been robbed with impunity. The methods of the Tweed ring have long been out of date in the city of New York, and fraud upon the public treasury has become a respectable calling.

It is not easy—in fact, not possible—to determine accurately how much the expenses of the city have been increased in recent years by the lax interpretation of an imperfect law and the tolerance of a public sentiment that demands proof of crime on a large scale before becoming aroused to a condition of effective action. It is safe to say, however, that a perfect system of buying in the open market at the lowest prices obtainable, if honestly enforced, would save to the taxpayers more than $1,000,000 a year.

Honest and intelligent administration in every department of the city government would reduce expenditures, but the extent of the reduction that might be made would depend largely upon the proper amendment of certain laws, and to an even greater extent upon the development of a thoroughly informed public sentiment that would sustain retrenchment and economy. The expenses of the city are far greater than 22
they should be, but it is going to be a difficult matter to make even an appreciable beginning in economy so long as the State Legislature is permitted to exercise practically unlimited power to regulate the financial affairs of the municipality. Persons and corporations, be they honest or corrupt, when they seek to obtain money from the city treasury for any purpose, are going to proceed along the line of least resistance, and the smooth and open way has long been the Legislature at Albany. Every session of that body adds something to the expenses of the city, and it is a short and dull one that does not add many thousands of dollars to the burden of the New York taxpayers.

The revenues of the municipality are so small in comparison with what they should be that it is a difficult matter to find any excuse for the theory of government that existed in the days when perpetual franchises were given away. It is small consolation that the policy of municipal ownership is at last to prevail after so much of the public property has passed into the possession of private corporations. If all the outstanding franchises that were the property of the people had been sold on short terms for percentages even as large as have been fixed in recent cases, the city to-day would drive from that source an annual revenue of more than $5,000,000, instead of the paltry $300,000 now collected.

The mistakes of the past, however, are beyond undoing, and the taxpayers must look to the future for relief from the burdens they bear. They are paying now $15,000,000 a year for the sentiment that demanded a city great in all save honesty and political wisdom. Consolidation in fact as well as sentiment must result to prove the material advantage of the arrangement. Public opinion and politicians must realize sooner or later that income and expenses are to be adjusted the one to the other upon sound and enduring principles of business, honesty, and intelligence. There must be a union of public and political interests. Every section of the great city must be brought into close touch with every other section by cheap and rapid transit.

The possibilities of the future are greater than the dreams of to-day, but new policies and new methods must and will prevail. The development of Greater New York must not be hampered by a financial system antiquated and imperfect. The city should have power to develop its material resources into revenue-yielding improvements, and then, with honest and intelligent government, the burden of taxation will be reduced to a minimum, and the ideal of the grandest municipality in the world will have been achieved.

23

A BUBBLE-BLOWING INSECT.

By Prof. E. S. MORSE.

Many years ago, while preparing an elementary book on zoölogy, I had occasion to make a drawing of the little insect which is found on grass and other plants immersed in flecks of froth. This substance is commonly known as frog spittle or cuckoo spit, and, being found in the spring, is known in France as “spring froth.”

Works on entomology gave the general statement that this insect emitted the frothy mass from its body. Curious to ascertain what peculiar gas-secreting apparatus was contained within its anatomy, I dissected a number of specimens, without finding a trace of any structure that could produce from within the body a single bubble of air. On the contrary, I found that the little insect emitted a clear, somewhat viscid fluid, and by means of appendages at the extreme tip of its tail secured a moiety of air by grasping it, so to speak, and then instantly releasing it as a bubble in the fluid it had secreted. At the time of this observation—twenty-five years ago—I supposed that entomologists were familiar with this fact, but, on the appearance of my little book, I received a letter from the late Dr. Hermann Hagen, the distinguished entomologist, stating that he had ransacked his library and failed to find any reference of the nature of my statement. Doubtless the whole history of this insect has since been published, but a somewhat superficial survey of the literature has failed to reveal any reference to the matter. In this connection it is interesting to observe how often the more easily accessible facts of Nature escape the special student. The history of science is replete with such instances. One can hardly take up any subject connected with the life history of animals without finding lacunæ which ought to have been filled long ago. The facts in regard to the ossification of the hyoid bones in man is a case in point. The persistence of these erroneous concepts or half-truths comes about by the acceptance at the outset of some fairly trustworthy account by an authority on the subject, and ever after the statements are copied without a doubt being expressed as to their accuracy.

If we look over the literature of the subject under discussion, we find that in nearly every case the statement in regard to the spit-insect conveys the idea that the creature secretes the froth in which it is immersed. Beginning with De Geer in the last century, we quote as follows: “One may see coming out of the hinder part of its body a little ball of liquid, which it causes to slip along, bending it under its body. Beginning again the same movements, it is not long in producing a second globule of liquid, filled with air like the first, which it places side by side with and close to the preceding one, and continues the same operation as long as there remains any sap in its body.” Kirby and Spence, in their Entomology, describe “the white froth often observed on rose bushes and other shrubs and plants, called by the vulgar ‘frog spittle,’ but which if examined will be found to envelop the larva of a small hemipterous larva (*Aphrophora spumaria*), from whose anus it exudes.” In Westwood’s Insects we find the following statement: “One of the best-known insects in the family is the *Aphrophora spumaria*, a species of small size which frequents garden plants, the larva and pupa investing themselves with a frothy excrementitious secretion which has given rise to various fancies. A species of *Aphrophora* is also found in great quantities upon trees in Madagascar, the larva of which has the power of emitting a considerable quantity of clear water, especially in the middle of the day, when the heat is greatest.” Here the statement is definitely made that the froth is excrementitious, and the Madagascar insect is shown to be different from *Aphrophora* in that it exudes a clear water. In Dr. Harris’s Treatise on some of the Insects Injurious to Vegetation, of Massachusetts, we find a most definite statement as to the origin and nature of this froth. He says: “Here may be arranged the singular insects, called frog hoppers (*Cercopididæ*), which pass their whole lives on plants, on the stems of which their eggs are laid in the autumn. The following summer they are hatched, and the young immediately perforate the bark with their beaks and begin to imbibe the sap. They take in such quantities of this that it oozes out of their bodies continually in the form of little bubbles, which soon completely cover up the insects.” In Dr. Packard’s admirable Guide to the Study of Insects the statement is made that “*Helochara* and *Aphrophora*, while in the larva state, suck the sap of grasses and emit a great quantity of froth, or in some cases a clear liquid, which in the former case envelops the body and thus conceals it from sight. It is then vulgarly called ‘toad’s spittle.’”

In other accounts it is stated that the larvæ live covered by masses of froth which the insects produce by expelling from their beak the juices drawn out of the tree.

The above extracts are sufficient to indicate the common belief among entomologists that the insect in some way emits this froth from the body. A most cursory examination of the creature, however, shows that its only secretion is a clear fluid.

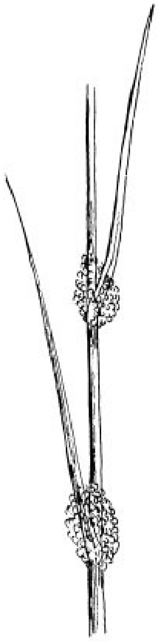

Fig. 1.—Grass stalk and leaves, showing appearance of froth.

The so-called frog spittle or cuckoo spit (Fig. 1) appears as little flecks of froth on grass, buttercups, and many other plants during the early summer. These flecks of froth may be found very commonly at the junction 25 of the leaf with the stem. Immersed in this froth is found a little green insect, sometimes two or three of them, concealed by the same moist covering. This little creature represents the early stage of an insect which in its full growth still lives upon grass, and is easily recognized by its triangular shape and its ability of jumping like a grasshopper. There are a number of species; the one living on grass apparently confines itself to the grass alone, though I have seen one species that frequents a number of different plants. A species found on the white pine is dark brown in color, and the froth in which it is found not only hangs pendent from the branch, but the lower portion appears as a large drop of clear water.

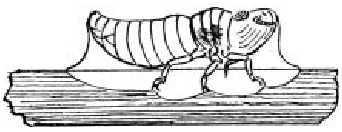

Fig. 2.—The insect first emitting a clear fluid which fills up the interspaces between its body and the stem of grass upon which it rests.

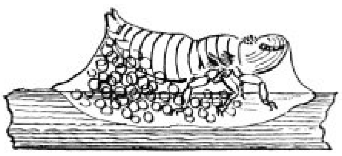

Fig. 3.—After the lapse of some time it begins rapidly to make bubbles.

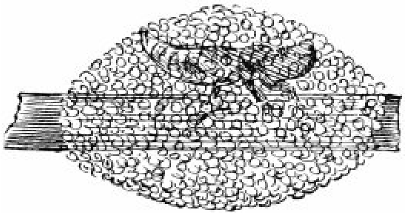

Fig. 4.—Entire fluid filled with bubbles, and the froth thus made enveloping the stem.

Magnified Figures of Aphrophora, showing Successive Stages in the Production of Froth.

Let one provide himself with a good hand lens, a bit of glass (a watch crystal is especially suitable for this purpose), and a common camel's-hair brush, and he is ready to make a preliminary study of *Aphrophora*. The brush is convenient for easily removing the insect from the froth which invests it. If the insect is cleared from the mass of froth, it will crawl quite rapidly along the stem of the plant, stopping at times to pierce the stem for the purpose of sucking the juices within, and finally settling down in earnest, evidently exerting some force in thrusting its piercing apparatus through the outer layers, as shown by the firm way in which it clutches the stem with its legs. After sucking for some time, a clear fluid is seen to slowly exude from the posterior end of the abdomen, flowing over the body first and gradually filling up the spaces between the legs and the lower part of the body and the stem upon which it rests (Fig. 2). During all this time not a trace of an air bubble appears; simply a clear, slightly viscid fluid is exuded, and this is the only matter that escapes from the insect. In other words, its secretion of clear fluid is precisely like that of the Madagascar species referred to by Westwood and others.

This state of partial immersion continues for half an hour or more. During this time, and even when the insect is roaming up and down the grass or twig, the posterior segments of the abdomen are extended at intervals, the abdomen turning upward at the same time. It is a kind of reaching-up movement, but whether this 26 action accompanies a discharge of fluid or is an attempt at reaching for air I have not ascertained. Suddenly the insect begins to make bubbles by turning its tail out of the fluid, opening the posterior segment, which appears like claspers, and grasping a moiety of air, then turning the tail down into the fluid and instantly allowing the inclosed air to escape (Fig. 3). These movements go on at the rate of seventy or eighty times a minute. At the outset the tail is moved alternately to the right and left in perfect rhythm, so that the bubbles are distributed on both sides of the body, and these are crowded toward the head till the entire fluid is filled with bubbles, and the froth thus made runs over the back and around the stem (Fig. 4).

Even when partially buried in these bubbles the tail is oscillated to the right and left, though when completely immersed the tail is only occasionally thrust out for air which is allowed to escape in the mass apparently without the right-and-left movement, though of this I am not sure. It is interesting to observe that in half a minute some thirty or forty bubbles are made in this way—a bulk of air two or three times exceeding the bulk of the body—without the slightest diminution in the size of the body.

If the insect is allowed to become dry, by resting it upon a piece of blotting paper, and is then placed upon a piece of glass and a drop of clear saliva be allowed to fall upon it, it proceeds to fill up this fluid with bubbles in precisely the same manner as it did with its own watery secretion. It is quite difficult to divest the creature of the bubbles of air which adhere to the spaces between the legs and the segments on the underside of the body. 27 It may be readily done, however, by immersing it in clear water and manipulating it with a brush. If now it is again dried and placed on the glass it will slowly secrete what spare fluid it has in its body, but not the minutest bubble of air is seen to escape. These experiments should be made on glass, for then one may get transmitted light, and the highly refractive outlines of the air bubbles are more quickly detected. Using a higher power with a live cell, new features may be observed. Confining the insect in this way, inclosed in a drop of water, a very clear proof is offered that it gets all the air for its froth in the way I have described. So long as the insect remains surrounded by water not the minutest bubble of air is seen to escape from the body. During this immersion the creature is incessantly struggling to reach the edge of the drop, and no sooner has this been accomplished than it thrusts out its tail and begins the clutching of air and the making of bubbles. The bubbles, however, disappear as soon as made, as the clear water will not preserve them. As the water becomes slightly viscid from the insect's own secretions, the bubbles remain for a longer time. A bubble will be partially released and then held, or even partially withdrawn, between the claspers.

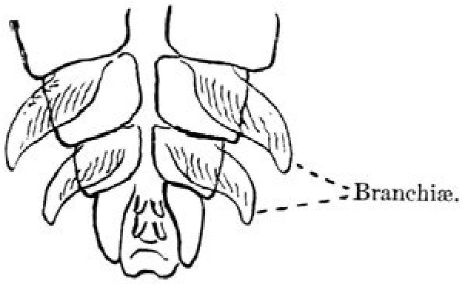

Fig. 5.—Showing underside of posterior extremity of body with appearance of branchiæ.

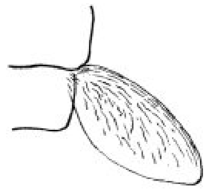

Fig. 6.—A single branchia under slight pressure.

The claspers seem to be the tergal portions of the ninth segment. On the sides of the seventh and eighth segments may be clearly seen leaflike appendages, which are possibly branchial in their nature (Figs. 5 and 6). They are extremely tenuous, and appear like clusters of filaments, slightly adhering together and forming lamellate appendages similar to the gill-like appendages seen in the early stages of *Potamanthus*, a neuropterous insect, not, however, having the definiteness of these structures. While in *Potamanthus* one may easily trace the ramifications of the tracheal system, I have not been able to detect a similar connection with these appendages in *Aphrophora*. Certainly the insect does not depend upon these structures for respiration, as when the creature is perfectly dry it seems to suffer no immediate inconvenience, but will crawl about the table 28 or even on the dusty floor and live for an hour or two in this condition. The usually glabrous surface of the body, however, becomes shriveled after a while. On the other hand, it immediately sinks in water, and will live for some time immersed in this way, and this leads me to believe that the appendages above described may perform a slight respiratory function. The fact that the insect immediately sinks may be cited as an additional evidence that it does not emit air.

It is interesting to observe that regarding this stage of *Aphrophora* as an aquatic stage, since it lives immersed in fluid, we have the same behavior that we observe in the aquatic stages of other *Hemiptera*, as well as in insects of other orders. The great water beetle *Hydrophilus* has an aquatic larva. Myall, quoting Lyonet, says: “They never remain long at the bottom of the water; air is necessary for them, and this they take in by the tail, which they raise from time to time to the surface of the water.” In the larva of *Dysticus*, another water beetle, the only functional spiracles are the last pair, opening at the tail. The little oval beetles, known as whirligigs, from their rapid whirling motion, when swimming on the surface of the water carry down a bubble of air on the end of the abdomen, and when this has been exhausted in the process of respiration rise to the surface for a fresh bubble. The larvæ of some forms are furnished on each side with long respiratory filaments.

A number of neuropterous insects whose early stages are passed in the water are furnished with branchial tracheæ or false gills. These consist of filaments springing from the sides of the abdominal segments. In the early stages of certain dragon flies the rectum supports epithelial folds which are filled with fine tubes from the tracheal system. Among certain aquatic insects belonging to the order of *Hemiptera* the creatures reach out the hinder portion of the body to secure air. Dr. Myall, in his very interesting book on the Natural History of Aquatic Insects, says: “A *Nepa* or a *Ranatra* may sometimes be seen to creep backward along a submerged weed until the tip of its breathing tube breaks the surface of the water.”

The *Aphrophora* while immersed in the watery fluid, whether secreted by itself or consisting of clear water which has been supplied to it, reaches out for air in a precisely similar manner. Primarily the froth made by this insect not only keeps the body moist, but acts as a protection against its enemies.

A number of individuals may often be found in one fleck of froth, and they are entirely hidden from sight while immersed in this way. The viscid character of the fluid secreted insures the retention of the air the insect collects in the form of little bubbles. This peculiar feature must have been a secondary acquisition. The bubbles 29 not only surround the insect and the stem upon which it rests, but flows in a continuous sheet between the ventral plates of the abdomen, and the insect probably utilizes this air in the manner of other air-breathing aquatic larvæ—namely, through its spiracles. As many aquatic larvæ respire in two ways, either inhaling air through the spiracles or by means of branchial leaflets, so *Aphrophora* may likewise utilize its branchial tufts for the same purpose. For this reason we can understand how each fresh bubble added to the mass may aërate the fluid, so to speak, and thus insure at intervals a fresh supply of oxygen.

THE NEGRO SINCE THE CIVIL WAR.

By N. S. Shaler,
DEAN OF THE SCIENTIFIC SCHOOL OF HARVARD UNIVERSITY.

The admirable conduct of the negro during the civil war made it seem possible to have the readjustment of his relations on the basis of freedom brought about with a minimum of friction. As a whole, the former slaves had stayed on the land where they belonged. Many of those who had wandered, moved by the homing instinct so strong in their race, found their way back to their accustomed places. The bonds of mutual interest and old affections were enough, had the situation been left without outside disturbance, to have made the transition natural and easy. It is true that the negro, with his scant wage paid in supplies, would not have advanced very far in the ways of freedom. He would have been hardly better than the middle-age serf bound to his field. It would, however, have been better to begin with a minimum of liberty, with provision for schooling and a franchise based on education. But this was not to be. Political ends and the popular misconception of the negroes as beings who differ from ourselves only in the color of their skin and in the kink of their hair led to their immediate enfranchisement and to the disenfranchisement of their masters. This was attended by an invasion into the South of the worst political rabble that has ever cursed the land. There were good and true men among the carpet-baggers, but as a lot they were of a badness such as the world has not known since captured provinces were dealt out to the political gamblers of Rome.

The effect of the carpet-bag period on the negroes was to raise their expectations of fortune to the highest point, and then to cast them down. Those of the poorest imaginations looked for forty acres of land and a mule. 30
In the resulting political corruption the native whites and blacks endured even greater losses than the war had inflicted, the most grievous being a great unsettling of the relations between the races. The way in which the white men of the better sort met this trial is fit to be compared with the best political achievements of their folk. Gradually, on the whole without violence, for they had to abstain from that, working within the limits of the Constitution to which they had been forced to trust for their remedies, they rewon control of their wasted communities, and brought them back to civilized order. There was a share of terrorism and shame from such devices as tissue ballots to lessen the dignity of this remarkable work, yet it remains a great achievement—one that goes far to redeem the folly of the secession movement. The full significance of this action is yet to be comprehended.

The overthrow of the carpet-bag governments, quietly yet effectively accomplished, removed the only danger of war between the blacks and whites. We can not well imagine another crisis so likely to bring about a conflict of that kind. The blacks were driven from power. Their desperate leaders would willingly have led them to fight, but the allegiance to the ancient masters was too strong, their trust in the carpet-bagger, for all his affectation of love, too slight to set them on that way. The negro fell back as near as might be to the place he held at the close of the war. His position was thereafter worse than it was at that station in his history, for the confidence and affection which the behavior of their servants during the rebellion had inspired was replaced in the mind of the dominant race by an abiding sense of the iniquities in which the ex-slaves had shared. Thereafter, and to this day, the black man is looked upon as a political enemy, who has to be watched lest he will again win a chance to control the state. In the greater part of the South this fear is passing away. In several States new laws concerning the franchise have made it practically impossible for the negro vote to be a source of danger for some time to come—until, indeed, the negro is better educated and has property. There is a share of iniquity in these laws, as there is apt to be in all actions relating to a situation that rests on ancient evils, but their effect is better than that of terrorism and tissue ballots which it replaces. They will afford time for the new adjustments to be effected.

In considering the present conditions of the negro, we may first note the important fact that he is hard at work. The production of the South clearly shows that the sometime slaves, or rather their children, are laboring 31
even more effectively than they did in the time of legal servitude. This disposes of the notion that the blacks will not work without other compulsion than those needs which bend the backs of his white brethren. It is evident that the generation born since the war is laborious and productive up to, if not beyond, the average of men. It is also plain that they are fitted for a rather wider range of employment than they were accustomed to follow as slaves. The negro has proved himself well adapted for labor in mines and about furnaces—in all places, indeed, where strength and a moderate share of intelligence are required. The fear that he would desert the land and flock to the cities has not been justified. He appears less disposed to yield to the temptations of the great towns than the whites. The first rage of the freed people for schooling seems to have passed. A good many of them are getting the rudiments of an education, some few a larger culture, but there appears to be danger that the folk may lapse into indifference concerning all training that is not immediately profitable.

As to the moral condition of the negroes, there appears to be good reason for believing that it is now in the way of betterment. Little as they were disturbed in their conduct by the sudden change in their apparent place in the world, they were for a time somewhat shaken as regards the limits of their rights. So far as I have been able to learn, they are much less given to stealing than they were just after they were freed, or even as they were as slaves. Their marital relations, though leaving much still to be desired, are improving, as is all that relates to the care of their children. Most important is the fact that loose relations between white men and negro women have in great measure ceased, so that the unhappy mixture of the races, which has been the curse of tropical states, is apparently not likely to prove serious.

Although the negro is not rapidly gaining property, he is making a steadfast advance in that direction. The money sense in all that relates to capital he, with a few exceptions, is yet to acquire. This part of his task is certain to be difficult to him, as it is to all peoples who are in the earlier stages of civilized thought. The experiment of the Freedman’s Bank, by which many suffered at the hands of designing white people, has left a bad impression upon the minds of the negroes. Where they save, they commonly hoard their store. As yet they have not become accustomed to associative action. They rarely enter into any kind of partnership. In this indisposition to attain the advantages of mutual support we have another evidence of the primitive condition of the folk.

Before endeavoring to go further with this account of the present state of the negroes of this country, it is [32] well to note the fact that while much has been done to blend the original diversities of their stock, these differences have by no means passed away. The seekers after slaves in Africa were not choice as to their purchases or captures; they reckoned as black if he were no darker than brown, and they were not at all careful to see that his hair was kinky. Thus it came about that from the wide ethnic range of the Dark Continent there came to us a great variety of people—a much more diverse population than we have received from Europe. It might be supposed that the conditions of slavery would quickly have effaced these differences, but even in that state there was choice in mating, and certain stocks have such prepotency that a small share of their blood stamps those who have it in a definite manner. The result is that, under the mask of a common dark, though really very variedly tinted skin, we have an exceeding diversity of race and quality.

It is discreditable to our students of anthropology that as yet there has been no considerable effort made to determine the varieties which exist in our negro population or the source of their peculiarities in the tribes whence they come. In a small way, for many years, on numerous journeys in the South, I have endeavored to classify the blacks I have met. For a long time I kept these results in a roughly tabulated form. Although such observations, including no measurements and giving only eye impressions of the general form, can have no determinable value, they may, in the absence of better work, deserve consideration. The result of this rough inspection of many thousand of these peoples in nearly every State in the South has been to indicate that there are several, probably more than six, groups of so-called negroes which represent original differences of stock or the mixed product of their union. The more characteristic of these I will now briefly describe.

For convenience I will first note those who are termed mulattoes, in which there is an evident mixture of white blood. Such admixture seems to be distinctly traceable if it amounts to as little as one eighth; it is said that one sixteenth of negro blood, or less, will be revealed on close study of the hair and skin. The proportion of the negroes in our Southern States who have white ancestry in any degree does not, in my opinion, exceed one tenth, and may be as small as one twentieth of the whole number. Judging only by the hue of the skin, the observer will be likely to make the proportion larger, for the reason that he will include many persons who, because they come from stocks that were not blackskinned, appear at first sight to be mulattoes of some [33] degree. These Eu-Africans, as we may term them—imitating in the term the useful word Eurasian, which is applied to the mixture of European and Asiatic people in India—are in appearance exceedingly diverse, the variety being caused by the varying share of the blood of the two races, as well as by the diversities of the stocks to which the parents belong.

Besides the mixture of the European and black, we have another less well known but not uncommon between the negro and the Indian. This is often met with among the remnants of the Indian tribes in all the eastern part of the United States. The two groups of primitive people appear to have found their despised lot a basis for a closer union. The dark skin of the Algonkins, however, makes the remnants of that people appear to have more black blood than they really possess. Not only did stray negroes resort to the Indian settlements, but some of the tribes owned many slaves. The result is that in many parts of this country, but particularly in Virginia, the Carolinas, Florida, and Georgia, the attentive observer often will note the Indian's features stamped on those of the African.

Coming to the diversities of the stock among the pure Africans, we may first note the type which, in the rough judgment of the public, is the real or Guinea negro. That he is so taken is doubtless because he is the most distinctly characterized of all black people. The men of this well-known group are generally burly fellows, attaining at a relatively early age a massive trunk and strong thighs; they have thick necks and small though variedly shaped heads. The bridge of the nose is low, and the jaws protruding. The face, though distinctly of a low type, very often has a very charming expression—one in which the human look is blended with a remnant of the ancient animal who had not yet come to the careful stage of life. The women of this group are well made, but commonly less so than the men. In general form the two sexes of the group are much alike, a feature which also indicates an essentially low station. These people of the Guinea type form perhaps one half of the Southern negroes.

Along with the Guinea type goes another much rarer, which at first sight might by the careless observer be confounded with the lower group. The only common features are the burly form of both, the deep-black hue, and the general form of the features. The men we are now considering have a higher and in every way better head. Their foreheads are fuller, and the expression of the face, to my view, quite other than that of the Guinea men. In place of the sly, evasive child-animal look of the lower creature, this fellow has rather a lordly port, the [34] expression of a vigorous, brave, alert man. This, which I am disposed to term the Zulu type, from the resemblance to that people, is on many accounts the most interesting of all the groups we have to consider. My idea that it may have come from the above-named tribe is based on an acquaintance with a party of southern Africans who some forty years ago were brought to this country by a showman. I came to know them well. They were attractive fellows, of the same quality as certain blacks I had known in Kentucky. When I saw these strangers I perceived their likeness to certain able blacks whose features and quality had made impressions on my mind that remain clear to the present day. It is likely that this element of the negro people I have termed Zulu is not of any one tribe; it may be of several diverse stocks with no other common quality than that which vigor gives. They may, in part, be from Bangora tribes of the Congo Valley, or even Soudanese. The proportion of this group to the whole is small; because it merges into the other it can not well be estimated. I find that I have reckoned it in my notes as one twentieth of the whole black population.

Set over against these robust blacks, but also of high quality, is a group less distinctly limited, which has for its characteristics a rather tall, lean form, a slender neck, a high head, and a thin face, usually with a nose of better form than is commonly found, sometimes approaching the aquiline. The skin of these people is often as black as that of the Guinea folk, yet it is of another hue—a deader black, perhaps due to some difference in the skin glands. Usually, however, there is a trace of brown in the complexion. Now and then the relative straightness of the hair and their facial profiles suggest that the peculiarity of this people is due to an admixture of Semitic (probably Arabian) blood. Negroes of this type are most abundant in the northern part of the South, particularly in Virginia. They are rare in the plantation States. This is mayhap due to the fact that in the selection of people to be sold to the traders such delicate folk were retained where they belonged—as house servants. These rare negroes, which for lack of a better name will be termed Arabs, are few in number. They can not be reckoned at more than one per cent of the whole.

Besides the comparatively recognizable types above reckoned, there is another which puzzles the observer. They are of varied shapes, generally, however, rather smaller than the average. Their peculiarity consists in the reddish-brown hue of their skins, which at first suggests that they are mulattoes. Their faces and hands are often distinctly blotched with darker patches, in the manner of freckles. At times I have been inclined to regard their features as indicating a tendency to albinism, or that change of pigment such as now and then gives silver 35
foxes or white blackbirds. All things considered, it seems more likely that we have in these red negroes the remnant of a people once distinctly separated from the other black Africans. In favor of this view is the fact that the members of the group are very evenly distributed, as they would be if they were a distinct race, and not as we should expect to find them if they were the result of albinism or of a mixture of white blood. The number of this variety of folk is small; it probably does not exceed one per cent of the population.

When the observer has made the divisions above noted he has set apart a little more than one half of the blacks he has tried to classify. Among the remainder he will have remarked other but indistinct types in a way that appears to indicate that several other fairly characterized groups might by close scrutiny be established. The greater part of this remainder, however, evidently consists of mixed people, who have come from a mingling of the original diverse stocks.

Imperfectly founded and inadequate as are the results of my rough inspection of the Southern negroes, they fairly serve to show some facts of importance to those who would helpfully foresee the future of the black people in this country. We may first remark that, notwithstanding the many distinct racial qualities and diversity which, to my eye, far exceed what we may observe among the whites of the United States, they are, with the exception of the mulattoes, in excellent physical condition. They are of curiously even, serviceable size, dwarfs and giants being very rare—much rarer than among the whites. The percentage of deformed persons is, so far as the eye can determine it, very low. I am fairly well acquainted with the peasant class in most of the European states, and I know of no region where the average condition of the folk appears to be so good as it is among the Southern blacks. In fact, this state is doubtless due to the rigid selection which was had when the Africans were chosen for export; in part to the care of their bodies during the time when they were slaves. The result is a distinctly chosen people, well fitted to carry the burdens of this world.

The variety of physical quality which appears to exist among the negroes is important, for the reason that it appears to be associated with mental differences even as great, thus affording a basis for the differentiation of the people as regards occupations and consequent station in life. It is even more difficult to get at the mental peculiarities of the several groups of black folk than it is to ascertain those of their bodies, so what I shall now 36
set forth is stated with much doubt. It represents my own opinion, qualified by that of others whose judgments I have sought. In the Guinea type we have a folk of essentially limited intelligence. The children are rather nimble-witted, but when the body begins to be mature it dominates the mind. It seems likely that thus the largest element of the race is to find its place in the field or in the lower stages of craft work. The Zulu type appears to me fit for anything that the ordinary men of our own race can do. They remain through life alert and with a capacity for a vigorous reaction with their associates. From them may come the leaders of their kindred of less masterful quality. From the Arab type we may expect more highly educable people than is afforded by the other distinct groups. They have more delicate qualities. They lack the wholesome exuberance of the ordinary negro, which is commonly termed “bumptiousness.” Their nature is often what we may term clerical. They are inclined to be somber, but are not morose in the manner of a “musty” elephant, as is frequently the case with the Guinea and Zulu types. Of the red or freckled negroes I have no sufficient grounds for an opinion, yet they as a whole impress me less favorably than any other of the distinct groups. As for the unclassified remainder of the blacks, it can only be said that they seem to be as varied in their mental as they are in their physical character.

The mulattoes of this country appear to be of less importance to the future of the people with which they are classed than they are in other parts of the world, where the white element of the mixture is from other than the Teutonic stock. They are in general of feeble vitality, rarely surviving beyond middle age. My father, an able physician, who had been for nearly all of a long life in contact with negroes, was of the opinion that he had never seen a half-breed who was more than sixty years old. There is certainly a notable lack of aged people of a hue that would indicate that they were anywhere near an equal mixture of the white and black races. Those in which the blood of white stock predominates appear to be more enduring than the half-breeds.

While the intellectual qualities of the mixed white and black are often very good and the attractiveness of the person and manner sometimes remarkable, they have in general a rather bad reputation as regards trustworthiness. Such a view of mestizos is common in all countries where they occur. Humboldt is quoted (though I have not found the matter in his works) as saying that all mixed races have rather the evil than the good of the races from which they sprang. In the case of the mulattoes, at least, there seems to be no warrant 37
for this judgment, and all we know of offspring of diverse species in the animal and plant world fails to give it any support. It is most likely that this opinion as to the mixed white and black people is but one of the varieties of race prejudice where the sufferer is often despised by those who are below him as well as those who are above. The lot of all human half-breeds is unhappy in that they are limited to a narrow field of association. They are not perfectly free to make friends with either of the peoples to whom they are kin. Considering the peculiar situation of the mulattoes, the difficulty of which no one who has not sought information on the matter can well conceive, it seems to me that their way of life is creditable to them. On their own and other accounts, however, we may welcome the fact that their mixed stock is likely to disappear, being merged in those whence it sprang.

In considering the future of our American negroes it is important that we should make a judgment as to their moral tendencies. This is not easy to do, for the statistics of crime are not in such form as to make it clear in what regards they depart from the averages of the white population. There can, however, be no doubt that at first they were addicted to small thieving, and that this habit continued until after the civil war. Southern

people, well placed for forming an opinion, believe that this evil is passing away, from the development of the property sense. As for drunkenness, the negro appears to be on the whole less tempted to it than are the whites. One rarely finds the sot type among them. Those of the lower class are liable to curious contagious excitements, which often make them behave as if they were intoxicated when they are not so. A scene I witnessed on a train out of New Orleans, a few years ago, illustrates this and other significant features of the negro character. It was a Sunday morning, and the car assigned to blacks was full of sturdy fellows, mostly of the Guinea type. Explaining to the conductor that I wished to see the people, he allowed me to take a seat in the rear of the carriage. At first my neighbors looked askance at me, but with a word they became friendly. While the train was at rest the throng was still, but as soon as it was in motion singing and shouting began. There was a lull at every station, but with each renewal of the motion the excitement rose higher, until it became very great. A white newsboy, a fellow of some eighteen or twenty years, was engaged in selling papers and candy. As he passed along the aisle one of the negroes sprang at him, knife in hand. In a flash the boy had the muzzle of his pistol almost against the assailant’s head. At this every negro in the car was afoot and shouting. Fearing the boy 38
might be struck from behind, I moved near to him, intending to caution him not to fire too soon, for I was sure that his opponent would quickly break down. The youngster needed no advice of mine. In a steady, low voice he called, “Put up your knife—*one*!” With that the throng became suddenly still. “Put up your knife—*two*!” whereupon the ugly fellow slowly hid his knife and sank into a seat with bowed head, while the newsboy went on crying his wares, as if nothing unusual had happened.

Thinking that the negro might have had some grudge in mind, I asked the newsboy for the facts. He assured me that he had never seen the fellow before, and had no reason to expect the attack. He agreed with me that none of the people were drunk, and accounted for their conduct much as I was disposed to do—that “coons would get wild when there was a racket going on.” It was interesting to note that the brakemen, who, with their pistols ready, came from either end of the car, took the affair as quietly as did the newsboy, making no kind of comment on it. I stayed on for an hour or so in the car. While I was there the negroes were perfectly quiet, it being evident that although the offender was not arrested and no blow had been struck, not even a brutal word used, a profound impression had been made on those half-savage people, as in another way on me. We both felt what means the strong hand of a masterful race—the stronger when it withholds from smiting. I had seen a good example of one of the ways by which the wild men of Africa have been shaped to the habits of their masters. Such a scene as I have sketched is happily possible in only a limited part of the South—that in which there is a great body of negroes who have not yet been to any extent influenced by civilizing contact with the whites.

There is a common assertion that the male negroes are sexually dangerous animals. The lynchings for assaults on white women appear at first sight to give some color to this view. It is, however, evidently a difficult matter on which to form an opinion. It may be fairly said that these instances of violence occur in by far the larger proportion in the States where the blacks are least domesticated, where they have been in the smallest measure removed from their primitive savagery. If we could eliminate this uncivilized material, mostly that which took shape, or rather kept its primitive shape, on the great plantation, the iniquity would be as rare everywhere as it is in Virginia, Kentucky, Missouri, North Carolina, and Tennessee. When we recall the fact that there are now some five million negro men in the South, and that probably not one in ten thousand is guilty of the crime, we see how imperfect is the basis of this judgment. We have also to remember that this offense when 39
committed by a negro is through the action of the mob widely published, while if the offender be a white man it is unlikely to be so well known. I therefore hold to the belief that violence to women is not proved to be a crime peculiarly common among the blacks. I am inclined to believe that, on the whole, there is less danger to be apprehended from them in this regard than from an equal body of whites of the like social grade. This matter is one of exceeding importance, for on it may depend the future of the South. It is fit that in considering it men should keep their heads clear.

In reviewing the condition of the Eu-Africans a third of a century after the war that gave them their new estate, we have, I think, reason to be satisfied with the results of the change. The change has brought us no distinct economic evils, as shown by the statistics of the industries. The labor of the blacks is quite as productive as it was while they were slaves. Their moral situation is not evidently worse than it was before they attained the measure of liberty which they now possess. The first step, that which naturally caused the most fear, has been taken, the people are free and have not turned their liberty to license. In looking forward, however, we see that only a part of the task has been done. The negroes have failed to acquire, save in very small proportion, the capacity for a true political life. It has been found necessary to deprive them of the control they once exercised, to the peril of the States and their own great harm. The question is as to the ways in which they are to be lifted into the safe plane of American citizenship. They must be so lifted, or we shall in time see established in the South a system of serfdom under the control of an oligarchy—a state of affairs in some regards worse than that of slavery, for it will lack the element of personal interest which did much to help the black in the first stages of his life with us.

Faro II is a dog of fine breed and great intelligence, belonging to one of the artists of *La Nature*, and has been engaged as an actor in the play of Robinson Crusoe, at one of the theaters in Paris. On the stage his name is Toby, and he knows it, and knows just what he has to do. He has entered into relations with his fellow-actors, and obeys his cue instantly. He does the stage business with strict accuracy, picks up the bird that is shot and takes it to Robinson, looks up his yams and the vegetable soup and his pipe. He is grieved when Robinson is sad, exults when he is rejoicing, and looks after his fellow-actors—the goat, the monkey, and the parrot—who are not so bright as he. Off the stage he knows nothing of Toby or of Robinson Crusoe, answers to no name but

Faro, and recognizes no master but the artist, M. Weisser.

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THE BIRDS OF THE ADIRONDACKS.

By Senator GEORGE CHAHOON.

I shall make no appeal for the protection of our birds, for that is not necessary to those who know them; but I wish we could all know them better, and when we knew we would surely love and give them our protection. We would then realize their great use as insect and weed destroyers; they would fascinate us with their cunning habits, and charm us with their beauty and grace.

Most of our birds are migrators, passing their breeding season in summer with us and then leaving for warmer climes. In addition to the climatic reasons for this migration, the question of food supply is doubtless an important factor, for while they might stand the severity of our winters the insectivorous birds could not get any food when our ground was covered with snow and ice, and, in proof of this, as a rule the omnivorous migratory birds are the first to come in the spring and the last to leave in the fall.

In 1877 I began making notes of the arrival of the robin, bluebird, and swallow; these notes have been made every spring, mostly by myself, but during my absence by some member of my family, and were all taken at Au Sable Forks. The earliest date for the robin is March 10th; for the bluebird, March 7th; and for the swallow, April 4th. The latest date for the robin is April 7th; for the bluebird, April 7th; and for the swallow, April 25th. The average date is for the robin, March 28th; bluebird, March 26th; and the swallow, April 15th.

In every year the first robins that came were males, and this was true with the bluebird excepting two years when I saw both male and female birds on the same day. The sex of the swallow is not as easily determined, and I am not sure about them, but my general observation has been that the males come first, and are followed in a few days by the females, and that the courtship and mating are all arranged after their arrival. My observations have been quite careful, and I think they are full enough to go far toward establishing this fact. Of course, there will be exceptions and our observations are necessarily imperfect, for it is not probable that we happen to see the very first bird that comes.

No bird is more generally known or more universally liked than our common robin. Every year he sings for us our praises to the coming spring from the tallest limb of the elm, and he hops across our lawn with a cuteness that forces a hearty welcome, and, differing from most birds, he seems to be more numerous each year. In a few days his mate joins him, and a search for a site for their first nest begins. The robin lays four [41] eggs, and frequently raises three broods of young in a season, never, so far as I know, using the same site or the same nest twice in one season, or more certainly never using the same nest or site for two consecutive broods. Year after year the same corner in the porch or the same crotch in the apple tree will be used as a nesting place by the robin, and we have all wondered if the same robins came back every year, or if the young birds returned and used the nest in which they were hatched. The birds look and act wonderfully familiar when the old site is occupied, and many people are sure they remember the birds from the year preceding. I have never seen a statement from any ornithologist throwing light on this interesting question, and I twice made an attempt, without success, to obtain the information for myself.

All thrushes except the robin are mottled on the breast, and the breast of the young robin is mottled for the first season, so the young can be readily told from the old birds. The robin is a great lover of angleworms. The young follow the mother while she gathers worms to feed them, and about the time for weaning the young birds I have frequently seen the mother bird pick up straws and sticks and offer them to her young instead of food. This may be done to discourage them from following her any longer, but I think it is more probably caused by a return of the nest-building instinct to the mother.

Some years ago I put a small bird box on a post in our yard, which was soon occupied by a pair of summer wrens, and all went nicely with them until a pair of English sparrows concluded to drive the wrens away and take the house for themselves, and for three or four days the wrens and sparrows were constantly fighting, but the wrens finally won and held possession of the house, although at a great sacrifice, for after the fight was over I raised the lid of the box and found the young birds dead, the fight evidently taking so much of the time and attention of the old birds that they allowed their young to starve. I removed the dead birds, and in a short time the wrens rebuilt the nest, and this time they closed the hole for entrance until it was scarcely large enough to admit my thumb.

The box was occupied by wrens for several years, but the entrance was never closed afterward, and I kept the sparrows from any further interference. In this connection I would say that, at least so far as the English sparrow is concerned, the male selects the site for the nest. When I shot the female the male soon returned with another mate, but when I shot the male the female did not return. The wren builds a very coarse nest, and fills the box nearly half full of sticks three or four inches long. As these sticks are carried in the birds' bills by the [42] middle, they would naturally strike the hole crosswise and could not enter, so when the birds get near the box they turn sideways and poke the sticks in end first, following in and arranging them afterward.

The merganser is a fish duck nearly as large as our common domestic duck, and is known under the names of sheldrake and sawbill duck. The male is considerably larger than the female; he has a jet-black head, and the black extends down the neck for about two inches, where the color changes to a pure white, the line being as regular and distinct as the painting on the smokestack of a steamship. The body is generally white, with black markings on the wings and some black on the body; the breast is a beautiful salmon color when the bird is killed, but if mounted soon fades to a pure white. The male merganser in full plumage is one of our most beautiful birds.

The female, besides being smaller, is of a grayish color, and the plumage and general appearance are entirely unlike the male, so that the sex can be easily determined even at a long distance.

This bird is common on the Champlain and waters of the Adirondacks. Like all fish ducks, it has a long, sharp bill, which is serrated with sawtooth-shaped notches strongly suggesting teeth, a fact which has given this bird much interest to our evolutionary scientists.

I have noticed a habit of this bird that I believe is entirely unique, and one I am surprised that our authorities on birds have not mentioned—that is, that the males are entirely migratory and the females are not. After the lakes and still waters freeze the mergansers go to the rivers which are open in some places on the rapids all winter. For more than twenty years I have seen female mergansers on the Au Sable River all winter, and I have frequently seen them on the other Adirondack rivers; but I have never seen a male merganser in the winter, and in the late fall the males and females gather in separate flocks, and when the male mergansers appear in the spring they are always in flocks by themselves.

I think the merganser lives entirely on fish, and it is surprising to one who has made no observations on the subject to know what an enormous number of young fish a flock of these ducks will destroy in a season. I quote the following from my notebook: “October 13, 1882, killed fish duck (female merganser) in Slush Pond, and found in her throat and stomach one pickerel, four black bass, and eleven sun perch. Bob (my brother) present. October 18, 1882, killed same kind of duck on Lake Champlain, and took out of her sixty small perch. James R. Graves present.”

Our most valuable game bird is the ruffed grouse or partridge. He stays with us all the time. He is a strong, 43
swift flier, and taxes the nerve and skill of the sportsman to a high degree, and to bring down a partridge under full wing in the evergreens in November sends a thrill of delight through one’s veins.

The partridge is a gallinaceous bird, and the young leave the nest as soon as hatched, running around with the mother like chickens. Upon the approach of danger the young hide themselves under the leaves in an incredibly short time, and the mother flutters off with an apparently broken wing, keeping just out of reach to lure you away from the hiding place of her young. This ruse is employed by many birds, but in none, so far as I know, to as large an extent as the partridge. Naturally a very timid bird, the partridge will put up quite a bluff for a fight in defense of her young, and on two occasions I knew a partridge to show fight without any young. Experience has satisfied me that a partridge knows enough to try and get a tree between himself and the huntsman, and to keep it there until he is out of range.

Partridges are less numerous around my home than they were twenty years ago, and their habits have undergone a very decided change. Then they usually took to a tree when flushed; now they seldom light on a tree, and take much longer flights. When hunting in Canada last fall I found that the partridges were very tame, and simply ran away from me, or if pressed flew into trees near by and waited for their heads to be taken off with rifle balls.

I notice considerable difference in the shade coloring of the partridge, some being much darker than others, but all have the same markings. The partridge is omnivorous, and, like man and the pig, he eats almost everything. In the winter he lives upon the buds of trees, and many a bird has lost his life while filling his crop from this source, as he is then an easy mark for the hunter, and I have seen the marks of his bill on the carcasses of animals. He is fond of blackberries, and sportsmen often visit blackberry patches when looking for him in the early fall, but I have been surprised to find that when feeding in a blackberry patch he apparently shows no preference for the ripe berries, filling his crop with all kinds. A fact about the partridge which I find is not generally known is, while in summer its toes are plain, like the toes of a chicken, in the winter they are bordered with a stiff hairy fringe that gives it support on the snow, having the same effect as the meshes of our snowshoes. This is a fact of considerable interest, for it seems to have a bearing upon the theory that there is a tendency in animals to develop conditions favorable to their environment. Under this theory one might hope to
find a development of a substitute for a snowshoe on a non-migratory bird whose habits keep it largely upon the 44
ground, while no such development would be expected on a bird that leaves us in the winter for warmer climes.

In this connection I would say that while few of our native birds change the color of their plumage as an adaptation to the seasons, our pretty thistle bird, or American goldfinch, undergoes a radical change. In summer he has a bright yellow body with black markings and a black head, while in winter his plumage is all pale brown or sparrow-color, and we often fail to recognize in our somber winter resident the brilliant goldfinch of our summer. These little birds are gregarious in the winter, and as they fly in small flocks into the trees by the roadside they are frequently mistaken for sparrows, and in fact are usually called tree sparrows.

There are few things connected with the study of natural history more interesting than the tendency in animals to develop conditions suitable to their environment, and it is surprising to see for how long a time an acquired habit will sometimes survive after its usefulness has ceased.

The common chimney swallows always build their nests in chimneys that are unused during their breeding season. They make a semicircular nest of sticks, which they glue to the inside wall of the chimney with a secretion from their mouths. It is interesting to see the swallows gather the sticks for their nests, for they do not alight on the ground, but, while flying, break off dead twigs from trees without stopping in their flight.

This habit of building in chimneys must have been acquired in a comparatively short time, for there were no chimneys in this country before the arrival of the white man, and for a long time afterward the settler had but one chimney in his house, which must have been used, at least for cooking purposes, in the summer. So perfect is this habit that the swallow looks and acts as though he were made for the chimney; his color is a sooty black, so that he does not tarnish his coat by rubbing against the chimney walls; the feathers of his tail end in hard spikes, that he can use them to prop himself against the wall. I have been interested on a summer evening watching these swallows in hundreds circling around a church chimney in Plattsburg, until finally the birds in the center began to enter the chimney, the circle growing smaller and smaller as they apparently poured down in the vortex of a whirlpool of swallows. Many birds have acquired a habit of associating with man, and we rarely find them, except during the season of their flight, far away from houses.

The barn swallows always place their nests under the eaves or cornices of some building, usually a barn. 45
These nests are built of mud gathered by the birds from wet places on the ground, and carried in their mouths to the sites chosen by them. Many of our farmers have an unkind feeling for the barn swallows, as they think the mud-daubed nests on the new red paint are not an artistic addition; but if our cattle could give an intelligent opinion they would welcome the birds, for all swallows are entirely insectivorous, and they must eat many flies

and mosquitoes that otherwise would be left to torment our animals.

Birds that build in inaccessible places seem to rely upon that for security, and apparently make little effort to conceal their nests, while those building on or near the ground are generally careful to hide them, and they display considerable cunning in preventing discovery. Robins, for instance, after the young are hatched, never drop the eggshells over the side of the nests to the ground, where they would attract attention and cause one to look directly overhead and thus find the nest, but take the broken shells in their bills and carry them off, dropping them while flying. Frequently birds are very shy and easily frightened away from their nests, but after they are well established they sometimes show a good deal of tenacity in staying by them until the young are ready to leave.

Some years ago we opened an old ore mine, where a pair of phœbe birds had placed their nest on a shelf a few feet overhead, a projecting rock protecting it from the flying stones of the blasts that were fired several times a day, and the men were working so near that they could almost touch it with their hands. These birds did not desert their nests until the young were old enough to leave. The site was not used the following year, as is usually the case with the phœbe bird.

No bird has insinuated himself into our affections more deeply than the bluebird. He charms us as he flits through the air like a painted arrow, reflecting the sunlight from the metallic luster of his wings, while he pours out his inspired song “in notes as sweet as angels’ greetings when they meet.” He comes to us before the unfolding of the first bud of spring, sings to us until our hills and mountains are covered with the richness of their summer verdure, and stays with us until this verdure is changed to all the beauty of its autumnal glory. I am very sorry, but I believe our bluebirds are gradually though steadily decreasing in numbers. Some years ago two pairs nested in our yard, one pair in a hole in an old apple tree and one pair in a box, but for several years these nesting places have been unoccupied, and I know of a number of other former nesting places that have been vacant for years.

Twenty years ago the wild pigeons were quite plentiful in the fall of the year in this part of our State, but 46
each fall they came in decreasing numbers, and for the last four or five years I have not seen a single bird.

There is no sweeter songster than the shy hermit thrush, and I am much pleased in believing that his numbers are increasing. In former years they were not often heard; now, as our spring afternoons decline into twilight, his charming notes come to us from almost every suitable point.

For the first eight or ten years of my residence in Au Sable Forks I did not see a turtle dove, and now I see them nearly every summer.

Our American eagle is occasionally seen in the Adirondacks, and some years ago a large female golden eagle was caught in a steel trap near my home and came into my possession, where she occupied a slatted hencoop, and whenever curiosity led a hen to poke her bill through the slats her head was taken off very quickly. I was afraid that if I kept the eagle I would turn vivisectionist or become too cruel for a hunter, so I presented her to the Zoölogical Gardens in Central Park.

In birds of prey the female is the larger and finer bird, while the reverse is true with other birds; but there is a striking exception in the noble woodcock. No bird is held in higher appreciation by the sportsman, and a female woodcock in full plumage is as rich in coloring and as beautiful in marking as any bird I know. He lies well for the dog, is rare sport for the gunner, and has no equal for the palate. He nests in our alder thickets or on wet marshy ground, and around my home it is the work of a man to get him. He is nocturnal in his habits, feeding at night and pushing his long, slender bill into the soft ground, leaving holes that to the casual eye look like worm holes, but which are easily recognized by one familiar with his habits.

Cow blackbirds are common to this locality during the summers, and they are found in our pastures with the cattle. I have never found their eggs in the nests of other birds, but they are Mormonistic in their habits, one often having as many as a dozen wives, and I have known the crow blackbird to have more than one mate.

Some years ago an article went the rounds of the newspapers telling of a man catching a flock of crows by soaking corn in alcohol and leaving it for the crows to eat, and when they became drunk he caught them. I tried bread crumbs soaked in whisky on English sparrows, but they would not eat them, and I finally got a crow, and though I kept him until he was very hungry I could not get him to eat corn soaked in whisky, and he found no
difficulty in picking up every unsoaked kernel and leaving the others. You may draw your own moral, but I am 47
satisfied that the crow will not eat food saturated with alcohol. He is either too uncivilized or too intelligent.

Orioles and other birds sometimes give us much annoyance by eating the green peas from our gardens, and, except in the case of English sparrows, we do not like to shoot them. I once killed a hawk and roughly stuffed it with straw, putting it on a pole near my pea vine, where the birds collected in numbers to scold and peck at it, but they were afraid to touch the peas, and finally left mine for those of my neighbors across the street.

The Acadian owl is a pretty, cunning-looking little bird, not much larger than a robin. He is the smallest of our owls and quite tame, and is not often seen around my home. Some two years ago, while hunting with my brother we saw one of these little birds on the limb of a tree not far from the ground, and we concluded to try and snare him. We cut a long pole and made a slip noose with a shoe string, and while my brother kept the owl’s attention by standing in front of him I slipped the noose over his head from behind. When we had the owl we wanted to tie him, and since we could not spare the shoe string for that purpose, my brother decided to tie him with his watch chain. He snapped the catch around one leg, and while trying to fasten the other leg the owl made a flutter and got loose, and the last we saw of him he was sailing over the tops of the trees with the watch chain hanging to his leg.

I have always taken an interest in birds because I have loved them, but it does not follow that I know much about them. Some one said that the more we know men the less we love them, but that man was an old cynic and doubtless told an untruth. Certain it is that the more we know our native birds the more we love them, and it is one of the encouraging signs of the day that it has become fashionable for young people to take an increasing interest in the birds and wild flowers of their own country, and a young person would hardly be considered accomplished to-day who is entirely ignorant of at least the common names of the flowers that bloom in our fields and woods and the birds that pour out their ecstatic music from our trees and hedges.

Herbert Spencer's work on Education has been translated into Sanskrit by Mr. H. Soobba Row, who gives as his reason for publishing a version in an "unspoken" language that the pundits, for whom the version is primarily intended, "can more easily appreciate the ideas conveyed in Sanskrit than perhaps in any other vernacular."

48

THE STRUCTURE OF BLIND FISHES.

By CARL H. EIGENMANN,

PROFESSOR OF ZOÖLOGY, INDIANA UNIVERSITY.

The Color of the Amblyopsidæ.—The three species of Chologaster are colored, with varying intensity, from C. cornutus, which is darkest, to C. Agassizii, in which the color is faintest. The color cells are in all cases arranged in a definite pattern. These are determined by the underlying muscles. The pattern consists of three longitudinal bands on the sides, following the line where the muscle segments are angularly bent, and cross-stripes along the line separating successive segments.

The general color of Typhlichthys is cream and pink. It is abundantly pigmented. In younger specimens the pigment is arranged in more definite areas about the head. In the old it is more uniformly distributed, being, however, specially abundant about the brain. The pigment pattern of the body is precisely as in Chologaster, except that the individual pigment cells are minute and their aggregate not evident except under the lens.

The retention of the color pattern of Chologaster in Typhlichthys is not less interesting than the retention of similar habits. It is perhaps due to different causes. The color pattern in Chologaster is determined by the underlying muscular structure, and the retention of a similar pattern in Typhlichthys is due to the same underlying structure, rather than to the direct hereditary transmission of the color pattern.

Amblyopsis is flesh-colored, ranging to purple in the gill region, where the blood of the gills shows through the overlying structures, and over the liver, which can be seen through the translucent sides and ventral wall. About the head and bases of the fins the color is yellowish, resembling diluted blood. The surface of the body is slightly iridescent, and the surface of the head has a velvety, peach-bloom appearance.

The general pink color of Amblyopsis is due to the blood. It is not due to any abnormal development of blood-vessels in the dermis. In the fins, where the blood-vessels are near the surface, the general effect is a yellowish color. The surface vessels of the dermis also appear yellowish. It is only on account of the translucent condition of all the tissues, permitting the deeper vessels to show through a certain thickness, that the pink effect is produced. Amblyopsis has always been spoken of as white. The term "white aquatic ghosts" of Cope is very apt, for they do appear white in the caves, and their gliding motion has an uncanny effect. All alcoholic specimens are white. 49

The pigment cells can not be made to show themselves, even by a prolonged stay in the light. The old, if kept in the light, will not become darker, and a young one reared in the light until ten months old not only showed no increase in the pigmentation but lost the pigment it had at birth, taking on the exact pigmentless coloration of the adult. Pigment cells are late in appearing in Amblyopsis. When the young are two months old pigment is abundant. This pigmented condition is evidently a hereditarily transmitted condition. It disappears with age. Primarily this disappearance was probably individual. But, as in the flounder, the depigmentation has also become hereditarily transmitted, for even those individuals reared in the light lose the color. Numerous facts and experiments show that while pigment may be, and is, developed in total darkness, the amount of color in an individual animal depends, other things equal, directly on the amount of light to which it is habitually exposed.

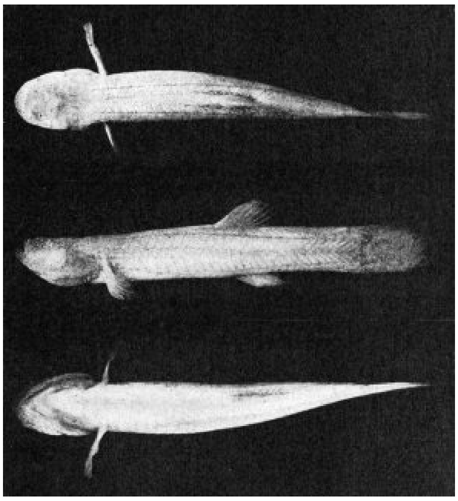


Fig. 1.—*Chologaster Agassizii* from Cedar Sinks Cave, Kentucky.

The lower and upper surfaces of the flounder, the one protected and the other exposed to the light, give the most striking example, and the argument is clinched here by the fact, noted by Cunningham, that a flounder whose lower side is for long periods exposed to the light takes on color. Loeb has shown that in the yolk sacs of Fundulus embryos more pigment cells are developed if the embryos are kept in the light than when they are kept in the dark. However, in the body, and especially in the eye, the pigmentation was not affected by the absence of light. 50

The general absence of color in cave animals is conceded. Packard states, "As regards change of color, we do not recall an exception to the general rule that all cave animals are either colorless or nearly white, or, as in the case of Arachnida and insects, much paler than their out-of-door relatives.” Chilton has made the same observation on the underground animals of New Zealand. Similar observations have been recorded by Lönnberg, Carpenter, Schmeil, and Viré. Hamann enumerates a number of species living both in caves and above ground. In such cases the underground individuals are paler than the others. This confirms similar observations by Packard.

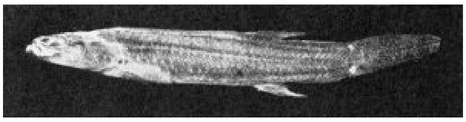


Fig. 2.—*Chologaster papilliferus* from Illinois.

Poulton has mentioned that Proteus becomes darker when exposed to the light. This has been verified by others. Typhlotriton larvæ living at the entrance of a cave are dark, while the adult living farther in the cave are much lighter, but with many chromatophores containing a small amount of color. Epigæan fishes found in caves are always lighter in color than their *confrères* outside.

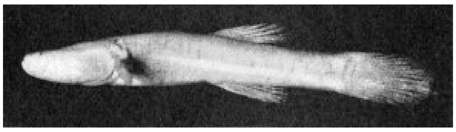


Fig. 3.—*Typhlichthys subterraneus.*

We have thus numerous examples of colored epigæan animals bleaching in caves, and also bleached cave animals turning dark when exposed to the light. We have also animals in which the side habitually turned to the dark is colorless, while the side habitually turned to the light is colored. Finally, we have cave animals that are permanently bleached.

Natural selection can not have affected the coloration of the cave forms, for it can be absolutely of no 51
consequence whether a cave species is white or black. It could affect the coloration only indirectly in one of two ways: First, as a matter of economy, but since the *individual* is in part bleached by the direct effect of the darkness there is no reason why natural selection should come into play at all in reducing the pigment as a matter of economy; second, Romanes has supposed that the color decreases through the selection of correlated structures—a supposition he found scarcely conceivable when the variety of animals showing the bleached condition is considered.

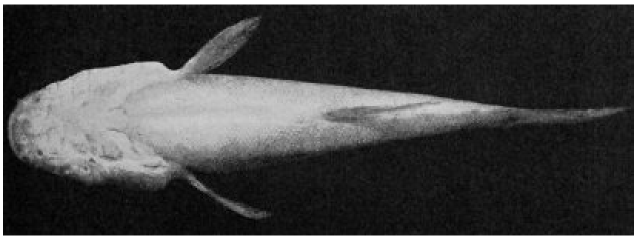


Fig. 4 *a.*

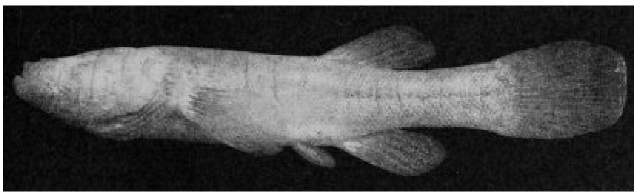


Fig. 4 *b.*

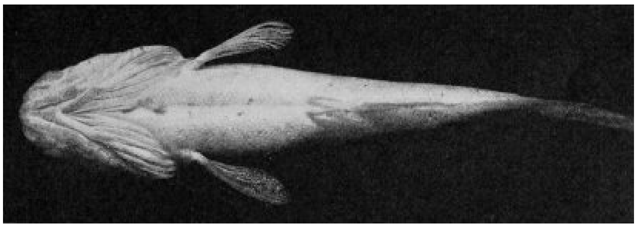


Fig. 4 *c*.

Fig. 4 *a*, *b*, *c*.—Three views of *Amblyopsis*.

Panmixia can not account for the reduction of the color, since it returns in some species when they are exposed to the light, and disappears to a certain extent in others when kept in the dark. Panmixia, Romanes thinks, may have *helped* to discharge the color. In many instances the coloration is a protective adaptation, and therefore maintained by selection. Panmixia might in such instances lower the general average to what has been termed the “birth mean.” Proteus is perhaps such an instance. But in this species the bleached condition has not yet been hereditarily established, and since each individual is independently affected “the main cause of change must have been of that direct order which we understand by the term climatic.” 52

Since, however, the bleached condition, which in the first instance is an individual reaction to the absence of light, has become hereditarily established in Amblyopsis so that the bleaching goes on even when the young are reared in the light, it is evident that in Amblyopsis we have the direct effect of the environment on the individual hereditarily established.

The Eyes of the Amblyopsidæ.—The structure of the eyes has formed the basis of a separate, fully illustrated paper.[A] The prominent features in the eyes of the various species must, however, be known before the question of the origin of these forms and the causes of degeneration can be seriously considered. The eyes of the species of Chologaster are normally formed, possessing a lens, pupil, vitreous body, retina, and optic nerve, and all the eye muscles normal to the fishes. The eyes are functional. The retina is, however, very much simplified. The eye of papilliferus is, in this respect, more perfect than the eye of cornutus. In papilliferus the outer nuclear layer consists of two series of nuclei, the inner layer of about five series of nuclei, and the ganglionic layer of a complete single layer of nuclei except where the optic fibers pass between them, for an optic-fiber layer is not present. In Chologaster cornutus the outer nuclear layer has been reduced to one or two series, and the ganglionic layer to cells widely separated from each other or in rows and little groups, but no longer forming a complete layer. In Amblyopsis and Typhlichthys the largest eyes are not more than one twentieth the diameter of those of Chologaster, or one thousandth of their bulk; the lens is nearly, if not quite, obliterated; the same is true of the vitreous body and the optic nerve in the adult. Beyond this the eyes differ much. In Amblyopsis scleral cartilages are present and prominent, the pigmented layer is prominent, the outer and inner nuclear layers form one layer only, two or three cells deep. In T. subterraneus the pigmented layer is insignificant, and 53
no pigment is ever found in it, while the outer and inner nuclear layers are still separate. In both these species the ganglionic layer forms a central core of cells. In Amblyopsis several or all the eye muscles are present; in Typhlichthys nothing is left of them.

[A] Archiv f. Entwickelungsmechanik, viii, pp. 545–617, Plates XI-XV.

Scleral cartilages are not present in Chologaster or Typhlichthys; in Troglichthys they are very prominent, sometimes *several times as long as the eye*. While there is no pigment left in Typhlichthys, there is in Troglichthys. The eye in the former is about 0.168 millimetre in diameter, while the entire eye of the latter is but about 0.050 millimetre, or less than one third the diameter, and less than one ninth the bulk.

The entire eye of Troglichthys is smaller than many single cells, and I shall be pardoned for not going into the details of its structure here.

Fig. 5.—Three views of the head of an *Amblyopsis*, prepared to show the tactile ridges.

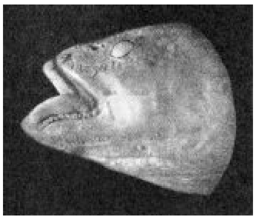


Fig. 6.—Snout of *Chologaster papilliferus*, to show the tactile ridges.

The Tactile Organs.—The tactile organs are among the most important in the consideration of the blind forms. Their minute structure will form the basis of a separate paper. The prominent tactile organs about the head of Amblyopsis have been mentioned by nearly every writer, and they have been figured by Putnam-Wyman[B] and Leidig,[C] but the figures of the distribution of the ridges are worthless. The description of Professor Forbes[D] of Chologaster papilliferus is the only systematic enumeration of the ridges that has appeared. The accompanying figures, drawn by me with the *camera lucida*, and verified and copied by Mr. U. O. Cox, give the exact extent and position of the ridges in Amblyopsis and Chologaster papilliferus. It will be seen that in the number and distribution of the tactile area the two forms agree very closely, the eyed form having the same number and distribution of ridges or rows that the blind forms have. In Chologaster papilliferus most 54 of the ridges are much less prominent than in the blind species, being sunk into the skin. About the nose and chin, however, the ridges are as prominent as in the other species. In the small Chologaster cornutus there are no distinct ridges at all, the tactile organs being arranged as in other species of fishes. In specimens of the same size the papillæ are not more prominent in papilliferus than in cornutus. It is only in the oldest of papilliferus that the papillæ become prominent. The number of individual papillæ in each tactile ridge differs considerably with age (size), so that an exact comparison between the large Amblyopsis and the much smaller species of Chologaster and Typhlichthys can not be made. From a number of counts made by Professor Cox I take the liberty of giving the following: Ridge No. 6 contains, in Chologaster papilliferus, six organs; in Typhlichthys, eleven; in two specimens of Amblyopsis, respectively eighty-three and one hundred and six inches long, twelve and twenty.

[B] American Naturalist, 1872, Plate II, Figs. 1 and 2.

[C] Untersuchungen z. Anatomie und Histologie d. Tiere, Plate III, Fig. 28.

[D] American Naturalist, 16, 1882, p. 2.

Aside from the tactile organs in ridges, there are many solitary ones not evident from the surface in Amblyopsis. When the epidermis is removed by maceration, the dermal papillæ on which these rest give the whole head a velvety appearance.

In the young, at least of Amblyopsis, each of the tactile organ of the ridges is provided with a club-shaped filament abruptly pointed near the end. They wave about with the slightest motion in water, and are so numerous as to give the whole head a woolly appearance.

To recapitulate the facts ascertained concerning the eye and tactile organs:

1. The eyes were degenerating and the tactile organs developing beyond the normal before the permanent underground existence began.

2. The eyes continued to degenerate and the tactile organs to increase after permanent entrance to underground waters.

3. In the degeneration of the eye the retina leads; the vitreous body and lens follow; the more passive pigmented layer and sclera remain longest; the bony orbit is not affected.

Bearing of the Facts gained on the Origin of the Cave Fauna.—The origin of the cave fauna and of the blind fauna are two distinct questions. This was first recognized by H. Garman. Before, the two questions were considered as one, and two explanations are prominent among those suggesting its solution: 55

1. The explanation of Lankester seems either a pleasantry or the most unwarranted speculation. He says: “Supposing a number of some species of Arthropod or fish to be swept into a cavern or to be carried from less to greater depths in the sea, those individuals with perfect eyes would follow the glimmer of light, and eventually escape to the outer air or the shallower depths, leaving behind those with imperfect eyes to breed in the dark place. A natural selection would thus be effected. In every succeeding generation this would be the case, and even those with weak but still seeing eyes would in the course of time escape, until only a pure race of eyeless or blind animals would be left in the cavern or deep sea.”

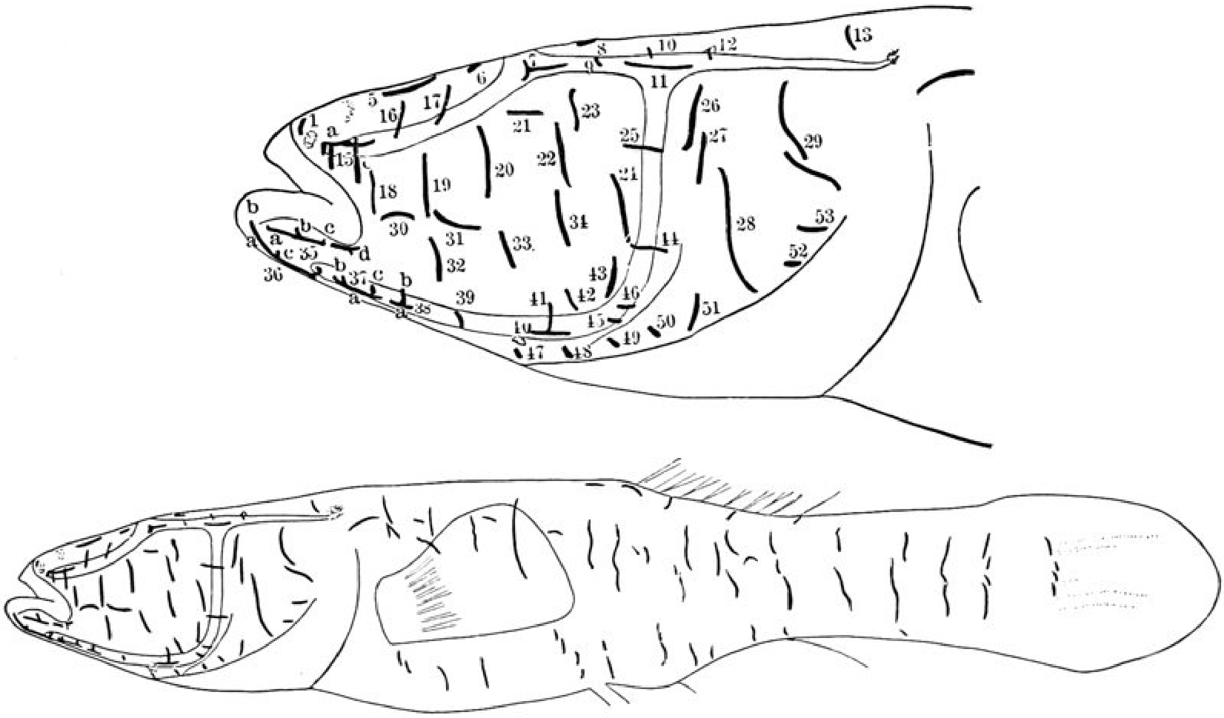


Fig. 7.—Lateral view of *Amblyopsis*, showing the location of the tactile ridges.

This process does not, of course, account for the degeneration of the eye beyond blindness. But, aside from this objection, the humor of his “glimmer of light” impresses itself very forcibly on one after spending a day in following the devious windings of a living cave, not to mention his tendency in cave animals, which are negatively heliotropic, to follow it. There are other objections. Fishes are annually swept into the caves, but they are not able to establish themselves in them. To do this they must have peculiar habits, special methods of feeding and mating before a successful colonization of caverns can become successful. Further, if the origin of the cave fauna is due to accident, the accident must have happened to four species out of six of the Amblyopsidæ, while none of the numerous other species of fishes about the caves met with the same accident. 56

2. The second explanation is that of Herbert Spencer:[E] “The existence of these blind cave animals can be accounted for only by supposing their remote ancestors began making excursions into the caves, and, finding it profitable, extended them, generation after generation, farther in, undergoing the required adaptations little by little.”

[E] Popular Science Monthly, vol. xliii, pp. 487, 488.

This second view has been modified by H. Garman in so far as he supposes the adaptations to do without eyes and consequent degeneration of eyes to occur anywhere where a species has no use for eyes, enumerating burrowing animals and parasitic animals, concluding that “the origin of the cave species (nonaquatic especially) of Kentucky were probably already adjusted to a life in the earth before the caves were formed.” In this modified sense, Spencer’s view is directly applicable to the Amblyopsidæ. Hamann goes so far as to suppose that darkness itself is not the primary cause of degeneration, but unknown factors in the animal itself.

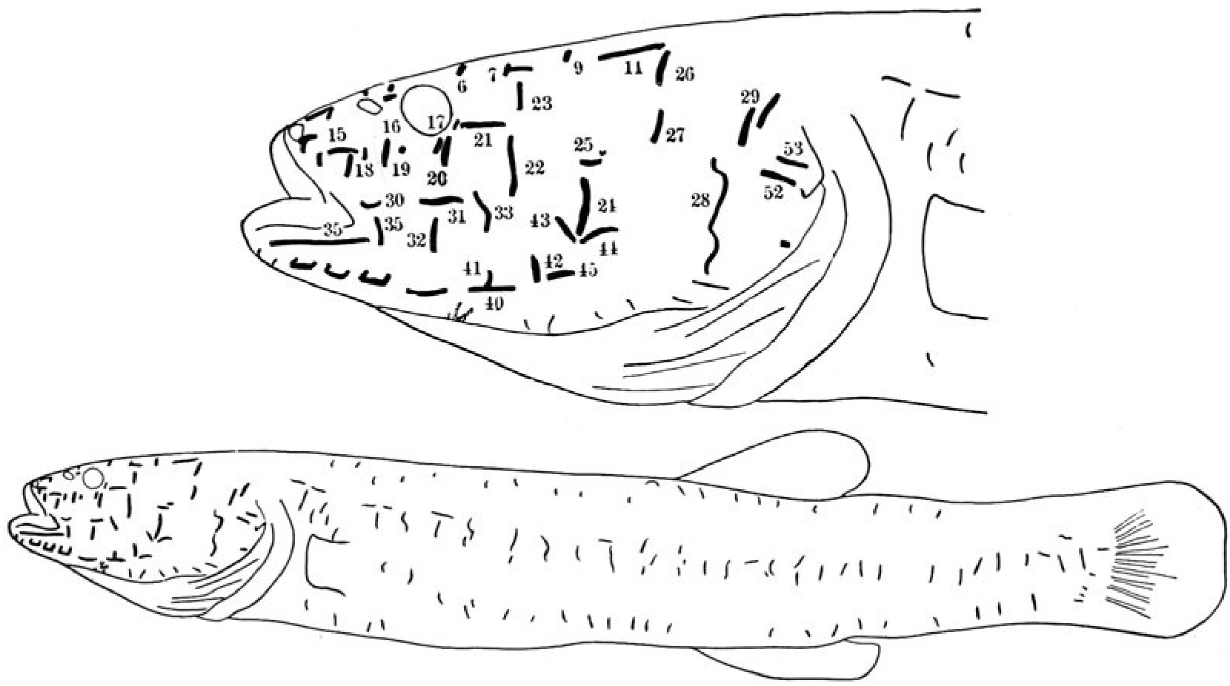


Fig. 8.—Lateral view of *Chologaster papilliferus*, showing the location of the tactile ridges.

The three things to be considered in this connection are (*a*) the habit of the cave form, (*b*) the modifications to enable the form to do without the use of light, and (*c*) the structure of the eye as a result of *a* and *b*.

a. The prime requisite for a candidate to underground existence is a negative reaction to light. We found that even the epigæan Chologaster is negatively heliotropic.

b. It must also be evident that a fish depending on its sight to procure its food can never become a cave 57 form. Sunfishes, which are annually carried into caves, belong to this class of fishes. They are always poor when found in the caves, and will never be able to establish themselves in them. On the other hand, there are no reasons why fishes detecting their prey either by smell or touch should not be capable of colonizing caves. The catfishes and Amblyopsidæ belong to the latter class. It is surprising that more catfishes have not established themselves in caves. Among the Amblyopsidæ even those with functional eyes depend on touch and vibrations for their food. Chologaster has well-developed tactile organs and poor eyes. It is found chiefly at the mouths of underground streams, but also in the underground streams themselves. The tactile organs are not different in kind from those of other fishes, and their high development is not more marked than their development in the barbels of the catfishes. The characters which distinguish Chologaster as a fish capable of securing its food in the dark are emphasized in Typhlichthys, and the tactile organs are still more highly developed in Amblyopsis. The eyes of the last two genera are so degenerate that it is needless in this connection to speak of degrees of degeneration. On account of the structure of their eyes and their loss of protective pigment they are incapable of existence in open waters. With the partial and total adaptation to an underground existence in the Amblyopsidæ and their negative reaction to light, it is scarcely possible that for this family the idea of accidental colonization can be entertained for a moment. Their structure is not as much due to their habitat as their habitat is to their structure and habit.

Typhlogobius lives in the holes of shrimps under rocks on the coast of southern California. It is a living example of the origin of blind forms in dark places remote from caves. Here again the “accidental” idea is preposterous, since no fish could by accident be carried into the devious windings of the burrows they inhabit. Moreover, a number of related species of gobies occur in the neighborhood. They live ordinarily in the open, but always retreat into the burrows of crustaceans when disturbed. The origin of the blind species by the gradual change from an occasional burrow seeker to a permanent dweller in the dark and the consequent degeneration of the eye is evident here at once. Among insects the same process and the same results are noted. We have everywhere the connection of diurnal species with dark-loving and blind forms, a transition the result of habit entered into with intent, but no evidence of such a connection as the result of accident. Also numerous instances of daylight species being swept into caves, but no instance of one establishing itself there.

This view accounts also for the wide distribution of the blind fishes. The ancestry of the Amblyopsidæ we 58 may assume to have had a tendency to seek dark places wherever found, and incipient blind forms would thus arise over their entire distribution. The structural differences between Troglichthys and Typhlichthys argue in favor of this, and certainly the fearless, conspicuous blind fish as at present developed would have no chance of surviving in the open water. Their wide distribution after their present characters had been assumed, except through subterranean waters, would be out of the question entirely. The same would not be true of the incipient cave forms when they had reached the stage at present found in Chologaster. It will be recalled that Chologaster, and even the blind forms, have the habit of hiding underneath boards and in the darker sides of an aquarium. These dark-seeking creatures would, on the other hand, be especially well fitted to become distributed in caves throughout their habitat. S. Garman’s able argument for the single origin and dispersal of the blind fishes through epigæan waters was based on the supposition that the cis-Mississippi and trans-Mississippi forms were identical. The differences between these species are such as to warrant not only that they have been independently segregated, but that they are descended from different genera. The external differences between these species are trifling, but this was to be expected in an environment where all the elements that make for external color marking are lacking. The similarity between Typhlichthys and Amblyopsis is so great that the former has been considered to be the young of the latter.

Judging from the structure of the eye and the color of the skin, Troglichthys has been longest established in caves. Amblyopsis came next, and Typhlichthys is a later addition to the blind cave fauna.

“Those,” said Dr. J. N. Langley, in his sectional address on Physiology at the British Association, “who have occasion to enter into the depths of what is oddly, if generously, called the literature of a scientific subject, alone know the difficulty of emerging with an unsoured disposition. The multitudinous facts presented by each corner of Nature form in large part the scientific man’s burden to-day, and restrict him more and more, willy nilly, to a narrower and narrower specialism. But that is not the whole of his burden. Much that he is forced to read consists of records of defective experiments, confused statement of results, wearisome description of detail, and unnecessarily protracted discussion of unnecessary hypotheses. The publication of such matter is a serious injury to the man of science; it absorbs the scanty funds of his libraries, and steals away his poor hours of leisure.”

A HUNDRED YEARS OF CHEMISTRY.

By F. W. CLARKE,
CHIEF CHEMIST, UNITED STATES GEOLOGICAL SURVEY.

[*Concluded.*]

It is evident, from what has been already said, that chemistry and physics are near akin—indeed, they can hardly be separated. Avogadro’s law and spectrum analysis are but two illustrations of the relationship, but many other examples are equal to them in importance. Take, for instance, the action of light upon chemical substances; it may provoke union of elements, or effect the decomposition of compounds; upon the latter phenomenon the art of photography depends. That salts of silver are chemically changed by light was the fundamental observation, and upon this fact most photographic processes, though not all, are founded. Thus light, working as a chemist in the laboratory of the photographic plate, has become the useful servant of all arts, all sciences, and all industries—an indispensable aid to invention and research. On this theme a volume might be written; a bare reference to it must be sufficient here.

Still another branch of chemistry, recently developed but essentially an extension of the theory of valence, is also due to the study of optical relations. That different crystalline bodies differ in their behavior toward polarized light has long been known, and the polariscope is recognized as an instrument of great value in chemical research. To the analysis and valuation of sugars and sirups it is most effectively applied, and commercial transactions of great magnitude depend in part upon its testimony. Here is practical utility, but the development of theory is what concerns us now.

The discovery of isomerism, of the fact that very different compounds might contain the same elements united in the same proportions, was easily interpreted by the theory of valence in a fairly complete and satisfactory way. In the structural formulæ the different atomic groupings were clearly shown, but with one essential limitation—the arrangement was in a single plane. That is, the linking of the atoms was considered, but not their relations to tridimensional space. For the study of reactions, for the classification of compounds, the structural symbols sufficed; but human thought is not so easily satisfied, and more was soon required. One class of isomers was unexplained, and an explanation was demanded.

A typical example of the difficulty was offered by tartaric acid, which exists in two forms differing crystallographically and optically. One form, dissolved in water, twisted a ray of polarized light to the left, the 60
other produced a rotation to the right, while the crystals of the two acids, similar in all other respects, also showed a right- and left-handedness in the arrangement of their planes. The crystal of one variety resembled the other as would its reflection in a mirror—the same, but reversed. These differences, discovered by Pasteur as long ago as 1848, the theory of valence could not explain; to interpret them, and other similar cases, the arrangement of the atoms in space had to be considered.

In 1874 two chemists, Van t’Hoff and Lebel, working independently, offered a solution of the problem, and stereochemistry, the chemistry of molecular structure in three dimensions, was founded. They proposed, in effect, to treat the carbon atom essentially as a tetrahedron, the four angles corresponding to the four units of valence or bonds of affinity. They then studied the linking or union of such tetrahedra, and found that with their aid the formulæ for tartaric acid could be developed in different ways, showing right- and left-handed atomic groupings. Other similar compounds were equally explicable. Thus the definite conception of a tridimensional, geometric atom led to a new development of structural formulæ, from which many discoveries have already proceeded. The fruitfulness of the speculation vindicates its use, but it is only the first step in a method of research which must in time be applied to all of the chemical elements. Probably the study of crystalline form will be connected with these chemico-structural expressions, and from the union some greater generalizations will be born. From the geometry of the crystal to the geometry of the molecule there must be some legitimate transition. With all their utility, our present conceptions of chemical structure are incomplete; they represent only portions or special phases of some great general law, but so far as they go, properly used, they are valid.

But light is not the only physical force involved in chemical changes; heat and electricity are far more important. Heat, in particular, is essential to every chemical operation; it provokes combination and effects decomposition; it appears in one reaction and vanishes in another; apart from thermal phenomena the science of chemistry could not exist. From the very beginnings of chemistry this interdependence has been recognized, and its study has led to notable discoveries and to great enlargements of resource. In the theory of phlogiston the connection between heat and chemical change was crudely stated, and when Lavoisier saw that combustion was oxidation, thermochemistry began to exist.

In every chemical change a definite amount of heat is either liberated or absorbed—a distinct, measurable 61
quantity. This fact was established by Hess in 1840, and since then the thermal values of many reactions have been determined, notably by Thomsen in Denmark and Berthelot in France. The data are already numerous, but as yet they have not been co-ordinated into any general law. They are in great measure the raw material with which some future scholar is to build. One fact, however, is already clear—namely, that the heat of formation or of combustion of any compound is conditioned by its structure. Two isomeric substances may differ widely in their calorific constants, an observation which has repeatedly been verified. Thus the conception of structure, of atomic grouping, appears again a chief factor in a set of unsolved problems.

In the relations of chemistry to heat perhaps the greatest advances have been made in the extension of our resources, particularly in regard to the development and control of temperatures. At the beginning of the century the range of temperatures available to the chemist was narrowly limited—from the freezing point of mercury at one end to the heat of a blast furnace at the other. His command of heat and cold are now vastly greater than then, and the steps which have been taken are worth tracing.

At the lower end of the scale the greatest progress has been made through the liquefaction of gases. When a liquid evaporates, heat is absorbed, or, reversely stated, cold is produced, and the more rapid the evaporation the greater is the cooling effect. A command of more volatile liquids is therefore a command of cold, and the liquefied gases represent the extreme limit of our power in that direction.

Near the beginning of the century, by combining cold and pressure, sulphurous acid and chlorine were reduced to the liquid state. In 1823 Faraday succeeded in liquefying still other gases, and in 1835 Thilorier went even further and reduced carbonic acid to a snowlike solid. Liquid chlorine, sulphurous acid, and carbonic acid, stored in strong cylinders of steel, are now commercial products, manufactured and sold in large quantities like any other merchandise. They can be transported to long distances and kept indefinitely, to the great convenience of chemists and the furtherance of research.

In 1845 Faraday published the results of further investigations, when it appeared that all but six of the known gases had been reduced to the liquid state. Through cold and pressure lower and lower temperatures were gained, each step forward having given a foothold from which a new advance was possible. In 1877 Pictet and Cailletet simultaneously succeeded in liquefying four of the supposedly permanent gases; nitrogen yielded 62
to the attacks of Wroblevsky and Olzewski in 1883, and hydrogen alone remained unconquered. In 1898 Dewar overcame this last obstacle, and in the year following he actually reduced hydrogen to an icelike solid which melts at only eighteen degrees centigrade above the theoretical absolute zero. Every gas has been liquefied, and probably the lowest degree of cold attainable by man has been reached. Within the century the work began and ended; the future can only improve the working methods and utilize the new resources. Liquid ammonia has long been used in the manufacture of artificial ice and for direct refrigeration; liquid air, with its temperature of two hundred centigrade degrees below zero, is now almost a commercial product, obtainable in quantity, but with its possibilities of usefulness as yet practically undeveloped. The infant Hercules will doubtless find no lack of tasks to do, each one more arduous and more helpful to man than any labor of his mythical prototype.

To the chemist the possibilities thus opened are innumerable. Pictet has shown that at the low temperatures which are now easily attainable all chemical action stops, even the most energetic substances lying in contact with each other quiet and inert. A greater control of the more violent chemical reactions is therefore within reach, doubtless to be utilized in many ways yet unforeseen. At the highest temperatures, also, chemical union ceases, and compounds are decomposed; each reaction is possible only within a limited thermal range, of which the beginning and the end are measurable. From future measurements of this sort new laws will surely be discovered.

The first step in the upward scale of temperatures was taken in 1802, when Robert Hare, an American, invented the oxyhydrogen blowpipe. With this instrument platinum, hitherto infusible, was melted, a result of great importance to chemists. Apart from recent electrical applications, platinum finds its chief use in the construction of chemical apparatus, and Hare’s invention was therefore of great assistance to chemical research. Later in the century electrical currents were utilized as producers of great heat, until in the very modern device of the electric furnace the range of available temperatures has been at least doubled. Temperatures of three to four thousand degrees of the centigrade scale are now at the disposal of the chemist, and these are manageable in compact apparatus at very moderate cost. Cheap aluminum is one of the products of this new instrument, and the extraordinary abrasive substance, carborundum, is another. New industries have been created by the electric furnace, and in the hands of Moissan it has yielded scientific results of great interest and remarkable variety. The rarest metals can now be separated from their oxides with perfect ease, 63
and new compounds, obtainable in no other way, the furnace has placed at our disposal. This field of research is now barely opened; from it the twentieth century should gather a rich harvest.

With electricity also chemistry is nearly allied, and along some lines the two branches of science have been curiously intertwined. Like the other physical forces, electricity may either provoke or undo combination, and, like heat, it may itself be generated as a product of chemical action. The voltaic pile and the galvanic battery owe their currents to chemical change, and it is only since the middle of the century that any other source of electric energy has become available for practical purposes. It is not surprising, therefore, that many thinkers should have sought to identify chemical and electric force, the two have so much in common. It was with the galvanic current that Davy decomposed the alkalies, and since his day other electro-chemical decompositions have been studied in great number, to the development of important industries. To the action of the current upon metallic solutions we owe the electrotype and all our processes for electroplating, and these represent only the beginnings of usefulness. Even now, almost daily, advances are being made in the practical applications of electrolysis, and the forward movement is likely to continue throughout the coming century. From the curiously reversible chemical reactions of the secondary battery the automobile derives its power, and here again we find a field for invention so large that its limits are beyond our sight. From every peak that science can scale new ranges come into view. The solution of one problem always creates another, and this fact gives to scientific investigation its chief interest. We gain, only to see that more gain is possible; the opportunity for advance is infinite. Forever and ever thought can reach out into the unknown, and never need to weep because there are no more worlds to conquer.

It was the study of electro-chemical changes which led Berzelius to his electro-chemical theory of combination, and then to the dualistic theory, which has already been mentioned. In or about the year 1832, when the Berzelian doctrines were at the summit of their fame, Faraday showed that the chemical power of a current was directly proportioned to the quantity of electricity which passed, and this led him to believe that chemical affinity and electric energy were identical. Electrolysis, the electrical decomposition of compounds in solution, was a special object of his attention, and by quantitative methods he found that the changes produced could be stated in terms of chemical equivalents or combining numbers. One equivalent weight of zinc 64
consumed in the galvanic battery yields a current which will deposit one equivalent of silver from its solution, or which, decomposing water, will liberate one equivalent each of oxygen and hydrogen. All electro-chemical changes followed this simple law, which gave new emphasis to the atomic theory, and furnished a new means for measuring the combining numbers.

In the early days of electro-chemistry the products of electrolysis were studied in the light of the dualistic theory. But as chemical investigation along other lines overthrew this hypothesis, a closer examination of electrolytic reactions became necessary. Electrical decompositions were dualistic in character, but the dualism was not that taught by Berzelius. When a salt, dissolved in water, is decomposed by the current it is separated into two parts, which Faraday called its *ions*; in Berzelian terms these were in most cases oxides, but this conclusion fitted only a part of the facts, and finally was abandoned. Whatever the *ions* might be, they were not ordinary oxides.

Many and long were the investigations bearing upon this subject before a satisfactory settlement was reached. The phenomena observed in solutions, raised still another question, that of the nature of solution itself, and this is not yet fully answered. Two lines of study, however, have converged, within recent years, to some remarkable conclusions, the latest large development of chemical theory.

It has long been known that solutions of salts do not freeze so easily as pure water, and also that their boiling points are higher. In 1883 Raoult discovered a remarkable relation between the freezing point of a solution and the molecular weight of the substance dissolved, a relation which has since been elaborately studied by many investigators. From either the freezing-point depression or the elevation of the boiling point the molecular weight of a soluble compound can now be calculated, and many uncertain molecular weights have thus been determined.

Another phenomenon connected with solutions, which has received much attention, is that of osmotic pressure. A salt in solution exercises a definite pressure, quantitatively measurable, which is curiously analogous to the pressure exerted by gases. In a gas the molecules are widely separated, and move about with much freedom. In a very dilute solution the molecules of a salt are similarly separated, and are also comparatively free to move. The kinetic theory of gases, therefore, is now paralleled by a kinetic theory of solutions, founded by Van t’Hoff in 1887, which is now generally accepted. All the well-established laws connecting pressure, temperature, and volume among gases find their equivalents in the phenomena exhibited 65
by solutions. In Avogadro’s law we learn that equal volumes of gases, under like conditions of temperature and pressure, contain equal numbers of molecules. According to the new generalizations, equal volumes of different solutions, *if they exert the same osmotic pressure*, also contain equal numbers of molecules. The parallelism is perfect. With these relations the freezing- and boiling-point phenomena are directly connected.

But, both for gases and for solutions some apparent anomalies existed. Certain compounds, when vaporized, seemed not to conform to Avogadro’s law, and called for explanation. This proved to be simple, and was supplied by the fact that the anomalous compound, as such, did not exist as vapor, but was split up, *dissociated*, into other things. For instance, ammonium chloride, above a certain temperature, is decomposed into a mixture of two gases—hydrochloric acid and ammonia—which, on cooling, reunite and reproduce the original compound. Twice as much vapor as is required by theory, and specifically half as heavy, is produced by this transformation, which is only one of a large class, all well understood.

In the case of solutions it was found that certain compounds, notably the acids, alkalies, and metallic salts, caused a depression of freezing point which was twice as great as ought to be expected. This fact was illuminated by the phenomena observed in gases, and soon it was seen that here too a splitting up of molecules, a true dissociation, occurred. These anomalous solutions, moreover, were electrolytes—that is, they conducted electricity and underwent electrolytic decompositions—while normal substances, especially solutions of carbon compounds, such as sugar, were not.

Van t’Hoff’s discoveries went far, but one more step was needed, and this was taken by Arrhenius in 1888. Electrolytic compounds, when dissolved, are actually dissociated into their *ions*, partially so in a strong solution, entirely so in one which is infinitely dilute, a statement which leads to some extraordinary conclusions. For instance, the *ions* of common salt are sodium and chlorine. In a dilute solution the salt itself ceases to exist, while atoms of sodium and atoms of chlorine wander about, chemically separated from each other but still in equilibrium. Sodium sulphate may be regarded as made up of two parts—sodium and an acid radicle which contains one atom of sulphur to four of oxygen—and these parts, its *ions*, are severed apart during solution to move about independent of each other.

This theory of Arrhenius, the theory of electrolytic dissociation, is supported by many facts, and fits in well
with the kinetic theory of Van t’Hoff. Electrolysis is no longer to be considered as a separating process, but 66
rather as a sorting of the *ions*, which receive different electrical charges and concentrate at the two electrical poles. The phenomena of freezing and boiling points in solutions, and of the absorption of heat when solid salts are dissolved, all harmonize with the conclusions which have been reached. A complete theory of solutions is yet to be proposed; but these new doctrines, which are true so far as they go, represent a long step in the right direction. A final theory will include them, but they are not likely to be set aside.

As we near the end of the century we find one more discovery to note, from a most unexpected quarter—the discovery of new gases in the atmosphere. In 1893 Lord Rayleigh was at work upon new determinations of density, with regard to the more important gases. In the case of nitrogen an anomaly appeared: nitrogen obtained from the atmosphere was found to be very slightly heavier than that prepared from chemical sources, but the difference was so slight that it might almost have been ignored. To Rayleigh, however, such a procedure was inadmissible, and he sought for an explanation of his results. Joining forces with Ramsay, the observed discrepancies were hunted down, and in 1894 the discovery of argon was announced. Ramsay soon found in certain rare minerals another new gas—helium—whose spectral lines had previously been noted in the spectrum of the sun; and still later, working with liquid air, he discovered four more of these strange elements—krypton, xenon, neon, and metargon. By extreme accuracy of measurement this chain of discovery was started, and, as some one has aptly said, it represents the triumph of the third decimal. A noble dissatisfaction with merely approximate data was the motive which initiated the work.

To the chemist these new gases are sorely puzzling. They come from a field which was thought to be exhausted, and cause us to wonder why they were not found before. The reason for the oversight is plain: the gases are devoid of chemical properties, at least none have yet been certainly observed. They are colorless, tasteless, odorless, inert; so far they have been found to be incapable of union with other elements; apart from some doubtful experiments of Berthelot, they form no chemical compounds. Under the periodic law they are difficult to classify; they seem to belong nowhere; they simply exist, unsocial, alone. Only by their density, their spectra, and some physical properties can these intractable new forms of matter be identified.

In a sketch like this a host of discoveries must remain unnoticed, and others can be barely mentioned. The isolation of fluorine and the manufacture of diamonds by Moissan, the synthesis of sugars by Fischer, the 67 discovery of soluble forms of silver by Carey Lea—all these achievements and many more must be passed over. Something, however, needs to be said upon the utilitarian aspects of chemistry, and concerning its influence upon other sciences. Portions of this field have been touched in the preceding pages; the interdependence of chemistry and physics is already evident; other subjects now demand our attention.

Medicine and physiology are both debtors to chemistry for much of their advancement, and in more than one way. From the chemist medicine has received a host of new remedies, some new processes, and advanced methods for the diagnosis of disease. The staining of tissues for identification under the microscope is effected by chemical agents, the analysis of urine helps to identify disorders of the kidneys; nitrous oxide, chloroform, ether, and cocaine almost abolish pain. The disinfection of the sick-room and the antiseptic methods which go far toward the creation of modern surgery all depend upon chemical products whose long list increases year by year. Crude drugs are now replaced by active principles discovered in the laboratory—morphine, quinine, and the like—and instead of the bulky, nauseous draughts of olden time, the invalid is given tasteless capsules of gelatin or compressed tablets of uniform strength and more accurately graded power. A great part of physiology consists of the study of chemical processes, the transformation of compounds within the living organism, and practically all this advance is the creation of the nineteenth century. Modern bacteriology, at least in its practical applications, began with a chemical discussion between Liebig and Pasteur as to the nature of fermentation: step by step the field of exploration has enlarged; as the result of the investigations we have preventive medicine, more perfect sanitation, and antiseptic surgery. The ptomaines which cause disease and the antitoxins which prevent it are alike chemical in their nature, and were discovered by chemical methods. Physiology without chemistry could not exist; even the phenomena of respiration were meaningless before the discovery of oxygen. The human body is a chemical laboratory, and without the aid of the chemist its mysteries can not be unraveled.

To agriculture also chemistry is a potent ally, whose value can hardly be overrated. It has created fertilizers and insecticides for the use of the farmer and taught their intelligent use, and in the many experiment stations of the world it is daily discovering facts or principles which are practically applicable to agriculture. The beet-sugar industry was developed by chemical researches and chemical methods; the arts of the dairy have been chemically improved; the food of all civilized nations is better and more abundant than it was before the chemist 68 gave his aid to its production. Adulteration, always practiced, is now easily detected by chemical analysis, and, though the evil still exists, the remedy for it is in sight. To Liebig, who gave to agricultural chemistry its first great impulse forward, mankind is indebted to an amount which is beyond all computation.

In manufactures the influence of chemistry is seen at every turn. When the century began, probably no industrial establishment in the world dreamed of maintaining a chemical laboratory; to-day, hundreds are well equipped and often heavily manned for the sole benefit of the intelligent manufacturer. Coal gas is a chemical product; its by-products are ammonia and coal tar; from the latter, as we have seen, hundreds of useful substances, the discoveries of the last half century, are prepared. Better and cheaper soap and glass owe their existence to chemical improvement in the making of alkalies; chemical bleaching has replaced the tedious action of sunlight and dew; chemical dyestuffs give our modern fabrics nearly all their hues. Metallurgy is almost wholly a group of chemical processes; every metal is extracted from its ores by methods which rest on chemical foundations; analyses of fuel, flux, and product go on side by side with the smelting. The cyanide and chlorination processes for gold, the Bessemer process for steel, are apt illustrations of the advances in chemical metallurgy; but before these come into play the dynamite of the miner, another chemical invention, must have done its work underground. For rare minerals, the mere curiosities of twenty years ago, uses have been found; from monazite we obtain the oxides which form the mantle of the Welsbach burner; from beauxite, aluminum is made. The former waste products of many an industry have also revealed unsuspected values, and chemistry has the sole honor of their discovery.

In education, chemistry has steadily grown in importance, until a single university may have need of as many as twenty chemists in its teaching staff, teaching not only what is already known, but also the art of research. As a disciplinary study, chemistry ranks high in the college curriculum, and it opens the way to a new learned profession, equal in rank with those of more ancient standing.

For the material advancement of mankind the nineteenth century has done more than all the preceding ages combined, and science has been the chief instrument of progress. Scientific methods, experimental investigation, have replaced the old empiricism, and no man can imagine where the forward movement is to end. Hitherto research has been sporadic, individual, unorganized; but fruitful beyond all anticipation. In the 69 future it should become more systematic, better organized, richer in facilities. Through laboratories equipped for research alone the twentieth century must work, and chemistry is entitled to its fair share of the coming opportunities. The achievements of the chemist, great as they have been during this century, are but a beginning; the larger possibilities are ahead. The greatest laws are yet undiscovered; the invitation of the unknown was never more distinct than now.

MOUNT TAMALPAIS.

By MARSDEN MANSON, C. E., Ph.D.

Mount Tamalpais is the southern and terminating peak of the westerly ridge of the Coast Range, which confronts the Pacific Ocean from the Golden Gate to the Oregon line.

Its outliers form the bold headlands which skirt the Golden Gate and adjacent waters to the north, and which bound the peninsula constituting Marin County. The spurs extending to the east reach the shores of the Bay of San Francisco, and inclose small alluvial valleys of great fertility and beauty. In some instances these valley lands are fringed by tidal marshes, in part reclaimed and under cultivation.

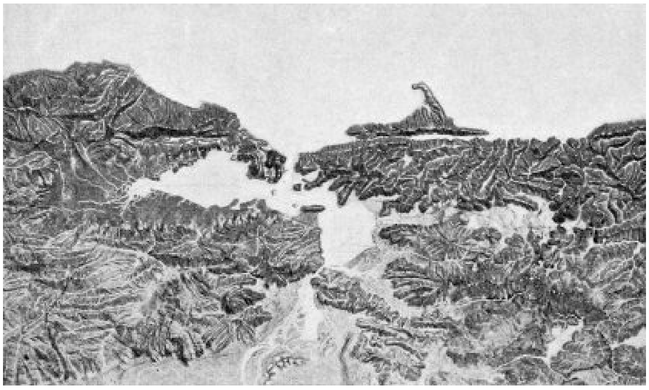
The top of the mountain breaks into three distinct peaks, each reaching an altitude of nearly half a mile above sea level, although bounded on three sides by tidal waters.

No land points visible from the summit, except those bounding the apparent horizon, reach equal or greater altitude. The mountain is therefore a marked feature from all parts of the area visible from its summit, which area has an extent of about eight thousand square miles.

The adjoined photographic reproduction of a portion of a relief map of the State gives a general idea of the adjacent land, bay, and ocean areas.

The westerly group of islands, opposite the Golden Gate, are the Farallones. The bold headland northwest of the Gate is Point Reyes; it protects from the north and northwest winds the anchorage known as Drake’s Bay. The strip of water between the adjoining peninsula and the mainland is Tomales Bay.

The most westerly headland south of the Golden Gate is San Pedro Point, and the prominent headland farther south is Pescadero Point. The whole of San Francisco Bay is visible from Mount Tamalpais, except a few 70 sheltered nooks and portions behind islands.

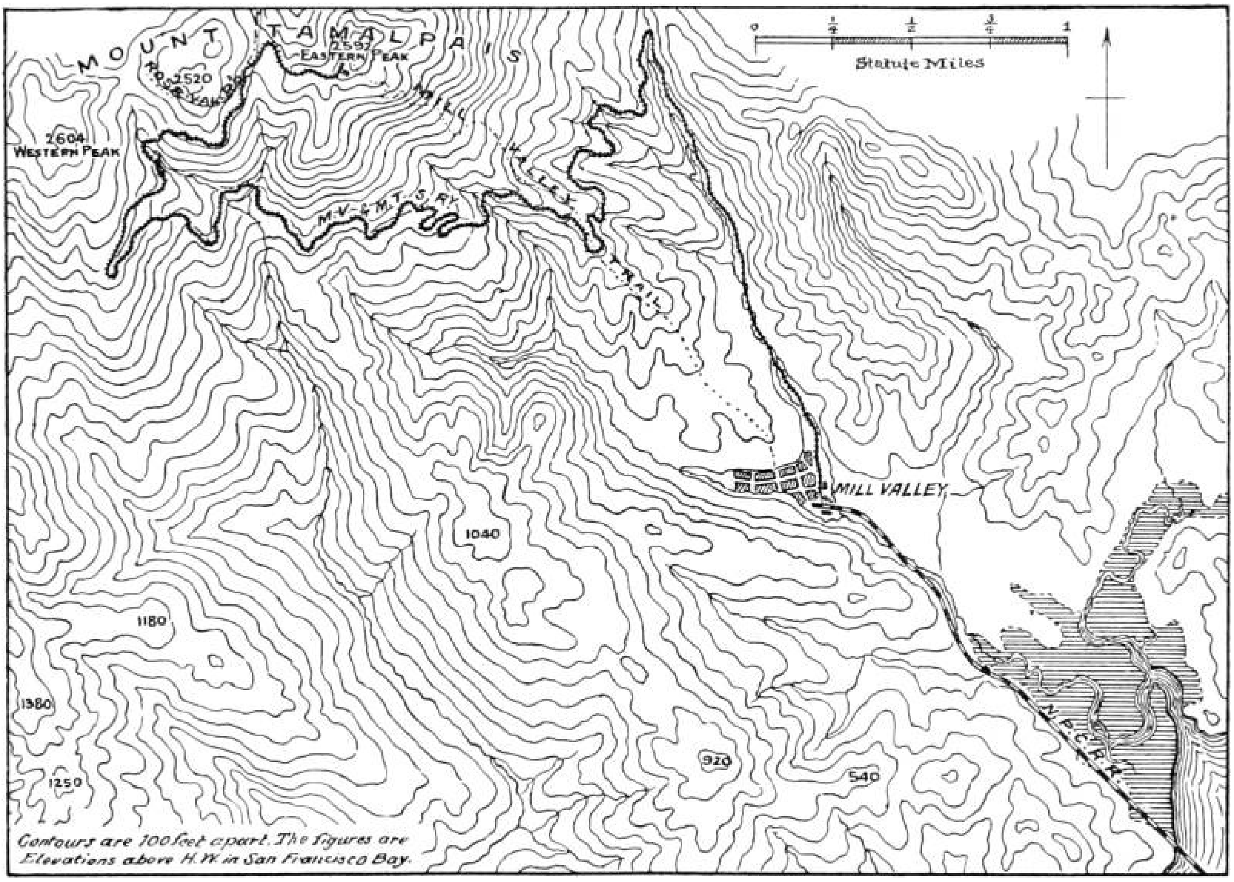


Vicinity of the Golden Gate.

The tidal area inside the Golden Gate is about seven hundred and forty square miles at high tide; this includes that portion which extends east of the Coast Range into the valley of California, and known as Suisun Bay; this bay is connected with San Francisco Bay through the Straits of Carquinez and San Pablo Bay. Emptying into Suisun Bay at its easterly end are the Sacramento and San Joaquin Rivers. Thus the tidal waters washing the base of Mount Tamalpais are connected with the interior valley of California, and tributary to them are about twelve hundred miles of navigable channels, tapping the central part of the State.

From the summit of this peak the eye sweeps the horizon of the Pacific Ocean for nearly one hundred and fifty degrees. To the northwest, north, and northeast lie Petaluma, Santa Rosa, Sonoma, and Napa Valleys, the view over these being bounded by the ridges inclosing them. To the east are the Straits of Carquinez, the outlet of the fifty-eight thousand square miles of drainage of the Sacramento and San Joaquin Rivers, and the only water gap in the entire perimeter.

From the east to the south lie the slopes of the Contra Costa Hills and the ranges bounding the drainage into the Bay of San Francisco, and including the Santa Clara Valley, thus embracing a magnificent view of the garden spots of California, and the cities and towns around the bay—the homes of about one third the population of the State. Three prominent peaks mark the limits of the land view: Mount Hamilton, the site of the 71 Lick Observatory of the University of California; Mount Diablo, the base and meridian of the United States land surveys of central California; and Mount St. Helena, a volcanic peak the summit of which is common to Napa, Sonoma, and Lake Counties, and whose spurs are noted for their quicksilver mines, mineral and hot springs.



Map showing Location of Railroad from Mill Valley to Summit of Mount Tamalpais.

The plant life of the immediate Tamalpais region is abundant and interesting; the flowering plants are represented by about eighty orders, three hundred and fifty genera, and from seven to eight hundred species, of which about one hundred are trees and shrubs.[F] Some of the Sierra forms occur on Mount Tamalpais, and it is also the locus of the most southerly extension of certain boreal species. Owing to the wide range of temperature, moisture conditions, and exposures, many of these plants can be found in bloom during every week in the year. During the warm, moist autumn and winter the hardiest species bloom from October to April in protected areas, and in the cold, exposed areas these same species require the heat of the season from April to September to bring them into bloom. Thus, within a radius of four or five miles from the summit there is not a week in the year when the flowers of certain species can not be gathered—this in face of the fact that during 72
the months of December, January, and February the summit may be covered with sleet or snow for a day or two at a time.

[F] Estimated by Miss Eastwood, curator of the Department of Botany of the California Academy of Sciences.

Mount Tamalpais is therefore a point of great interest to the sight-seer, the tourist, and the student of Nature.

View of Summit from a Point Sixteen Hundred Feet above Tide.

Modes of reaching the Summit.—For many years a trail has existed from Mill Valley to the summit, and another from Ross Valley, both practicable for pack mules. Later the Ross Valley trail was improved so as to be practicable for light vehicles, but these did not answer the needs of the increasing travel, and in 1895 the Mill Valley and Mount Tamalpais Scenic Railway Company was organized. The purpose of this company was bold—to construct a traction railroad from tide level to the summit of a peak not two miles off and nearly half a mile high appeared visionary, if not impossible, to many. But with persevering skill a road was located upon a line 8.19 miles long, having an average grade of five and a half per cent and maximum grades of seven per cent, and overcoming 2,353 feet elevation in this distance. Four and nine tenths miles are curved, the minimum radius being seventy feet. Owing to the rough and ravine-cut topography, twenty-five trestles were necessary, the curvature and grade being maintained over these.

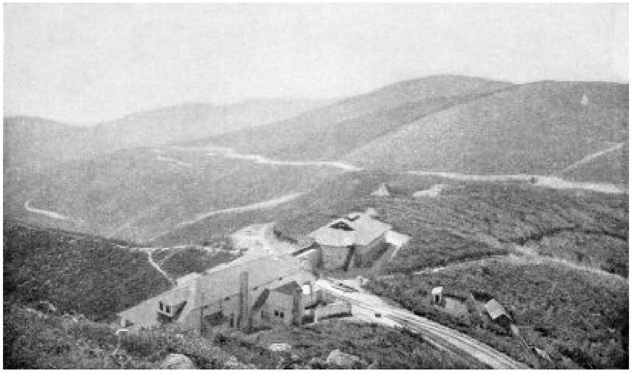
In order to reduce the cost of grading and to develop sufficient length to overcome the elevation, the grade contour was followed as closely as possible. The very short radius employed permitted this to be done without [73] tunnels and with but two through cuts.

The accompanying map, prepared from the United States Coast and Geodetic charts and the maps and profiles of the company, gives a general idea of the location and main features. To the student of railroad location it forms an interesting exhibit of the extreme flexibility of railway location.

The rails are steel, fifty-seven pounds to the yard, laid to standard gauge upon the ordinary redwood ties in use on the Pacific coast. Grading, trestle work, and laying cost about $55,000. The entire road cost $136,746.44, or practically $16,700 per mile.

The equipment consists of one thirty-ton geared locomotive (Heisler), one twenty-ton geared locomotive (Shay), six open canopy-top observation cars, one half-closed passenger car, and two flat cars. Cost of equipment, $22,450.[G]

[G] The writer is indebted to the officers of the Mill Valley and Mount Tamalpais Scenic Railway for the above accurate statistics.



View from Summit of Mount Tamalpais Hotel at Terminus.

The locomotives and cars are very thoroughly provided with brakes: first, the Westinghouse automatic air brake; second, a water brake; and, third, a powerful hand brake to each locomotive and car. The efficiency of this equipment is attested in the operation of the road without accident or injury of any kind. The locomotives are always operated on the lower end of trains, and the maximum speed allowed is eight miles per hour.

The ride up the winding cañons and through the superb scenery traversed by this road is a treat of which one never tires. The point of view, the direction, and the character of the landscape are continually changing. [74] With no deep cuts, no tunnels, facing first one and then the other and finally all the points of the compass, sweeping around spurs, with distant views of land and sea, and near views of great beauty; then facing the steep sides of the mountain, its geology and flora affording interesting pictures; then over trestles with the branches of the bay, redwood, madroño, oak, and manzanita just out of reach—all these form beauties and attractions possessed by no other road known to the writer. A faint idea of the appearance of the road and of the scenery may be had from the appended photographs.

The Double Bow.

The Meteorological Station.—The advantages of Mount Tamalpais as a meteorological station have long been recognized, and many efforts have been made to utilize them. It frequently projects many hundreds of feet above fogs which cover the adjacent shores, and during these periods one can look out upon an ocean of rolling, fleecy clouds which break upon the mountains around its base and visible from its summit. This freedom from obscuring conditions gives an opportunity to more freely observe and study meteorological phenomena, and caused the Weather Bureau to make a series of preliminary observations in 1897, and, these resulting favorably, a fully equipped permanent station was subsequently built. The results have fully equaled expectations. The advantages of the location may be briefly summarized as follows:

1. It is close to the coast line, and is so elevated that it is not seriously affected by the local indraught of air through the Golden Gate and adjacent gaps in the Coast Range. This local indraught is a disturbing and often a misleading factor in all observations taken near and south of the Golden Gate for at least a score of miles. The elevated station on top of the peak eliminates the source of errors based upon observations at lower stations, and enables the forecast official to determine the effects of the local disturbances, and thus to give observations taken at or near sea level their true weight at the proper time. 75

2. No station in the United States has so full and free a projection into the lower third of the vapor-bearing stratum as has the station on this peak. No other station furnishes, as it does, an opportunity to study the distribution of vapor in the lower third of that stratum of the atmosphere, the physics of which is most important to human life and industries.

3. In studying the phenomena connected with the occurrence of fog, this station furnishes highly valuable data that could be obtained from no other; and, again, enables the student of weather lore to correct misleading impressions and deductions based upon observations taken below the one-thousand-foot contour above sea level.

On the 16th of June, 1899, the observations taken on Mount Tamalpais marked a difference of about thirty degrees in temperature over those around its base. In San Francisco, at Point Lobos and at Point Reyes, the temperature was down to 48°, while on Mount Tamalpais it was 79°, thus marking an approaching change in weather conditions, and giving the Weather Bureau the first opportunity of using the vertical temperature gradient in forecasting.

As a station for furnishing the data for a study of the problems of the physics of the atmosphere Mount Tamalpais is of further importance, as it stands near the easterly limits of the great area of high pressure which, during summer, lies over the North Pacific and which dominates the climatic phenomena of California for the greater portion of the year.

Stations on the Hawaiian Islands to the south and others on the Aleutian Islands to the north of this area of high pressure will still further aid in the solution of the great and vital problems now before meteorologists. These stations are the most reliable ones which can surround on three sides the two great “weather breeders”—the “summer high” and the “winter low” of the North Pacific.

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INTERNATIONAL LAW AND THE PEACE CONFERENCE.

By JAMES HARRIS VICKERY, LL. B.

> "In truth these 'cut-and-dried' schemes are of no value at all, unless as monuments of the mingled simplicity and ingenuity of their authors."—Lawrence.

The view has been very generally entertained that all efforts to promote the cause of peace and order in the world by cut-and-dried schemes are bound to fail, and it must be admitted that few truer words have been written than those which stand at the head of this article. But this truth, like some others, may be abused. Evidences are not wanting to show that the incredulity which preceded the convening of the Peace Conference, the skepticism which marked its first sessions, and a certain want of faith which has since been manifested in various quarters in the practical value of the measures adopted, are all mainly due to a misapplication of this truth.

The measures formulated at The Hague do not constitute a "cut-and-dried scheme," but, on the contrary, they form an additional step in a natural, healthy, and orderly evolution of the forces of peace which have so effectively asserted themselves in the improvement of international relations during the latter half of this century.[H]

> [H] For an excellent statement of the work of the Conference from the German point of view, see Die völkerrechtlichen Ergebnisse der Haager Conferenz, by Professor Zorn, of Königsberg, one of the German delegates, published in the Deutsche Rundschau, January *et seq.*

The Geneva Red Cross Rules.—The first matter to which attention will be invited is the extension of the Red Cross rules to naval warfare.

The Geneva Convention of 1864, which marks the beginning of the organization known as the Red Cross Society, inaugurated a vast and beneficent improvement in the then existing usage of nations as regarded the care of the sick and wounded in war. Its two salient features are the neutralization of the officers and forces of the society and the disabled soldiers under their care, and the establishment of a *system* to govern the conduct of its humane work.

At the dawn of modern international law during the first quarter of the seventeenth century not only the sick and wounded of a vanquished foe, but every prisoner, and even women and children, suffered to the fullest the indignities and cruelties incident to the rough warfare of the age; but the growth of mercy has softened the [77] asperities of war, and among the milestones that mark this advance toward a more humane usage the Red Cross Society holds an honored place. Under its rules the sick and wounded were no longer left to the irregular and capricious care of private benevolence, but were made the subject of organized and systematic treatment by a staff of skilled physicians and experienced nurses provided with hospital and ambulance facilities, and, thus equipped and assured the protection of both combatants, they were able to work effectively in their ministrations to the sick and dying.

Vast as was this progress from the days when at the siege of Acre the first real attention since the dark ages was given to the wounded by the Order of Teutonic Knights, there was still one serious imperfection that limited its sphere of usefulness—it did not apply to warfare on the seas. An effort had indeed been made in 1868 to extend the Red Cross rules to naval warfare, but it failed, and the wounded in conflicts on the sea continued to be left to the old provisions, which were necessarily inadequate and could not be exercised under the joint protection of the combatants. The virtue of the good Samaritan is a potent force, but to be fully effective on the field of battle it must be exercised under a common system established and maintained by the mutual consent of nations. It would, however, be a mistake to suppose that because the effort made in 1868 to extend these rules to sea warfare failed on account of their non-ratification, they were not sustained by public opinion. Many difficulties, especially those of a technical character, stood in the way; but public opinion was ever growing in their favor, and it eventually came to be regarded as an anomaly that while the care of the sick and wounded in land warfare had been regulated upon a common basis of international agreement, no similar provision existed for the care of the victims of naval combat. Without some such extension of the rules no adequate expression could be given to the growing humanity of the age.

For these reasons it will be obvious that the next step necessary in the further development of the Red Cross work consisted of its extension to naval warfare. The Peace Conference subjected the Convention of 1864 and the additional rules of 1868 to a careful examination, considered at length the difficulties in the way, and finally adopted a new series of rules providing for an organized staff of physicians and nurses, with hospital ships and life-saving appliances, which shall, without interfering with operations, be henceforth employed in naval engagements and enjoy the protection of both combatants.

The newly formulated rules, in conjunction with the previous ones relating to land warfare, are the practical embodiment of the growing feelings of humanity and mercy in the conduct of warfare which, commencing with [78] the Peace of Westphalia, has been ever more and more effective in securing the evolution of a better usage.

The Brussels Rules.—So, too, with reference to the rules governing the conduct of armies in the field the work of the conference represents a sound and healthy evolution.

It may be remarked, by way of preface, that the old idea of war regarded hostilities as working the absolute interruption of all relations between belligerents, save those arising from force; it also regarded the enemy as a proper object of violence and depredation. Even in the time of Grotius the universal usage permitted the putting to death of all persons found in the enemy's territory, and in the terrible struggles of the Thirty Years' War in

Germany and the Eighty Years' War in the Netherlands the story of the fate of men, women, and children at the hands of a conquering soldiery forms one of the darkest chapters in human history.

But while Grotius declared this to be the usage, he also took care to point out that considerations of justice and mercy dictate a better course, and he made a distinction between certain classes, declaring that justice requires the belligerent to spare those who have done no wrong to him, especially old men, priests, husbandmen, merchants, prisoners, women, and children. This merciful distinction was eagerly seized upon by his successors, who gradually developed out of it different rules for the treatment of the "combatant" and "non-combatant" portion of the enemy inhabitants. After the Peace of Westphalia in 1648, which marked the close of the great struggles that had so long convulsed Europe, the older and more brutal customs fell into disuse, and the theory that only so much stress should be put upon an enemy, and primarily upon the combatant portion, as was sufficient to destroy his power of resistance was substituted for it. Along with this new usage grew the ever-increasing rights of neutrals, among them being that of trade and commerce with the non-combatant portion of belligerent states, which has done so much to lighten the hardships of war suffered by those devoted to peaceful pursuits in the enemy's territory.

The next important step in this evolution belongs to the present century, and is due to the enlightened initiative of the United States. This step consisted in the preparation of a manual containing a code of rules for the conduct of land warfare. Keenly alive to the inevitable sufferings incident to the great civil conflict then being waged, Abraham Lincoln commissioned Francis Lieber to prepare a series of rules for the conduct of the armies of the republic in the field which should set bounds to the passions of the soldiery.[I] In pursuance of this 79 commission, a code of rules was prepared and adopted which has since been known as Lieber's Manual; it was published in 1863, and proved a blessing to soldier and civilian alike. So obvious, indeed, were its good results that other nations rapidly followed the lead of the United States, and similar manuals were issued by Great Britain, France, Germany, Russia, and other powers.

[I] See Pierantoni, Die Fortschritte des Völkerrechts im neunzehnten Jahrhundert.

But while Lieber's Manual was thus taken as the model by various nations, there were inevitably developed serious divergencies in the rules and details. Recognizing the desirability of a common code, which should be binding upon all nations, Alexander II of Russia attempted to secure the united action of the leading states, and, pursuant to his initiative, the Conference of Brussels was called in 1874. In the sessions of this conference the rules already developed were carefully examined, and ultimately a series of articles, well calculated to form the basis for an excellent international code, was adopted. As the delegates, however, had not been given plenary powers by their respective governments, their action was necessarily ineffective without subsequent ratification. Upon this rock the conference was wrecked, and the rules which it had formulated acquired no binding authority.

But indirectly they had a most happy effect, for they worked as a unifying influence in the preparation of subsequent manuals and the amendment of existing ones. The increasing interest in the subject thus stimulated led the Institute of International Law to give the matter still further thought, with the result that that eminent body of jurists in 1880 adopted a very full and excellent code, which gave evidence of much advance in the knowledge of the subject.

But neither the Brussels rules nor the code of the Institute of International Law possessed any binding authority, save in so far as they embodied generally accepted usage; their influence, however, increased the tendency in the direction of a common manual such as that which Alexander II had hoped to secure—a hope which has now been realized, and in a manner worthy of the subject. This logical step, too long delayed, is due to the Peace Conference. It devoted most careful consideration to the various codes, and has enriched, extended, and unified the rules and improved the whole by many valuable provisions suggested by the intervening experience. Altogether, the result is a splendid example of a natural evolution which, commencing with the distinction between "combatant" and "non-combatant" founded on the considerations of mercy and justice pleaded by Grotius, subsequently recognized in the Peace of Westphalia, increasingly practiced since 80 then, and at the instance of Lincoln embodied in a manual, has now led to the adoption of a common international code for the conduct of future armies in the field—a result which marks the triumph in our day of the conception of civilized warfare tempered with mercy over the old idea of indiscriminate and inhuman slaughter.

The Sphere of Arbitration.—A matter that has given rise to much speculation is the *jurisdiction* of arbitral tribunals. It has come to be recognized that a distinction must be made between different classes of international disputes. What may be called "business disputes" between states, such as boundary lines, tariffs, damages, fishery claims, questions of citizenship, and various treaty arrangements—like the most-favored nation clause—are all fit subjects for arbitration.[J] But the graver questions involving the consideration of national policy and aspirations, vital interests and honor, race and religious prejudices and passions, and last of all self-preservation, are, at least for the present, far beyond the competence of an arbitration tribunal.[K]

[J] See Essai sur l'Organisation de l'Arbitrage International, by M. Descamps, p. 24.

[K] The Transvaal War pertinently illustrates the prevailing want of knowledge regarding the true sphere of arbitration. Ever since the outbreak of war the Continental press and some American papers have been asking why the provisions of the Peace Conference are not put in operation. Much of this is due to anglophobia; much to a genuine ignorance of the matter. The treatment of the subject usually takes the form of an antithesis in which Great Britain as a peace power at the conference is contrasted with Greater Britain making war on a little republic, and this is invariably followed with a statement or inference that the Peace Conference was a huge farce, and the Permanent Court a dire failure. It is now quite plain that the root of the difficulty between England and the Transvaal was not the franchise nor the dynamite monopoly, but English *versus* Dutch predominancy in the whole of South Africa, and therefore a grave clash of two opposing policies, involving the deepest questions of interest and even self-preservation. Regarding these questions the conference was unanimous in the opinion that they are entirely outside the sphere of arbitrable question.

If the list of arbitral decisions hitherto given be examined it will show that questions of the first sort above are those which have thus far been submitted to judicial settlement.[L] It is therefore in harmony with past experience that the conference, in generally defining the scope of arbitration, declared it to be intended for the settlement of "questions of a juridical nature," especially the interpretation and application of international agreements upon the basis of respect for law.[M] The frequency of these "business questions" is on the increase; they seriously embarrass diplomatic representatives, whose proper duty is the conduct of graver matters of policy, and there is a growing disposition to submit them to legal settlement. Under these circumstances, there is little doubt that the time has come when the system of special temporary courts of arbitration, splendid as 81
their work has been, must give way to a more adequate system—they were indeed but stepping stones to a more permanent organization. Under the old system each power was likely to wait for the other to take the initiative; then came a squabble as to just how much and what part of the difficulty should be submitted to arbitration, then a squabble about judges, then a squabble about procedure, place of trial, and so on—all was unpreparedness, uncertainty, and meantime angry passions had full play.

[L] See especially the list given in the back of Darby's International Tribunals, p. 286.

[M] See Article XV of the Convention.

In the preparation for war the modern state lays no end of force on the necessity for a rapid and systematic mobilization. The weak point, however, in preparing for a judicial contest hitherto has been the absence of any system by which to "mobilize judges and counsel" and get the legal forces out into the field. To attain this end the scheme presented by Lord Pauncefote and unanimously adopted by the conference will be found to be a most striking example of the happy adaptation of a means to an end where the way seemed blocked by infinite difficulties. It consists of a few simple provisions for the establishment of an International Bureau of Arbitration with an Administrative Council, and this, with the addition of various other features drawn from the United States, Russia, France, and Italy, with some others, constitutes the composite plan embodied in the Final Act. In brief outline it is as follows:

Permanent Court of Arbitration.—The diplomatic representatives of the signatory powers accredited to The Hague, including the Netherlands Minister of Foreign Affairs as president,[N] are to constitute an administrative council. This council shall organize and establish an International Bureau of Arbitration, of which it shall retain the direction and control, pursuant to the provisions of the conference. This bureau shall serve as the office of the court, and contain the archives, and the routine business shall be conducted therein. The signatory powers will each appoint four persons, who shall be men of recognized ability in international law and of high character, and the whole number of persons so appointed shall form a list or panel of members of the court, or the international bench. In case of a difficulty arising between two or more powers which they desire to submit to arbitration, they agree to notify the bureau, and the bureau will ask them to choose a certain number of judges from the panel, and these shall constitute the special bench.[O] An agreement is then to be drawn up 82
stating the object of the litigation and the powers of the arbitrators. This agreement implies the engagement of the parties to submit in good faith to the sentence.

[N] The amendment to Lord Pauncefote's plan, by which the Dutch Foreign Minister was made the president, is due to Mr. White, President of the American Commission.

[O] In case states, between whom a dispute may arise, do not of their own accord have recourse to the tribunal, Section 27 permits the powers to remind such states that the Permanent Court is open to them, and the giving of this reminder is declared to be a duty in the superior interests of peace, and is to be regarded only as an exercise of "good offices." To this section the United States agreed on condition that its consent should not be regarded as a departure from the well-known principles underlying the foreign policy of the Republic.

Arbitral Procedure.—For the purpose of promoting the development of arbitration certain simple rules are formulated. The powers will appoint special agents, who shall be intermediaries between them and the tribunal; they will also appoint counsel. The proceedings consist first of *instruction*—communications by the agents and counsel to the tribunal and the opposing party, of the pleadings, etc.; and, secondly, of *argument*—the oral development of the pleadings. The argument being closed, the bench shall deliberate in secret, and a decision is to be reached by a majority vote. The decision shall be written, and is to contain the reasons of law and fact upon which it is based. In case of disagreement, the dissenting opinion shall also be written and contain the reasons therefor; the signature of each member is to be added to his opinion. Subsequently the decision is to be read in open session, in the presence of the agents and counsel of the parties.

To sum up: it contains all the essentials; it is immediately available, provided with a permanent office, with officials, with a code of procedure, with directions for the commencement of proceedings, the presentation of cases, the taking of evidence by an International Commission of Inquiry, the oral explanation and argument of the printed case, the pronouncement of sentence in open court, the recording of such decision, the subsequent rectification of an error therein on the discovery of new and important facts of a decisive character, and the preservation of the records.[P]

[P] See Articles XV to LVII of the Convention.

Basis for Future Evolution.—With these essentials there is a basis for a future evolution until the court shall have become as perfect in its organization and details as the High Courts of Justice in England or the Supreme Court of the United States.

It may not be amiss here to suggest the influence which the permanent tribunal is calculated to exercise in the future development of international law. The provision for a permanent bureau or record office, in which the archives shall be kept, is sure to prove a valuable condition for future growth, for the deposit in such bureau of all arbitral decisions will mark the true beginning of what we may call "International Law Reports." To this bureau the powers undertake to send certified copies of all special arbitration agreements, whether embodied 83 in treaties or otherwise; to it also will be sent the result of all special arbitrations hereafter resorted to, and in it will be deposited the papers, pleadings, and other documents, and especially the decisions of the permanent court, as well as those of any special courts which may hereafter be created from time to time. These archives will thus furnish a wealth of material not locked up or available only by jurists of the particular state where they may happen to be situated, as has too often been the case heretofore, but accessible alike to the great text writers and commentators of all nations. The criticisms and opinions of eminent text writers have heretofore been of great value in the improvement of international law, and under these new and more favorable conditions their influence should be even more beneficial in the future.

To the works of text writers will in future be added the able discussions of counsel and the learned opinions of judges handed down in writing, with the reasons upon which they are founded.[Q] Where rules and usages are becoming obsolete or obviously hostile to the growth of opinion, international judges may feel themselves bound for a time by them and give their decisions accordingly, but they may embody in their written decisions an *obiter dictum* which shall prove the death knell of the old rule and the establishment of a healthier one. Many are the wholesome changes that have thus been wrought in English "judge-made law" as the direct result of learned and convincing *obiter dicta*.

[Q] For an admirable example, see the published proceedings of the Paris Tribunal in the Venezuelan case.

The interest which will thus be stimulated in the whole subject of international law will promote its study in all nations. Hitherto this branch of legal education has been rather slighted; not being regarded as essential to the ordinary practitioner, it has been neglected for the petty provisions of some state code or involved corporation law, but the influences already at work in favor of a more thorough and scholarly study of this branch will be effectively aided under the new conditions.

Though the law of nations should be uniform in all countries, a comparison of the leading works in different countries, English and German for instance, will reveal many differences partly traceable to the particular system of law in which the author was grounded, and in part to his peculiar "judicial instinct." It is not often that one finds an English or American lawyer thoroughly grounded in the Roman system and the modern Continental systems founded upon it; quite as rare is it to find a Continental lawyer learned in the system of English jurisprudence. There have been such men, as, for example, Rudolf Gneist, whose great work on English 84 Constitutional Law and History has become a classic. But, as a rule, there is among text writers on this branch of law and among the eminent jurists who have hitherto been connected with international tribunals much "provincialism in thought and conception," if the phrase may be allowed, and to overcome it the future jurists who shall take part in international contests before the high tribunal of the nations will require to be more thoroughly grounded in the history and evolution of law in general and in the study of comparative law, both private and public, in particular, than their predecessors have been.[R] In this connection it is not too much to hope that the unifying influence of an international tribunal will eventually exercise a good effect in promoting the solution of various perplexing problems on the private side of international law, or what is known as "conflict of laws."

[R] As evidence of increased attention to this matter in Germany, see Wertheim, Wörterbuch des Englischen Rechts.

Having indicated some directions in which the growth of international law will be likely to be promoted by the tribunal, the question suggests itself whether the jurisdiction of the international court will eventually be enlarged beyond the scope at present contemplated by the Convention of The Hague. Will the time ever come when such a court shall take cognizance of various matters which now lie without the sphere of "business disputes and questions of a juridical nature" and within that of essential interests, honor, race, and religious policies and ideals? The statement, which is sometimes heard, that such will never be the case, does not seem warranted when we regard the growth of law in general, and indeed the development of this particular branch of it, in the past, but it is safe to say that the time is a long way off; it will depend on many things: the efficiency of the court itself, the continued growth of neutral rights, the increasing necessity for preserving international peace, and the infinite forces which have tended to widen the jurisdiction of municipal law.[S]

[S] See Le Droit de la Paix, by M. Descamps.

In the growth of systems of "National Law"[T] there has been evolved from small beginnings an ever-widening jurisdiction. Impartial courts have inspired confidence which stimulated individuals to seek their aid, and this has reacted to extend their jurisdiction, until now the most intimate and complex relations between individuals, at one time wholly without their sphere, are in these days submitted as a matter of course to judicial settlement. Even questions of individual honor are settled according to the well-developed principles of libel and slander which were once considered as requiring a duel for their satisfaction. 85

[T] In contradistinction to "International Law."

A similar growth may be expected in the jurisdiction of the international tribunal. Upon the reputation which it shall succeed in establishing for impartiality, freedom from race and national prejudices, regard for broad principles of law and equity, and the thoroughness and ability with which it shall discharge its high duties within its present sphere, will largely depend the extent to which an advancing public opinion will enlarge its jurisdiction until it shall embrace various classes of questions now declared non-arbitrable. No detailed classification, however, can be thought of; each difficulty as it arises must be determined in view of the surrounding circumstances with due regard to the growing public feeling in favor of judicial settlement. Under the system of voluntary arbitration there is abundant room for growth, for the *onus* will be thrown on each contending state to square its conduct with that growing feeling in favor of arbitration which it will become more and more difficult to ignore. In every country the growth of law and the extension of the jurisdiction of the courts which administered it have been concurrent; the same rule must govern in the field of international law.

There are vast fields at present untouched by the law of nations. The discovery of the New World threw the jurists of that day into bewilderment as to how rights in the American continents might be acquired and established. A period of doubt and dispute ensued, until finally Grotius, by applying certain rules of Roman law regarding the acquirement of rights by individuals through purchase, possession, etc., and by inventing certain other rules, helped to supply a legal foundation upon which the acquisition of these territories could be regulated. Looking toward the future, one can see that, since there are no more continents to be discovered and the habitable parts of the earth have been already taken possession of by the colonial pioneer, the great principle of the survival of the fittest must henceforth mainly work itself out in competitions confined to the existing territories of the various powers. This will necessitate the consideration of some deep questions concerning the life and death of nations and the heirship to their dominions.[U]

[U] *Vide* Contuzzi, Leggi di Composizioni e di Decomposizioni degli Stati.

It is widely believed, for instance, that China is dying a natural death. Assuming it to be the fact, what will be the rules to govern the inheritance of these Oriental domains? Great Britain, Russia, Germany, the United States, and other nations have acquired footholds and established interests within Chinese territory. Disputes 86 will inevitably arise between them; many will be settled by mutual compromise in which, perhaps, the chief consideration will be the amount of warlike force behind the arguments advanced; many others will be sure to find their way to an arbitral tribunal, and before that body arguments will be made and by that body decisions will be handed down embracing principles not now to be found in the books, but which the circumstances of the case and the demands of justice require. And so will doubtless ensue a growth of "international judge-made law and equity" which will gradually work an extension of the arbitral jurisdiction into fields at present unknown to the law of nations. One thing is certain: the law so developed must not, on the one hand, be in conflict with the Grotian doctrine of the equality of states as rightly understood, nor, on the other, with that great all-pervading law of the survival of the fittest—a law which determines the destinies of men and nations alike.

THE FATE OF THE BEAGLE.

By the Rev. V. MARSHALL LAW.

On the 27th of December, 1831, his Majesty’s ship Beagle, a ten-gun brig, under the command of Captain Fitz Roy, R. N., sailed from Devonport, England, on an expedition the purpose of which was to complete a survey of Patagonia and Tierra del Fuego that had been begun under Captain King (1826–’30); to survey the shores of Chile and Peru, and of some islands in the Pacific; and to carry a chain of chronometrical measurements round the world. The voyage was one of the most memorable ones in the annals of scientific exploration, for, besides the direct results, which, in the condition of geography and natural history at the time, constituted very important additions to knowledge, it carried Charles Darwin, then young and full of the enthusiasm for study that never left him. Mr. Darwin accompanied the expedition on the invitation of its commander, Captain Fitz Roy, and with the special sanction of the Lords of the Admiralty, and, as it turned out, next to the captain of the vessel was perhaps the most important member of it. He made it his special business to inquire into the character and method and the reason of all the natural objects and phenomena he saw, examining what was in the sea while they were upon it, and, when they landed, going ashore and studying the geography and geology and life of the region as thoroughly as the time of stay would permit, and collecting no end of notes and specimens as material for future study.

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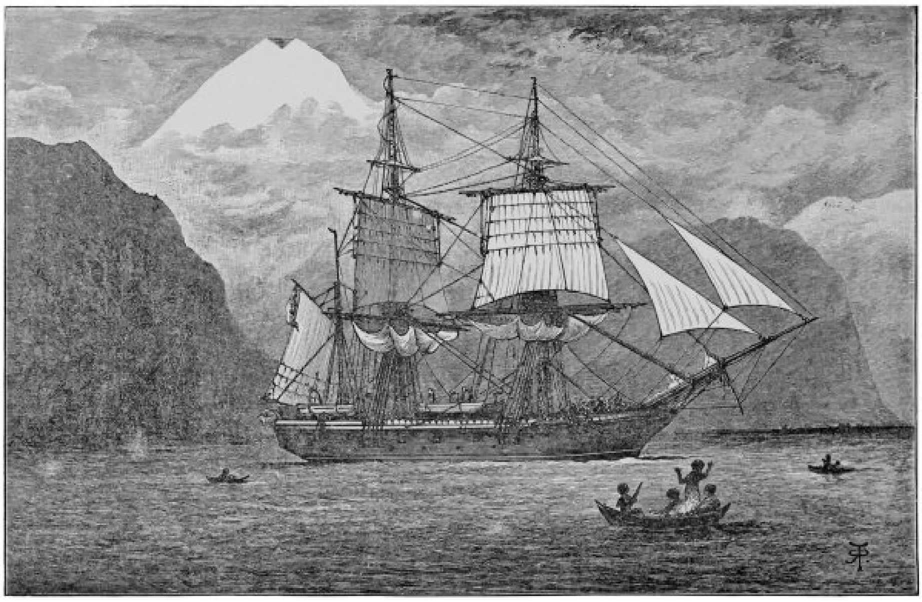

H. M. S. Beagle in the Straits of Magellan. Mount Sarmiento in the Distance.

Besides his elaborate work giving the full story of the expedition and the details of its scientific results—a book which has ever since been a standard authority, and still keeps students in active discussion and investigation—the voyage of the Beagle has to be credited with having supplied the occasion for the composition of the briefer and more popular account which has become one of the classics of English literature. 88

More than this, and vastly transcending it in the importance of its bearing on the future of science, it was while going round the world and observing on the Beagle that those fundamental facts were gathered and stored in Mr. Darwin’s mind which, worked over and developed in after years and compared and combined with subsequently accumulated facts, bore fruit in the Origin of Species and the transformation of science that resulted upon the enunciation of Mr. Darwin’s theory of descent.

We all regard the association of any object with great events or with those in which we have great interest as making it precious. We endow ships with a kind of personality, regard them affectionately, and often speak of them fondly, as if they were real living beings in whom we had an interest. Such feelings we might legitimately entertain with regard to the Beagle, so closely associated with the history we have referred to. Few associations deserve, in fact, to be more highly valued than that of this brig, the Beagle, with Mr. Darwin’s books and his theory. It is therefore a matter of legitimate concern to inquire into what was the fate of the famous vessel.

The inquiry has been made, and is answered by the Rev. V. Marshall Law, of Oakland, Cal., whose account follows:

“I was lying in my room, in Tsukiji, as I had been day after day, in 1890, watching the lazy roll of the school-ship in the Imperial Naval Academy, just a little to the south, when a caller and an old resident, Mr. Arthur Morris, said to me, ‘I see you have Darwin’s old ship, the Beagle, in plain sight out there.’

“‘Is that the Beagle?’ I asked in great surprise.

“He assured me that it was, and somehow after he had gone it impressed itself more strongly on my mind the more I thought of it. I lay ill, and part of the time in delirium, for ten days. When I at last got up, the Beagle was gone. I sent inquiries to the Naval Academy, but no one seemed to know anything about her. As soon as I was able to go out, I lost no time in setting on foot inquiries of the whereabouts of the missing ship. I finally learned that she had probably gone to the Imperial Navy Yard in Yokosuka, about thirty miles from Tokio. As

soon as I was able to travel we started to go to Yokosuka in search of the missing vessel. Before this, however, I had taken the precaution to put on the track the Englishman, Mr. F. W. Hammond, who taught the young Japanese gunnery in the Imperial Naval Academy at Tokio, and he promised to do all in his power—which in this instance was very great—to help me in my search for the Beagle. To aid him, I gave him the following list of 89
questions, to which he sent me the answers given below months afterward. My questions had gone through the regular naval channels. The answers show how methodical the Japanese are, even if they are slow. In these answers I use their language:

"'Question. How did the Japanese Government happen to get the Beagle?'

"'Answer. The details of getting are not plainly known, but the Prince of Kagoshima procured it on seventy-five thousand dollars, at the 23d of July, first year of Genzi (1860), afterward he offered it to the Government at the June of the third year of Genzi.'

"'Q. Are there any good photographs of her as she was when a war ship?'

"'A. No, we have no one.'

"'Q. Where is the Beagle now?'

"'A. After out of use, she was applied as a Chastising Place for seamen at the Yokosuka station, and then was auctioned at the March, twenty-second year of Genzi.'

"'Q. What was the date of her arrival in Japan?'

"'A. She was received by the Prince of Kagoshima, at Nagasaki, July, the first year of Genzi.'

"'Q. What is her present name? When was her name changed?'

"'A. At the present this ship has no name in the consequence of out of use, but after procured by the Kagoshima Prince the name of Beagle was changed into Kenko Kan.'

"'Q. Do you know how old this ship is, and what she was used for by the British Government before the Japanese got her?'

"'A. She was actually used during twenty-three years, after which she was put out of use, having been constructed at Liverpool, and we can not know what she was applied for before got by Japan, but she remained more or less than one year in England.' (Darwin made his famous voyage in her from 1831 to 1836.)

"'Q. What is the name of the captain who had charge of her after she became the property of the Japanese Government?'

"'A. Commander Sadakumi Shiba was appointed the acting captain February, 2d year of Genzi; Commander S. Hamataki, from December, 5th year of Genzi; Commander M. Omura, from November, 10th year of Genzi; Commander Sadakumi Shiba, from December, 11th year of Genzi; then the last was dismissed on the September, in the 14th year of Genzi.'

"'Q. In what capacity did the Japanese Government use her from the time she arrived up to the time she was dismantled?'

"'A. She was rated as the fifth class at the November, 4th year of Genzi, then the fourth class May the 8th 90
year.'

"We found Yokosuka, and our party were shown every courtesy by the Japanese naval officials; so at last we ran down the Beagle, lying on the shore and showing not a vestige of her proud, historic self. She was being torn to pieces, and the parts were sold for 'old junk.'

"I reflected, as I stood among her spars and chains, her anchors and her capstan, of the significance of the career of the famous vessel, and of her associations with the man whose investigations revolutionized scientific thought and spread consternation for a time in the pulpits of the world. The attitude of these pulpits has been modified by reason of those researches, and the blessings of the world and of the Church now follow the author of them for having shown the way to a juster and more rational conception of the power and purposes of the Creator."

SCIENCE STUDY AND NATIONAL CHARACTER.

By ALBERT B. CROWE.

Until very recently it had come to be a commonly accepted view in America that the civilization of a nation is directly proportional to the amount it expends for education, and inversely proportional to the amount it expends for war. The budgets of European countries have given Americans good reason to accept this standard, since its application gave the most gratifying evidence of our great intellectual and moral advancement. Less than three years ago the President of the National Educational Association proudly exclaimed: “England, six to one for war; Russia, thirty-eight to one for war; America, four to one for education!”

Since that time our country has become involved in war projects, from which we can hardly hope it will withdraw, that have increased our expenditure for war four times, and a policy has been inaugurated which, if persisted in, will certainly almost at once reverse our boasted ratio, making it “four to one for war”! This course has been supported by a great body of our people. Even our Christian ministers have committed “The White Man’s Burden” to memory, and breathe never a whisper of the sixth commandment. If, as has been held by all wise and good men, the victories of peace are more worthy to be sung than those of war; if the ability to avoid quarrels or to settle them without force of arms is nobler than that which achieves military success; if true 91
enlightenment and education make for peace and not for war, then our law of direct and inverse proportion has lately been scandalously dishonored.

If we have expended so much for education and at the same time have lowered our ideal of national greatness, something must be wrong with that education. If the sharpening and quickening of the intellect are accompanied by a blunting and atrophy of the moral sense, the best and the worst thing that can be said of our school system is that it gives daily rations to hundreds of thousands of teachers. Evidence of disease of the national conscience must raise in the minds of thoughtful men grave doubts as to the sufficiency of our education to “insure national progress, prosperity, and honor,” whether because of inherent weakness of the system or because of the strength of the forces opposed to it.

Has our system of education, then, failed to elevate our national character? He who would answer this question in the affirmative would be a pessimist indeed. Incalculable “general good” has come to us, we think, by the agency of our schools. Without them our civilization could not be so far advanced as it is; our national life might have ended long since. In every crisis, however black has been the storm, however fierce and ominous the lightning flash, there has followed in good time the gentle rain, soothing and allaying our fear, and giving renewed promise of prosperity and peace. It is the sober second thought, we are in the habit of saying, which saves us, which takes the helm and sheers us away from the half-hidden reefs in our first mad course. It is not. It is the sober first thought which has redeemed us from destruction time after time—the sober first thought of the few who are truly educated, who have looked below the surface of things and considered the hidden and obscure results, who have weighed the right and wrong and stood immovable for the right. It is the counsel of such men which has fallen like the rain that follows the first bursting of the storm, and has given us courage and power to restrain ourselves and to face our hardest duty. For such men in our national affairs we may reverently offer thanks, and for an educational system which is partly, at least, responsible for them we may have sincere praise. But our safety must always depend upon the presence of such men, strong enough in numbers and in influence to control each difficult and dangerous situation which may threaten us. Our work as teachers is not faithful if we do not increase this number and strengthen this influence. And if such men have been overpowered in the important events of the past two years, if they have been entirely ignored, or if they have been taunted and ridiculed, we have reached a dangerous crisis, and our sacred duty is to stop and take 92
our bearings. If we have manifested certain national traits hitherto scarcely suspected, and now unwillingly confessed, every motive of patriotism and of prudence should impel us to study our case, that we may effectively prescribe for it.

Are there not, then, certain signs which we may all agree are discernible? Have not the waves of powerful feeling which have swept over us, the storms of acrimonious debate which have raged in our papers and forums, the pæans of praise which we have chanted at our “peace jubilees” and hero parties, revealed the prevalence and rapid growth of certain sentiments which we may all, without regard to political belief, clearly recognize? I do not in this place raise the question of the political wisdom or simple justice of the course which the country has taken in its international relations. I do not now challenge any belief as to these matters which has been formed thoughtfully, honestly, manfully; but I do maintain that the past few months have left lessons for thoughtful, honest men to unite in studying.

Probably the most striking phenomenon which we have witnessed has been the tremendous display of excited feeling. However careful our national leaders may have been, however honest in basing their actions on what they considered sufficient information, or however careless and dishonest, no man who has read any considerable number of our papers, who has listened to the clamor of the crowds, can doubt that the force of blind passion has been in hundreds of thousands of men the dominant force. If during the war with Spain you stood in the cheering, surging crowds before the bulletin boards, if you heard storms of hisses greet the name of the innocent boy-King of Spain, or noted the cheer of triumph which applauded the capture of a lumber scow by an armored cruiser, you will have no difficulty in agreeing with me. You will smile at the idea of imputing to such men the credit of serious thought. On the birthday of the greatest American, whose life was a message of liberty—“who,” said a great Spanish orator, “laid down his life at the foot of his finished work”—our papers printed jokes about the mistake of the Filipinos in trying to fight Uncle Sam, and in our cities, at least, the report of their slaughter was received with exultation. Whether they were civilized or not, whether they were misled or not, whether they were ignorant of America’s carefully concealed intention or not, the killing of thousands of men who thought they were fighting for their freedom, who faced machine guns, and who crawled away into the bushes to die for the cause for which they had fought, is hardly a subject for jokes or for exultation, when people are governed by reason and not by feeling alone. When the Maine was sunk in Havana 93
Harbor her captain, in a notable dispatch telling of the disaster, urged a suspension of judgment until the facts

should be known. Facts! In an hour our battle-cry was, “Remember the Maine!” Under that motto, within a few days, one of the great Chicago dailies (the Inter-Ocean) hung out the pennant of the wrecked battle ship and enlistment signs. Who was right—the Maine’s captain or the paper? Which appeal meant safety, and which danger? Our own commission investigated the wreck. After an examination, which was kept entirely within our own hands, the commission reported that the ship had been destroyed from the outside, but that there was no evidence to fix the responsibility. Did we fix the responsibility? Though the investigation board could find no evidence, though reason said that the destroyer of the Maine, were he Spain’s own king, was Spain’s worst enemy, we forgot the cause of deliverance, and went into battle with the cry of vengeance on our lips. This is not a statement of sentiment but of fact. Your motives, or the President’s, or mine may have been pure—your opinion may have been unprejudiced—but these things around us we all saw and all heard. We know that many men were carried away by their feelings, and did not think. We know that their feelings grew into a prejudice which was absolutely certain to distort the facts and to drive them far from the truth if they ever came to the point of thinking. The ears of the multitude have been closed to all counsels, however wise; their eyes to all consequences, however fatal; their minds to all logic, however clear and simple.

We may consider more briefly, but not less carefully, other tendencies which have been shown, seeing many of them in the facts which have already been referred to.

From the fact that passion has so largely supplanted reason in moving many of our people we have developed some wonderful instances of credulity. The sequence is most natural. When men become unwilling, or uncaring, to ascertain the truth for themselves they inevitably display a great willingness to swallow any statement which may obligingly be offered them by some one else. So, with half of the Spanish navy sunk and the other half accounted for, we spent hours of glorious, wild conjecture, in the dear dead days beyond recall, listening to the awful sound of cannonading in the Windward Passage, which reached us by the way of Mole St. Nicholas. We believe what is sufficiently exciting to be true.

Related to the phenomena we have noticed is another—the evident loss of individuality—of moral and mental independence. How striking is it to compare some of our newspaper editorials of to-day with those of two years 94 ago in the same papers, and to see how their writers have been dragged, step by step, into line with those whom they formerly opposed! They have not changed their faith; they have deserted it. For them there is the defense of business necessity; but if you will to-day talk to many men who gave you their opinions a few months ago, you will find that they have broken down and given up—surrendered to superior numbers. In our bulletin crowds we have all seen the spirit of the mob, which meets the newcomer indifferent or doubtful, thrills him with the mysterious influence of the men packed around and against him, and sends him away an irresponsible monomaniac.

With such forces at work, it is inevitable that we should act, or be ready to act, quickly. Why not? Reflection takes time. To learn the facts fully and certainly takes time. To feel—how long? To take another man’s word—how long? To give way to a thousand other men—how long? We have all seen men cheering our war with Spain only yesterday. To-day Austria seems friendly to the queen regent. We’ll whip Austria, too. To-morrow Germany is impudent to Dewey. We shall be ready by night to whip Germany. If Europe combines against us, how long shall we consider the cost of such a war as that? Write it on the bulletin board—the crowd will be ready before the writing is done.

Near to this is the spirit of fickleness, of inconstancy, which has been frequently manifested. We have not only made up our minds on insufficient evidence, but we have unmade them in a hurry on no evidence at all, showing a startling lack of confidence in our own judgments and of respect for them. Attention might well have been called, in a former paragraph, to the small amount of our real knowledge of the character of Aguinaldo. On what petty and inconsequential evidence have we first called him a great liberator, and now a scheming politician! Men who could hardly read his most remarkable appeal to this country do not hesitate to call him an unprincipled, conceited, ignorant barbarian: what reliable information have they received with reference to his motives? They have found no trouble in changing their opinions. In the past few months we have been mercurial almost beyond mercurial Frenchmen. Think of the revulsion of feeling that followed Hobson across the continent; and, more recently, of our sad lack of self-restraint shown by the vicious and ungrounded attack upon Admiral Dewey, only a few days after he had been the object of the greatest display of hero worship America has ever seen. And how many important changes may we count, if we carry back our comparison to the time before the war?

But by so doing we uncover another significant fact. We find that many of the ideas so quickly thrown aside 95 are those which have been the foundation principles, and bear the prestige of great names. We have held it our special mission to show to warlike nations that a power which stands for peace may be greater than theirs; and, alas! many of our leaders, and our people, too, are crying that the time has come—has *now* come—for us to take our place among the great nations of the earth. We have pitied the war-taxed peoples of Europe, and offered them a home where they would not have to buy powder and guns. And now we are eagerly rushing to take up the burden from which they have been fleeing to us. We have held that great standing armies are unnecessary and dangerous, and already we have quadrupled ours. We have declared our determination to avoid foreign entanglements, and now we are in the very heart of the sputtering coil in the far East. With those who have thoughtfully decided that these changes have been necessary or wise I have no wish to debate now, but we must all unite in recognizing the spirit which has been shown, and is now shown, in speaking of our past positions. The principles which for years have been our rules of national conduct have been thrown aside in a day, scoffed at, mocked. And we smile at the names of the great men who have announced those principles and defended them, or we flatly declare they are out of date. We once listened with reverent and full hearts when our wise men spoke to us of freedom, and recalled our national traditions and taught national righteousness. Now we laugh at swaddling clothes outgrown, outused, and smile at the innocent simplicity of our fathers. We lift our brows at the name of Washington: we say he was a fine old gentleman, and his Farewell Address, considering everything, was a very creditable paper, and well adapted to the exigencies of the time in which it was written. And this carnival of irreverence is holding not only in our streets, but in our newspaper offices, in our pulpits, and in some of our higher institutions of learning.

These are the phenomena of our recent national experience which I desire you to consider. There may be other unfavorable indications. There may be others, and many more, which are hopeful and encouraging. But these clearly warn us of danger. Furthermore, I insist that whatever may have been your sympathy with the Administration, or your opposition to it; however numerous the men of your acquaintance who have been free from such influences, you must have seen them at work in a dangerously large part of our population. Even if that part has, in your judgment, reached the right position, you must recognize the ominous character of their method of reaching it.

Now, what has this to do with us? What connection has it with our work? If science teaching has any 96 educational value, the most definite and direct connection. I shall not do you the injustice of supposing that any tendency I have named did not at once bear to you its proper suggestion. If it has failed, the fault has been in the presentation of a very simple matter. For every perilous tendency I have mentioned has its life in direct violation of the essential principles of science study, and may be restrained by extending the knowledge and habitual use of those principles.

I do not wish to claim for science work an unwarranted value in this respect, nor to deny the influence of other subjects in bringing about a moral evolution. It is true that history warns us by examples, that it points us to the failure of free governments in whose steps to destruction many of us seem only too willing to follow. It is true that we can learn from Rome the results of imperialism; from France, of irreverence; from Spain, of tyranny. In other fields of learning we may find other lessons of present value. But to meet the dangers that just now assail us, the national weaknesses that I have enumerated, the scientific studies seem especially fitted.

“The great peculiarity of scientific training,” says Huxley, “that in virtue of which it can not be replaced by any other discipline whatsoever, is the bringing of the mind directly into contact with fact, and practicing the intellect in the completest form of induction—that is to say, in drawing conclusions from particular facts made known by immediate observation of Nature.” “The bringing of the mind into contact with fact.” This means the recognition of the existence of incontrovertible truth. The dawning knowledge of such truth must bring with it the consciousness that much that we have always accepted as truth is open to question. Thus every belief, no matter what its nature, is in time subjected to examination. If it stand, it stands because it is able to bear this searching scrutiny and to answer fairly the questions of honest doubt. Honest doubt may be the result of honest reasoning; it must absolutely demand honest reasoning to satisfy it. This exercise of the rational faculty, then, depends upon and results from an awakened love of truth. How directly do these most obvious principles of scientific investigation bear upon the facts we have been considering! How flatly do they forbid us to be carried away into excesses! Let us apply them briefly, point by point.

If love of truth and appeal to reason mean anything at all, they mean, first of all, eternal opposition to the power of unthinking passion—of blind feeling. They mean that every sentiment should have a rational cause and 97 a reasonable object. They do not forbid feeling, but they require thinking.

Secondly, they defy prejudice. They call for the open court, the fair trial, the impartial judge. They say “No” to worthless witnesses and to packed juries.

Thirdly, they demand a sufficient amount of evidence. True science is the enemy of wildcat theories and reckless generalizations. “The United States has always come out on top in every war!” cries one. “There’s no danger that we’ll ever be whipped.” “I don’t like foreigners,” says another. “I had a Frenchman for a neighbor once, and he was dishonest. I’m in favor of shutting out foreigners.” Such reasoning as this—and how astoundingly common it is!—must be cut down at the root by the habit of trained induction.

Fourthly, the love of truth and appeal to reason, which are in the very grain of the scientific mind and heart, laugh at credulity. They do not scoff at authority, or reject it. But they say: “We must know. If we learn from you, we must know that you know. Who are you? How do you know? If you know, you will not offer us absurd contradictions of reason and accepted truth.”

Again, they make their abode with the man who can receive them at his own intellectual fireside. They require that his mind be his own, that his opinions be his own, that his acts be his own, and that he defend his property in them, have pride in them, and stand by them.

Again, they demand sufficient time for care, for securing the evidence and for weighing it, and for considering its effect. They demand the completed work, and they reject all results which do not come from time employed, but are hasty guesses.

And they are not tossed about like a wave of the sea. They do command to prove all things, but they also exhort to hold fast that which is good. First, to what is good of our own and in ourselves. It is well enough to throw away our guesses, quickly made and often wrong. But the fruit of honest investigation, the conclusions of careful reasoning on sufficient information, these are the science student’s riches. He may add to them or replace some of them by better, but he will not throw them away at a suggestion, or trade them to the first speculator who offers something else. He will not have a supply of new beliefs for every day, or for every month, or for every year. Second, we should hold fast the proved good which we have received from others. And we should honor and revere those who have opened the way for us to the truth—those who have above other men possessed the power of reason and beneficently used it for the world. The spirit of science, which sets infinite 98 value on knowledge, can not fail to teach reverence for those who have made it possible for us to know.

At every point, then, the scientist opposes the tendencies I have deplored. Against them all he must stand, by training and by instinct. Against them all he would teach others to stand, by giving to them his own training. Against them all we science teachers may arm our countrymen if we are faithful to our duty. But this end of our work is defeated if our students are allowed to indulge in careless statements of what they see and do; if they are permitted to use exaggerated description or inaccurate terms. Right here is the crucial test of the teacher’s honesty of purpose. The careful examination of written descriptions and reports, the enforced correction of every inaccurate detail, the personal consultation—all require untiring labor, and time never allotted in the schedule. But such work carried out has its own reward. The student first respects the truth, then learns to love it. He conscientiously avoids the vague, the doubtful, the unsubstantiated. If in our schools we might insure to every boy and girl this attitude of mind, this desire for strict veracity, we should have started him well on the way to correct judgments and wise conduct; we should have implanted in his nature the first elements of good citizenship. As Tennyson says:

> “Self-reverence, self-knowledge, self-control,
> These three alone lead life to sovereign power.
> Yet not for power (power of herself
> Would come uncalled for) but to live by law,
> Acting the law we live by without fear,
> And because right is right, to follow right
> Were wisdom in the scorn of consequence.”

The fish called Lepidosiren (*Lepidosiren paradoxica*) is one of the only three still existing survivors of the once prominent group of *Dipnoi*, or lung fishes, which are characterized by the possession of well-developed lungs in addition to their gills. Mr. Graham Kerr, who spent several months in the swamps of the Gran Chaco, South America, a habitat of these fishes, describes them as living among the dense vegetation of the swamp, swimming in eel fashion, or clambering through the mass of vegetation by means of their leglike limbs. In the dry season they retire into the mud, and breathe entirely by means of their lungs. When the wet season begins they are set free, and at once prepare to spawn. They lay their eggs in burrows at the bottom of the swamp, where the eggs develop into larvæ. The phenomena of their development are of special interest, because it takes place in seclusion, away from the disturbing features due to adaptation to varied surroundings. It has been discovered that the young lepidosirens become white and transparent during the hours of darkness.

Editor's Table.

THOUGHTS FOR THE TIMES.

Good use was made of a Washington celebration at Oberlin College, Ohio, by the chief speaker of the occasion, the Rev. A. A. Berle, to utter words that are peculiarly needed at the present time. His subject was Popular American Fallacies, and among these he noted the following: That Anglo-Saxondom is identical with the kingdom of God; that national glory and power can supply the place of national character; that new occasions always teach *new* duties; and that political alliances may do away with the necessity for "a dual alliance," as he expressed it, "between the people and God."

These particular fallacies, in our opinion, were happily chosen. There is a great deal of silly talk current about the incomparable glories and unimaginable destinies of the Anglo-Saxon race; and it never seems to occur to those who indulge in such talk that a profound sense of one's greatness is very far from being a sure sign of greatness. The greatest characters are the simplest and least boastful. Their greatness is so native to them that they are scarcely conscious of it; and they leave it to others to sing their praises. It is presuming altogether too intimate an acquaintance with the designs of Providence to claim that any race in particular is charged, above all others, with carrying those designs into effect. Who knows what reservoirs of moral and intellectual force may reside in nations and tribes whose world-action has been very obscure as yet? Dr. Arnold, of Rugby, thought that much of high value for civilization lay dormant in the negro race, and it is too soon to say he was mistaken. Then, who knows what the Slavonic race may bring forth? Who can calculate the future of the vast human hive known as China? And, after all, what has any nation got to do except to behave itself, be it great or small, famous or of no great repute? How is it in the community? Do we admire great men who swagger, who boast of their wealth, their strength, their courage, or their virtue? A little quiet consideration will persuade any man that there is one law for all nations alike—the law of justice and humanity—and that the greatest nation, according to any true conception of greatness, is the one which exemplifies that law most perfectly in its domestic and foreign policy. The surest sign of greatness in a nation, we venture to say, is that it should hate war—not dread it, but hate it.

It is a singular thing that any but the most light-headed portion of the community should fall into the second fallacy which the speaker mentioned—that national glory and power can take the place of national character. A nation requires a true heart, an honest self-consciousness, just as much as an individual, and time will avenge national misdoings just as surely as it will those of individuals. No numbers, nor any amount of huzzaing or factitious enthusiasm, can make a vicious policy safe. You may win victories with chariots and horsemen, but to enjoy the fruits of peace there must be a dominant love of justice, and that is what war does not tend to promote. It is also very true, as the speaker said, that there are not many *new* duties to be learned in this age of the world. There is enough of moral truth taught in old Hesiod's Works and Days to make any society now 100
existing a good deal better than it is. When people talk of new duties they generally mean some new harum-scarum enterprise. The old duty would be good enough if they would only consider it closely and follow it faithfully. The Rev. Mr. Berle has spoken words in season; and it would be well if all who are like minded would unceasingly proclaim the same doctrines, if perchance they may sink into the heart of the masses, and give to this great people a public policy founded on righteousness and the love of peace.

A HUMILIATING SITUATION.

"How far, O Catiline, when all is said and done, are you going to abuse our patience?" So said the great Roman orator on a certain famous occasion. Our Catiline is no individual man; it is the party system which has inflicted on us the Puerto Rican disgrace. It was obvious to the common sense of every one that, having laid our hands on the island of Puerto Rico, there was no decent course to take save to make it, for all practical purposes, an integral portion of the Union. We had cut it off from the market it enjoyed in Spain, and left it to contend with the hostile tariffs of other countries—were we going, in addition to that, to make it a stranger to the land that had seized it, and subject its products to our own high scale of duties? The President, in his message to Congress, conceiving the proposition to be almost self-evident, had declared that it was "our plain duty to abolish all customs tariffs between the United States and Puerto Rico, and give her products free access to our markets." So thought nearly every disinterested citizen, and yet what have we since seen? The President, terrorized by the cry of party unity in danger, repudiates his former emphatic declaration, and gives his approval to a measure which virtually makes our unfortunate possession a foreign country. With the "free access to our markets" which the President had promised, the island would have entered on a new career of prosperity; but with its leading industries weighed down under an impost of fifteen per cent, there is nothing in view but commercial stagnation and general poverty. That the island has already languished under American rule—our revolutionary forefathers did not expect that their descendants would so soon go into the "ruling" business—the most disinterested witnesses attest. A leading journal of this city, The Herald, prints in heavy-faced type the following statement of a correspondent:

"American military officials told me at the outset that the year and a half of American sovereignty had been a blight on the island. This was not the echo of Spanish or of Puerto Rican feelings. They spoke their own views with soldierly frankness and sometimes with a word of regret for their own position. Their talk was more pointed than when filtered through official channels."

It is in these circumstances that our Legislature, at the instance of a benevolent President, decides to refund to the people of the island two million dollars of duties collected in our ports on their products. Our tariff system breeds poverty in the population it oppresses, and then we rush to their assistance with a largess. They ask for justice and we offer them alms—alms for which the correspondent already quoted says he can not find a single

individual who is grateful. We rob the Puerto Rican Peter to pay our own tobacco-growing Paul; and then we rob
the whole community in order to pay back Peter. And, strange to say, some of us feel very virtuous over the 101
business. The countenance of the President glows with satisfaction over the thought of all the good he is doing. For our part, we view the matter in a different light. The money will, of course, meet certain expenses of government in Puerto Rico; but there is reason to fear that it will do as much to pauperize the island in one direction as the restriction of its trade will do in another. What the Puerto Ricans want is not alms, but commercial liberty. The repayment of this money will not stimulate their trade; it will not stimulate anything except their helplessness. It is an open question whether they will suffer more by our protectionist greed or by our wishy-washy sentimentality. Meantime what are we to think of the party system whose exigencies place us in so ridiculous a position before the world? How long shall it abuse our patience?

Fragments of Science.

Ventilation of Tunnels.—The question of the ventilation of tunnels forms the subject of a series of articles, by M. Raymond Godfernaux, published recently in *Le Génie Civil*. The principal sources of definite information, upon which the discussion of M. Godfernaux is based, are the reports of the committee on ventilation of tunnels of the Metropolitan Railway of London, and of the commission appointed by the Italian Minister of Public Works to investigate the tunnels of the railways of the department of the Adriatic. Although the vitiation of the air in a tunnel may proceed from three sources—i. e., the lighting, the respiration of the passengers, and the combustion of the fuel in the engines—yet the two former sources are insignificant compared with the latter, which alone need be considered. The principal products of combustion which are injurious are carbonic acid, carbonic oxide, and sulphurous acid. Of these it is found that the proportion of carbonic oxide should not exceed 0.01 per cent, which corresponds to 0.13 per cent of carbonic acid in excess of the normal proportion of 0.03 per cent and to 0.00027 per cent of sulphurous acid. In practice it is found that if the total proportion of carbonic acid be limited to 0.15 per cent the proportions of the other gases will be well within the comfort and danger limits. This is much lower than is often attained in crowded auditoriums, where the proportion of carbonic acid sometimes reaches 0.4 to 0.5 per cent, but in such cases there is no carbonic oxide produced, while in the case of tunnels traversed by steam locomotives we may assume that the carbonic oxide will be about 1 to 13 of the carbonic acid, and the sulphurous acid about 1 to 440. Assuming a given limit of deterioration of the air, it would be easy to devise a system of ventilation if it were possible to treat the tunnel as if it were a closed room or controllable space. In practice, however, the conditions are peculiar. The space to be ventilated is a long, narrow passage, usually open only at the ends, and traversed periodically often almost continuously, by trains in one or both directions, these trains emitting the objectionable gases and also disturbing the air currents best adapted to proper ventilation. How best to reconcile these conflicting conditions forms the problem under consideration. Where there are but few trains it has been proposed to close the ends of the tunnel by doors, and provide a fan exhaust or pressure system, but this method is obviously limited in its applications. The practical conditions which must be considered are those in which frequent trains in opposite directions pass through the tunnel, and these conditions M. Godfernaux has analyzed graphically in a very interesting manner. Assuming a double-track tunnel eight hundred metres (a metre contains 39.37 inches) in 102
length, with an exhausting ventilator placed in the middle and with trains of a given gas-producing capacity passing on each track every three minutes, he constructs a diagram showing how the composition of the atmosphere of the tunnel varies at successive points, and how, by an examination of the diagram thus made, it is possible to discover the maximum vitiation of the air, and consequently the extent to which the conditions are satisfied. By one or two such constructions any such problem may be solved to a degree quite within the limits of practical work, and the effect of various systems of ventilation compared. M. Godfernaux discusses various systems of ventilation, including those involving the use of shafts, fan blowers and exhausters, and air jets, and concludes with a description of the Saccardo system, in use in the Apennine tunnel of the Bologna-Pistoia line, and to the St. Gothard Tunnel. While all this investigation and discussion is of much value, it certainly seems as if the true remedy lies not so much in the removal of deleterious gases as in the absence of their production. The substitution of electric traction avoids altogether the fouling of the air of tunnels and subways, and electric locomotives are already used in the Baltimore Tunnel in the United States and elsewhere, and it seems as if this remedy is the true one to be applied in all cases.

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Liquid Air.—The following warning appears in The Engineering and Mining Journal of March 3d: "The advertisements which are now appearing in the papers all over the country of companies which are to furnish liquid air on a large scale must be accepted with a great deal of caution. The public mind has been very adroitly worked up for the reception of these by lectures, paragraphs in the press, and other well-understood methods. Undoubtedly liquid air possesses some valuable properties, and many striking experiments can be performed with it. It is not by any means certain yet that it can be prepared, transported, and used economically on a commercial scale, or that the difficulties in the way have been overcome. We do not say that they may not be overcome in the future; but to talk, as the advertisements do, of the certainty that liquid air will soon largely replace steam in furnishing motive power is going entirely too far. Such assertions have no present basis of fact to warrant any one in making them. The liquid-air people have a great deal to do yet before they can establish their claims or carry on business on a scale that will warrant the organization of ten-million-dollar companies. The question of validity of patents is also quite an open one. It is doubtful if there is any valid patent on this subject."

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Taka-Diastase.—The following is taken from an interesting article, by W. E. Stone and H. E. Wright, in The Journal of the American Chemical Society: "Taka-diastase is, so far as known, somewhat similar to malt-diastase in its chemical character, viz.: a highly nitrogenous substance, readily soluble in water, and dependent upon certain conditions of temperature for its maximum activity. Its action is also affected by alkalies and acids. It is produced as the result of the growth of a species of mold (*Eurotium oryzæ*, Ahlberg) upon rice, maize, wheat bran, etc. For its production, as at present practiced in this country, wheat bran is steamed and, after cooling, is sown with the spores of the fungus. After twenty-four hours in culture rooms, at a temperature of about 25° C., the fungous growth becomes visible. In forty or fifty hours the content in diastatic material has reached the maximum, and further growth of the fungus is checked by cooling. The material, now consisting of the bran felted together with fungus mycelium, is called 'taka-koji.' It may be mixed with grain or starchy materials in the same manner as malt is used, and, like malt, will speedily convert the starch into fermentable sugars. An aqueous extract of the mass may be used for a similar purpose. For the preparation of a pure product, which, however, is not necessary for ordinary industrial purposes, the aqueous extract is concentrated by evaporation, and on the addition of alcohol the diastatic substance may be precipitated as a yellowish powder, easily soluble in water, of stable keeping qualities, and possessed of an unusual power of converting starch into sugar. The medicinal preparation above mentioned is obtained in this way, and represents a fairly pure form of the diastatic principle. This bears the name of ‘taka-diastase.’” 103

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Professor Agassiz’s Investigations on Coral Islands.—Having steamed and observed for twenty-five hundred miles among the Paumotu Islands, Prof. Alexander Agassiz says, in a second letter from the Albatross Expedition, published in the American Journal of Science, that he has seen nothing tending to show that there has anywhere been a subsidence, but that the condition of the islands does not seem to him capable of explanation on any theory except that they have been formed in an area of elevation. All the islands examined are composed of a tertiary coralliferous limestone, which has been elevated to a greater or less extent above the level of the sea, and then planed down by atmospheric agencies and submarine erosion, and the appearance of this old rock is very different from that of the modern reef rock. In these islands the rims of the great atolls, after having been denuded to the level of the sea, are built up again from the material of their two faces, so that a kind of conglomerate, or breccia, or pudding stone, or beach rock is found on all the reef flats. On the lagoon side sand bars grow into small islands and gradually become covered with vegetation. Whenever the material supplied from both sides is very abundant the land ring becomes more or less solid; the islets become islands, separated by narrow or wider cuts, until they at length form the large islands, which seem at first to be a continuous land around the rim of the lagoon, while they are often really much dissected. In time water ceases to pass through the channels, and only the marks of them are left. Few if any of the lagoons appear to be shut off from the sea as Dana and other writers have supposed. They simply have not boat passages. Unlike other coral regions, the Paumotu reefs seem to bear only a scanty life.

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“Winking.”—No satisfactory determination has been made of the reason we wink. Some suppose that the descent and return of the lid over the eye serves to sweep or wash it off; others that covering of the eye gives it a rest from the labor of vision, if only for an inappreciable instant. This view borrows some force from the fact that the record of winking is considerably used by experimental physiologists to help measure the fatigue which the eye suffers. In another line of investigation Herr S. Garten has attempted to measure the length of time occupied by the different phases of a wink. He used a specially arranged photographic apparatus, and affixed a piece of white paper to the edge of the eyelid for a mark. He found that the lid descends quickly, and rests a little at the bottom of its movement, after which it rises, but more slowly than it fell. The mean duration of the downward movement was from seventy-five to ninety-one thousandths of a second; the rest with the eye shut lasted variously, the shortest durations being fifteen hundredths of a second with one subject and seventeen hundredths with another; and the third phase of the wink, the rising of the lid, took seventeen hundredths of a second more, making the entire duration of the wink about forty hundredths, or four tenths of a second. The interruption is not long enough to interfere with distinct vision. M.V. Henri says, in *L’Année Psychologique*, that different persons wink differently—some often, others rarely; some in groups of ten or so at a time, when they rest a while; and others regularly, once only at a time. The movement is modified by the degree of attention. Periods of close interest, when we wink hardly at all, may be followed by a speedy making up for lost time by rapid winking when the tension is relieved.

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An Ingenious Method of Locating an Obstruction.—The Engineering Record gives the following interesting account of the scientific solving of a practical commercial problem: “The pneumatic dispatch tube for the delivery of mail between the main Philadelphia post office and a branch office at Chestnut and Third Streets is a cast-iron pipe buried below the surface of the street, and in it small cylindrical carriers, six inches in diameter, are propelled from end to end by air pressure. At one time a carrier became lodged at some unknown 104
point in the tube, and to remove the obstruction it was desirable to locate its position as closely as possible before digging down to the pipe. This was satisfactorily accomplished by firing a pistol at one end of the tube; its report was echoed from the obstruction, and indicated its position by the time required for the transmission of the sound. The pistol was fired in a hole in the side of the pneumatic tube near the end, which was capped and had a rubber-hose connection to the recording apparatus. The end of the rubber hose terminated in a chamber closed by a diaphragm about five inches in diameter, which had a stylus attached to it. A cock in the middle of the rubber hose was partly closed to reduce the force of the explosion on the diaphragm, and the pistol was fired. The sound-wave immediately produced a movement of the diaphragm, causing the stylus to make a mark on the record diagram. The hose cock was then fully opened, and when the sound-wave had traveled to the obstruction and been reflected back it again moved the diaphragm, and caused the stylus to make a second mark on the diagram. The lapse of time had been automatically recorded on the same diagram, so to determine the distance it was only necessary to note the exact interval of time between the direct and reflected reports, divide it by two, and multiply the quotient by the velocity of sound under the existing conditions.” The obstruction was indicated at 1,537 feet from the diaphragm. Excavations were made at this place, and the carrier was found nearly at the calculated point. The limits of distance at which this method is applicable have not yet been determined, but Mr. Batcheller, the engineer of the Pneumatic Tube Company and the deviser of the above ingenious expedient, has found that in a tube 43.3 inches in diameter a pistol shot will vibrate a sensitive diaphragm at a distance of 65,129 feet; decreasing the diameter of the tube decreases the distance over which the pistol shot will act.

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Diseased Meat in Paris.—The police of Paris, says the Lancet, have just laid hands on a vast fraudulent organization for evading the precautionary measures drawn up by the authorities for inspecting the meat distributed for consumption in the suburbs of Paris. Both for Paris and the suburbs all animals destined for food have to be killed in public slaughterhouses, where the strictest watch is kept by the municipal veterinary surgeons, who forbid the delivery to the butchers of any meat which exhibits the slightest suspicious signs. Elaborate regulations have been laid down as to the various diseases which render meat unfit for the food of man, and naturally enough tuberculosis is the complaint most rigorously watched for. The swindlers who have been arrested made up a vast organization which used to buy up from the farms of the eastern provinces and even in Germany such animals as, owing to disease, would have been refused for slaughter at the abattoirs, and, moreover, they bought them dirt cheap. These animals were then conveyed in regular herds to a small place near Paris and killed in sheds built at the bottom of an old quarry. Under cover of night the meat was taken away by the accomplice butchers and resold in the various suburban shops. In connection with this clandestine slaughterhouse the firm had a kind of cemetery, where those animals were buried the meat of which was too bad for even the swindlers to risk its sale in the market. Ivry was the place where the fraud was discovered, and the official inquiry shows that the organization was singularly complete. It is extraordinary that the slaughterhouse, which was in full work, should never have attracted the attention of the villagers, but it must be remembered that all killing was done by night and that the slaughtermen were all Germans who did not understand a word of French, and were therefore unable to engage in imprudent conversation with the neighbors.

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How Aluminum is made.—In a paper read before the Manchester Junior Electrical Engineers, J. H. Henderson describes the two commercial methods of making aluminum: The agent which has made aluminum a commercial product is electricity. This is how electrolysis produces it (by one successful method): In a metal, carbon-lined crucible having two carbon electrodes, one of which acts as anode and the other as cathode, are 105
put the following ingredients: Fluoride of calcium, 234 parts by weight; double fluoride of cryolite, 421 parts by weight; fluoride of aluminum, 845 parts by weight. To these add three to four per cent of a suitable chloride—for example, calcium chloride. To this add alumina sufficient to form a very stiff mixture. Before electrolysis can begin the above are fused by means of heat, which should not exceed 1,210° F. The heat is obtained from a furnace heated by gas, coke, or charcoal, care being taken that no gases from the furnace enter the crucible. The bath fused, the electrodes are dipped into it, the current switched on, and the metal is deposited (in the best and largest of these crucibles) at the rate of one pound per five electrical horse-power hours. The current pressure required is six to eight volts, at a density of one and a half ampères per square inch. The metal from time to time is removed from the crucible by means of a siphon or a ladle, care being taken to remove as little of the haloid salts as possible. There is another method of extraction equally successful with this, but also more economical. In this other method a set of similar ingredients are placed in a crucible having one or more vertically movable carbon electrodes, which are used as one, or a collective anode, respectively. The crucible, though lined principally with carbon, has some metal exposed to act as a cathode at the beginning of the process, this to generate heat enough to fuse the bath, after which the anode is placed so that the extracted aluminum acts as a cathode. The molten metal is from time to time run out of a tap-hole into a mold, and thence cast into ingots, or granulated by being poured into cold water. The same particulars as to results apply to this crucible furnace process also, only that not nearly so much of the bath is wasted in it, and the metal needs less purifying when molten. There are, also, no loss of time and money from the use of gas, coke, or charcoal, and of an extra furnace in this method.

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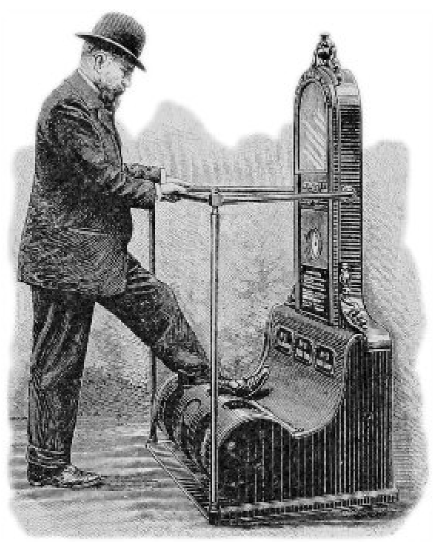

“A Mechanical Bootblack.”—A bootblacking apparatus is one of the latest developments of the nickel-in-the-slot machine, a specimen of which is undergoing trial in a French public garden. The customer drops his coin—in the present case a ten centime, or a two-and-a-half-cent piece—into the receptacle, which opens the way to a compartment where a brush cleans his boots; he next puts his feet into a second compartment and has them blackened; and then into a third, where they are polished. The operation takes about a minute and a half, and during the time the customer may watch the indications of its progress as they are shown upon the dial. The machinery working in the inside is very simple. An electric motor of small power—about eighteen kilogrammetres per second—controls the shaft on which the three rotary brushes are fixed, and the customer has only to unlock the machine, the same as all others of its kind, with his coin, and move the handle which opens the circuit and starts the motion. A representation of the machine at work is given in the accompanying illustration, for which we are indebted to *La Nature*.

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The “Barisal Guns.”—A curious phenomenon of unexplained sounds like those of explosions, occasionally heard in different places over the earth, has attracted much attention, has been made the subject of a book recording several hundred accounts of it, by M. Ernest Van den Broeck, of Brussels, and has already been mentioned in the Popular Science Monthly. The phenomenon has been most carefully observed in India, where it seems to have assumed a peculiarly marked form, and is known there as the “Barisal guns.” M. Van den 106 Broeck calls it “mistpoeffers,” or air-puffs. The most definite description of it is given in Nature by Mr. Henry S. Schurr, as he has heard it in India, where it has been observed over a wide range, but most clearly and frequently in the Baekergunge district, of which Barisal is the headquarters. The Barisal guns are heard most frequently from February to October, not during fine weather but just before, during, or immediately after heavy rain. They always sound in triplets—that is, three reports occur, one after another, at regular intervals—and though several guns may be heard, the number is always three or a multiple of three. Sometimes only one series of triplets of sounds is remarked in a day; at other times the author has counted as many as forty-five of them, one after another, without a pause. The report is exactly like the firing of big guns heard at a distance, except that it is always double, or has an echo. A number of conjectural solutions of the phenomenon have been put forth, but none of them accounts for it as a whole in any approaching a satisfactory manner.

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Photographing Live Fishes.—A number of methods are mentioned by Dr. R. W. Schufeldt, in a paper on the subject, by which fishes may be photographed in their natural element, with natural surroundings. This can be done, even under the surface of the water, by the use of certain subaquatic apparatus. By the employment of instantaneous photography some fishes have been taken in the air, as of salmon in the act of leaping, or of flying fish in flight. Such pictures, however, illustrate special habits rather than the ordinary life of the subjects. Well-arranged aquariums afford opportunities for photographing fishes in almost every condition and position, and a command of light and situation can be had in them which is of great advantage to the operator. The specimens of fish photographs published by the author with his paper are in every way satisfactory. The spots on the sunfish, for example, are almost as clear and distinct as if we had the fish lying before us in the broad light. The photograph of the pike has afforded opportunity to correct some inaccuracies in the drawing of it as given in previous works of high authority.

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Marine Life at Cold Spring Harbor, Long Island.—Mr. Francis N. Beach, in presenting to the Boston Society of Natural History a list of the Marine Mollusca of Cold Spring Harbor, Long Island, speaks of the locality as representing “a fairly distinct facies of molluscan life—the fauna of the oyster beds, broadly speaking. From this point of view, its homogeneity and the absence of stragglers lend it value. Probably almost every species enumerated lives on the spot where found or in the immediate vicinity. This characteristic makes the spot a good sample of actual conditions of life in that interesting transitional region where the ‘Virginian’ and ‘Acadian’ (or ‘Boreal’) faunas overlap. From this point of view it is, so far from being homogeneous, strikingly heterogeneous.” Of the two faunas, the southern one contributes a quota rather more than twice that of the more northern one, and the increase in the preponderance of southern forms can be detected in a range of forty miles. The author concludes from his examination that, notwithstanding the well-marked character of Cold Spring Harbor as “muddy,” its molluscan fauna is determined not at all by that character, but predominantly by the depth of water and by the factors included in the “inclosedness” of the place—that is, he supposes, by the temperature, the specific gravity, the percentage of organic matter, etc. “It looks as though the various species would manage somehow to be represented on almost any stretch of shore or bottom, provided only the *water conditions* be right.”

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Farm Homes for Neglected City Children.—The system of providing homes upon farms is represented in the last annual report of the New York Juvenile Asylum as being on the wane. While from 1880 to 1890 twenty-four per cent of the children committed to the asylum were placed in Western homes, the percentage from 1890 to 1897 was only fifteen. Among the reasons assigned for this diminution are the increase of undesirable material, chiefly of races against which prejudice is strong, and the growing habit of parents expecting their 107 children to be restored to them when their services become profitable. Placing out street waifs and neglected and dependent children in the homes of private families, the report says, has been sadly abused. The degradation and moral corruption of the condition of such children are apt to make them so refractory and unsusceptible to the wholesome influences of family life that an abrupt transfer is liable to be attended with failure and disaster. The children should therefore be previously brought under the restraining and reformatory influences of a training school. At the best, a placing-out work can not be exempt from serious contingencies. “The second decade, the adolescent age, under most favorable conditions, is the period when the will is apt to be wholly dominated by the emotions, and unless the environment is peculiarly favorable, guardianship becomes a difficult function. With an indenturing system that prolongs the term of apprenticeship for boys throughout their minority, both apprentice and guardian must possess an extraordinary measure of amiable qualities to insure a continuance of their relation through an extended period.” When the boy is old enough to earn wages from strangers the temptation to leave and go out for hire is very strong, and must be met by a corresponding degree of tact and liberality; and even when interests are happily adjusted “a placing-out system ought to take account of the tastes and aptitudes of young people, and leave the way open for the deserving at a suitable age to start upon a new career.”

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Animals Helping One Another.—While the ruminant animals as a rule do not seem to have made any further advance toward forming communal groups than to post sentinels while pasturing together, a few marked cases are found in which a division of labor and some system of assistance seem to have been given effect. One such instance is cited in the London Spectator as having been observed by Lord Lovat in the Highland deer, where large stags have smaller stags to attend them and serve them very much as the English school bully is attended and served by his fag. Lord Lovat tells another story of compassion manifested and help afforded by a stag to a younger animal. Of three stags on the move, two jumped the wire fence, and the third, a two-year-old, halted and would not venture the leap. The two waited for some time while the little fellow ran along the fence, till the larger of them came back to coax him, and “actually kissed him several times.” Finally, the animal gave up and went on, after which the little stag took courage and made the jump. The social organization is very far advanced with the beavers, and is quite elaborate with the rabbits, which excavate common and interlacing burrows, and with insects like ants and bees.

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Geological Formations and Forests in New Jersey.—From a study of the relation between forestry and geology in New Jersey, Arthur Hollick finds that two distinctly defined forest zones have long been recognized in the State—a deciduous and a coniferous—the contrast between the two being so obvious as to attract the attention even of superficial observers. While the deciduous zone is roughly confined to the northern part of the State and the coniferous to the southern part, yet when the line of demarcation is carefully followed up across the State and beyond its confines it is found not to coincide with any parallel of latitude or isothermal line, and not to be entirely dependent either on topography or the physiographic conditions. “If, however, a geological map of the region be examined, the line of demarcation between the two zones will be found to follow the trend of the geologic formations whose outcrops extend in a northeast direction across the State and southward beyond. A coincidence was suggested, and it became more apparent, as the investigations proceeded, that the two classes of angiosperms and gymnosperms were severally identified with certain geological formations, and also that the distribution of many species within each of the zones was capable of being similarly associated, and their limits of being more or less accurately defined. The deciduous zone is roughly located as lying north of a line between Woodbridge and Trenton, and the coniferous zone as being south of a line between Eatontown 108
and Salem. Between these two lines is an area about sixteen miles wide where these zones overlap, which the author calls the “tension zone,” because a constant state of strain or tension in the struggle for existence prevails in it. In the deciduous zone the geological formations are numerous, with various soils and every gradation of topography, and the diversity of trees is great. Its southern line is coterminous with the southern edge of the Triassic formation. The coniferous zone presents but little diversity in geology or topography, and little variety of trees. Its northern border is coterminous with the northern border of Tertiary gravels, sands, and sandy clays. The “tension zone” includes practically the whole of the Cretaceous plastic clays, and the clay-marls and marls.

MINOR PARAGRAPHS.

A conference was appointed, to be held at Wiesbaden, Germany, October 9th and 10th, to promote the formation of an International Federation of Science—a scheme which was referred to in Sir Michael Foster's presidential address before the British Association. This idea for the establishment of an international association of great learned societies appears, the London Athenæum says, to be the outcome of discussions carried on at Göttingen in 1898. For some time past the Academies of Vienna, Munich, Göttingen, and Leipsic have been federated into an association or "Castell," each meeting in turn at their respective headquarters to talk over scientific matters of joint interest. At two or three recent meetings questions were brought up, such as antarctic research and the cataloguing of scientific literature, which, besides being of sufficient interacademic value to come before the "Castell," were of prime importance to English men of science. English delegates were therefore invited to attend, and did so; and out of this invitation has grown a desire for a wider international basis for the association. The adherence of the principal learned societies of the world, including our National Academy, is said to have been secured to the movement.

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The thirteenth season of the Department of Botany at the Marine Biological Laboratory, Woods Holl, Mass., will open July 5th and continue till August 16th. Three laboratory courses are provided, accompanied by lectures, including the subjects of cryptogamic botany, plant physiology, and plant cytology and micro-technique. The principal instructors are Dr. Bradley R. Davis, Mr. George T. Moore, and Dr. Rodney H. True. The department extends a special welcome to investigators, and desires their co-operation in the development of the laboratory. Woods Holl offers great attractions in variety of material and facilities for biological research, and is proposed as an excellent center of resort where the botanists of the country may meet for a few weeks. A six weeks' course in Nature study, including both animals and plants, and consisting largely of field work, is a new feature offered this year for the first time.

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On Friday, March 9th, occurred the death of two of the six surviving founders of the American Association for the Advancement of Science—Dr. Charles E. West, of Brooklyn, and Professor Oliver Payson Hubbard, of Manhattan. Both were distinguished teachers. Dr. West was born in Washington, Mass., in 1809, and after being graduated from Union College, began his career as a teacher in the Albany Female Academy. He was afterward principal of the Rutgers Female Institute, the Buffalo Female Seminary, and the Brooklyn Heights Seminary, where he remained twenty-nine years. He also assisted in preparing the original courses of instruction of Vassar Female College. He was one of the founders of the Long Island Historical Society; was a fellow of the Royal Antiquarian Society of Denmark; and was a member of the American Ethnological, the American Philosophical, and the New York and the Long Island Historical Societies. Professor Hubbard was born at Pomfret, Conn., in 1809, was graduated from Yale College in 1828, and was appointed Professor of Chemistry, Pharmacy, and Mineralogy at Dartmouth College in 1836. He remained there, with an interval, from [109] 1866 till 1871, in which he devoted himself to lecturing, till 1883, when he became professor emeritus. He was made in 1871 overseer of the Thayer School of Engineering at Dartmouth, and he was a member of the New Hampshire Legislature in 1863 and 1864. Only four of the founders of the American Association are now living—namely, Dr. Martin H. Boye, of Cooperstown, Pa.; Prof. Walcott Gibbs, of Harvard; Dr. Samuel L. Abbot; and Epes Dixwell.

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The firm of Burroughs, Wellcome & Co., says the Lancet, are to be congratulated on the generous care which they have taken to promote the material and intellectual welfare of their employees. Their principal works are at Dartford, where they employ more than eight hundred persons of both sexes, including some two hundred scientific workers. For the purpose of establishing a sort of club for these employees, Mr. Wellcome succeeded in purchasing the Manor House known as Acacia Hall, and the extensive and beautiful grounds in which it is situated. The Manor House he has fitted up as a club for the members of his staff. An old mill which stands close by has been converted into what is called the library building. The upper floor is fitted out as a lecture-room, and there is a library which already contains some thousands of volumes. A third building, called the Tower House, contains club accommodations for men. Then there are elaborate bathrooms, and finally a large gymnasium. The grounds are most extensive, being half a mile in length and very tastefully laid out. There is a lake, a river, and many pleasure boats for rowing, a large field for sports of all sorts, a grand stand to witness the same, a rich orchard and a beautiful pleasure garden, several luxurious lawns, and many superb trees.

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A peculiar kind of glassy bodies, known as moldavite or bouteillenstein, is attracting the attention of Austrian and Bohemian geologists. These glasses are ovals from an inch to an inch and a half long, and are characterized by various markings, some of which suggest finger impressions, while others form a network of furrows, which may have in part a rough radial arrangement. They have been regarded by some authors as relics of prehistoric glass manufacture, but this view does not appear to have been sustained. Dr. F. E. Suess, the famous Austrian geologist, finds resemblances between them and meteorites, and the most general disposition of students of the subject is now to consider them of extra-terrestrial origin. Resemblances have further been pointed out between them and some peculiar obsidian bombs found in Australia. The moldavites in Bohemia occur in sandy deposits which are assigned to the late Tertiary or early Diluvial period.

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At the Massachusetts Institute of Technology, besides studies bearing directly on science and the arts, courses are given in modern languages, as an important means of access to foreign works in the student’s professional department: English, for the purpose of training pupils to express themselves readily, accurately, and adequately, and of aiding them in the understanding and appreciation of good literature; history and political and social science, the instruction in which is arranged to connect with that in biology, so that the two departments shall present “an unbroken sequence of related studies extending through three successive years, and resting upon the fundamental knowledge of living forms and of prehistoric man that is presented in general biology, zoölogy, and anthropology,” followed by comparative politics and international law; and economics.

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A witness recently admitted to the British Government’s Committee now making inquiry into the use of coloring matters and preservatives in food, that yellow coloring substances were largely purchased without any discrimination for the purpose of giving a rich appearance to milk and milk products. As a rule, no question was asked as to the injurious or non-injurious character of the dye so used. One of the best coloring matters was known as Martius’s yellow, naphthol yellow, naphthalene yellow, Manchester yellow, saffron yellow, or golden yellow, and is chemically the same as the dinitro-alpha-naphthol prepared from the naphthalene that crystallizes in gas mains, which is an important constituent in the making of lyddite. It is slightly explosive when heated, is injurious when it comes in contact with an abrasion of the skin, and has been shown by physiological experiments to be a highly improper substance to mix with food.

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A goose market is held regularly in October at Warsaw, Poland, to which about three million geese are brought, most of them to be exported to Germany. Often coming from remote provinces, many of these geese have to travel over long distances, upon roads which would wear out their feet if they were not “shod.” For this purpose they are driven first through tar poured upon the ground, and then through sand. After the operation has been repeated several times the feet of the geese become covered with a hard crust that effectively protects them.

NOTES.

The first summer session of Columbia University, 1900, will open July 2d, instruction beginning July 5th, and will continue till August 10th. The work will be under the general direction of Prof. Nicholas Murray Butler, and will be conducted by a large corps of instructors, in eleven courses, of thirty lectures or other exercises or their equivalent in laboratory or field work, each. The concluding examinations will be held August 9th and 10th. Credits will be given for courses pursued at the school in the requirements for a degree at the university, and for a Teachers’ College diploma, and in the examinations for teachers’ licenses in New York city.

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An International Congress of Medical Electrology and Radiology has been connected with the International Congress system of the Paris Exposition, 1900, and will be held July 27th to August 1st. The commission is composed of representative men from various universities, institutions, and hospitals of France, with Prof. E. Doumer, 57 Rue Nicolas Leblanc, Lille, as secretary.

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A curious fall of “black snow,” which was observed at Molding, Austria, at the beginning of the year, was found to consist largely of the insects known as “glacier fleas,” which were supposed to have come along with a violent snowstorm from some of the Alpine glaciers.

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How to write 1900 in Roman numerals is a question of the day that will have to be settled. Three ways are suggested by Mr. J. Fletcher Little in the London Times, either of which is correct according to the Roman system. They are MDCCCC, MDCD, and MCM. But when we reach the year 1988, if we use the first of these methods we shall have to write the formidable-looking formula MDCCCCLXXXVIII, whereas if we use the third and shortest method, it will only be MCMLXXXVIII—and that is long enough. The third method, therefore, which may be interpreted as meaning one thousand plus another thousand lacking a hundred, seems to be the simplest.

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Dr. St. George Mivart, Professor of Biology in University College, Kensington, died suddenly in London, April 1st, aged seventy-two years. He was author of numerous scientific works, of treatises critical of Darwinism and the theory of evolution, and of demonstrations of the harmony of Roman Catholic dogma with proved scientific facts. His name has been made prominent of late by his recantation of his previously expressed views of the consistency of dogma with science, and the correspondence with Cardinal Vaughan which grew out of it.

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An International Congress of Ethnographical societies has been arranged for by the Ethnographic Society of Paris, to be held in Paris, August 26th to September 1st.

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The Wollaston medal of the Royal Geological Society, London, for the most important geological discoveries, has this year been awarded to Mr. Grove K. Gilbert, of the United States Geological Survey. This is the third time the medal has been awarded to a citizen of this country.

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Among the recently announced publications of John Wiley and Sons we notice a third edition, revised and enlarged, of Allen Hazen’s Filtration of Public Water Supplies; a new and revised edition of Olof’s Text-book of Physiological Chemistry; The Cost of Living as Modified by Sanitary Science, by Ellen H. Richards; Examination of Water (Chemical and Biological), by William P. Mason; and the fifth edition of H. Van F. Furman’s Manual of Practical Assaying.

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In a method of sterilization of water by means of ozone, described by Dr. Weyl, of Berlin, at the German Scientific Conference, 1899, water is pumped to the top of a tower and allowed to flow freely over stones, meeting as it falls a current of air charged with ozone. The process appears to be likewise effectual in purifying peat and bog water, the solution of the iron salts of humic acid being decomposed and oxidized, and the brown color disappearing in consequence. The method, it is said, can be advantageously used in connection with filter beds.

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Our death list this month of men known in science is large. It includes the names of M. Philippe Salmon, archæologist, subdirector of l’École d’Anthropologie of Paris, President of the Ministry of Public Instruction’s Commission on Megalithic Monuments and author of numerous monographs on subjects of his studies, in Paris, aged seventy-six years; Dr. C. T. R. Luther, director of the Observatory at Bilk, near Dusseldorf, aged seventy-eight years. He discovered twenty-one of the minor planets and calculated the orbits of them all, as well as those of several other bodies; Dr. C. Piazzi Smith, formerly Astronomer Royal of Scotland, author of studies of the amount of heat given by the moon to the earth, and of some famous speculations upon the construction and purposes of the Great Pyramid as an exponent of the standard of measurement, February 21st, aged eighty-one years; M. Émile Blanchard, dean of the section of Anatomy and Physiology of the French Academy of Sciences; Captain Bernadières, member of the French Bureau des Longitudes and Director of the Observatory School of Montsouri for Officers of the Marine, who had fulfilled several astronomical and geodesic commissions; Dr. Hermann Schaeffer, honorary professor of Mathematics and Physics at Jena, aged seventy-six years; Leander J. McCormick, founder of the McCormick Observatory at the University of Virginia; President James H. Smart, of Purdue University, Lafayette, Ind.; General A. A. Tillo, Vice-President of the Russian Geographical Society, founder of an exact physical geography of Russia, based on scientific data, and of many contributions on the science, at St. Petersburg, January 11th, aged sixty years; Prof. E. Beltrami, of the University of Rome (Mathematical Physics), President of the Accademia dei Lincei, and correspondent of the Paris Academy of Sciences; M. Emmanuel Liais, Mayor of Cherbourg, France, also distinguished for useful and very meritorious work in Astronomy and Physics, aged seventy-four years; Dr. Hans Bruno, Professor of Mineralogy and Geology in the University of Dresden, Saxony, distinguished for his investigations of the Paleozoic, Cretaceous, and Permian rocks of Saxony, at Dresden, January 28th, aged eighty-five years; and William Thorpe, one of the Vice-Presidents of the Society of Chemical Industry.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Indiana (Purdue University). Twelfth Annual Report. Pp. 150.—Michigan. Monthly Bulletin of Vital Statistics, January, 1900. Pp. 18.—New Jersey: Bulletin No. 141. Forcing Tomatoes. By Alva T. Jordan. Pp. 18; No. 142. Pea-Growing in New Jersey. By Alva T. Jordan. Pp. 14.—New York: No. 162 (popular edition). Injury by Sun Scorching of Foliage. By F. H. Hale and F. C. Stewart. Pp. 6; No. 163 (popular edition). Canker, an Enemy of the Apple. By F. H. Hall and Wendell Paddock. Pp. 6; No. 164 (popular edition). Divers Diseases discussed. By F. H. Hall. Pp. 5; No. 165. Report of Analyses of Paris Green and other Insecticides. By L. L. Van Slyke. Pp. 10.—Ohio: No. 10. The Maintenance of Fertility. By C. E. Thorne. Pp. 91—United States Department of Agriculture Comparative Range Grass and Forage Plant Experiments at Highmore, South Dakota. By F. Lampson Scribner. Pp. 10.—List of Publications for Sale by the Superintendent of Documents, Union Building, Washington, to February 1, 1899. Pp. 33; Some Miscellaneous 112
Results of the Work of the Division of Entomology. Part IV. Pp. 109.—Report of the North Dakota Section of the Climate and Crop Service of the Weather Bureau for February, 1900. Pp. 8.

Aluminum Plate Press Company, New York. Calendar for 1900.

Baudouin, Marcel, Editor-in-chief. Bibliographica Medica. Monthly, January, 1900. Paris: Institute de Bibliographie. Pp. 64. 5 francs; 60 francs a year.

Borosher, C. A. World Relations. Man and the Cosmic Principle. Champaign, Ill. Pp. 155.

Burnham, Judge C. E. Cæsar Lombroso; and Shepherd, L. A Criticism of Lombroso. Kansas City, Mo. Pp. 20.

Butler, the Hon. Marion. Speech in the United States Senate on Postal Savings Banks. Pp. 13.

Chamberlin, T. C. An Attempt to Frame a Working Hypothesis of the Cause of Glacial Periods on an Atmospheric Basis. University of Chicago Press. Pp. 104.

Chambers, G. F. The Story of Eclipses Simply Told for General Readers. (Library of Useful Stories.) New York: D. Appleton and Company. Pp. 222. 40 cents.

Dean, Bashford. The Devonian Lamprey, Palæospondylus Gunni, Traquair, with Notes on the Systematic Arrangement of Fishlike Vertebrates. New York Academy of Sciences. Pp. 32, with plate.

Fernow, B. E. Beginnings of Professional Forestry in the Adirondacks. New York State College of Forestry, Cornell University. Pp. 56.

Field Columbian Museum, Chicago. Annual Report of the Director for 1898–’99. Pp. 90, with plates.

Folkmar, Daniel. The Duration of School Attendance in Chicago and Milwaukee. Pp. 50.

Folkmar, Daniel. Leçons d’Anthropologie Philosophique; ses Applications à la Morale Positive. (Lessons of Philosophical Anthropology; its Applications to Positive Morals.) Paris: Schleicher Frères. Pp. 336. 7½ francs.

Gibier, Paul. Quarterly Bulletin of the New York Pasteur Institute. March, 1900. Pp. 8.

Gray, Elisha. Nature’s Miracles. Familiar Talks on Science. Vol. I. Earth, Air, and Water. New York: Fords, Howard & Hulbert. Pp. 243. 60 cents.

Highsmith, George R. Contributions of the Medical Profession to General Literature and Collateral Sciences. Pp. 18.

Hinrichs, Gustavus D. The Present and Future Water Supply of St. Louis. Pp. 15.

Hollick, Arthur. Some Features of the Drift of Staten Island, N. Y. Pp. 12, with plate; The Relation between Forestry and Geology in New Jersey. Parts I and II. Pp. 221.

MacDougal, D. T. The Nature and Work of Plants. New York: The Macmillan Company. Pp. 218. 80 cents.

Manning, Warren H. Directions for Surveying and Arranging Home and School Grounds. Boston, Mass. Pp. 12.

Marriott, H. P. F. The Secret Societies of West Africa. London: Harrison & Sons. Pp. 4.

Martens, Adolf. Handbook of Testing Materials. Part I. Vol. II. Illustrations. New York: John Wiley & Sons. Pp. (plates and explanations) 240.

Mexico. Boletin del consejo Superior de Salubridad. (Bulletin of the Superior Sanitary Council.) Mexico, January, 1900. Pp. 32.

Roisel. Essai de Chronologie des Temps Prehistoriques. (Essay on the Chronology of Prehistoric Times.) Paris: Félix Alcan. Pp. 60. 1 franc.

Schufeldt, R. W. Notes on the Mountain Partridge in Captivity. Pp. 4, with plate.

Scientific Alliance of New York. Ninth Annual Directory. Pp. 60. 25 cents.

Siebel, J. E. Compend of Mechanical Refrigeration. Chicago: H. S. Rich & Co. Pp. 389. Price, $3.

South Kensington Museum (London). Catalogue of the Collection of Pottery and Porcelain illustrating Popular British History, Lent by Henry Willett, Esq. Pp. 123.

Trelease, William. Classification of Botanical Publications. Pp. 12.

Williams, Thomas A., Editor. The Asa Gray Bulletin. Devoted to Plant Life in Field, Forest, and Garden. Bimonthly. February, 1900. Pp. 26.

Transcribers' Notes

Punctuation, hyphenation, and spelling were made consistent when a predominant preference was found in this book; otherwise they were not changed.

Simple typographical errors were corrected; occasional unbalanced quotation marks retained.

Ambiguous hyphens at the ends of lines were retained.

Page 22: "the city to-day would drive from that source" may be a misprint for "derive".

Page 54: "each of the tactile organ" probably should be "organs".

Page 68: "beauxite" was spelled that way.

Page 107: Unmatched quotation mark in paragraph beginning "Geological Formations".

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