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THE QUESTION OF WHEAT.

By WORTHINGTON C. FORD,
CHIEF OF THE BUREAU OF STATISTICS, TREASURY DEPARTMENT, WASHINGTON, D. C.

II.—CONTINENTAL EUROPE: FRANCE.

IN passing from a market where no customs duties are imposed upon foreign breadstuffs to markets where such duties play an important part in controlling competition from abroad, a political rather than a commercial question is encountered. The form of protection which seeks to encourage the home production of food, and especially of grain, is of very early origin and of very wide application. It ranges from the almost brutal disregard of the wants of a neighboring nation implied by an embargo on exports of cereals to the light and insignificant registration duty, intended to assure a good quality of imported wheat. It runs from duties on imports so high as to permit of a commerce only in the face of actual famine, to the revenue duty that has no immediate purpose in hindering purchases abroad, but regards the necessities of the treasury. History offers a remarkable collection of experience in attempts to regulate the grain trade; but it offers a record of a far larger number of failures than of successes attending these attempts.

Throughout continental Europe wheat is generally subject to customs duties on importation, and the prevailing tendency in recent years has been toward higher duties. In five countries no duties are imposed; three are importers—Denmark, Belgium, and Holland—and two are exporters—Russia and Roumania. Of countries taxing wheat only one is an exporter, Austria-Hungary, where the duty is about seventy-five cents a metric quintal. Germany collects under her general tariff about one dollar and twenty cents the quintal, and under her conventional tariff 84.3 cents the quintal. Norway and Sweden, although both are dependent upon foreign supplies of wheat, pursue different policies. Norway levies a merely nominal duty of sixteen cents a quintal, but Sweden, importing a much larger quantity, collects one dollar a quintal. Switzerland, being in the same condition of dependence on imports, has a duty of only six cents a quintal, a purely revenue duty. Spain, a large importer, has framed a tariff on agricultural imports, particularly burdensome on wheat, the duty, both general and conventional, being two dollars per quintal. In the last year this high duty has brought increased revenue to the Spanish treasury, because the home supplies were deficient, and heavy importations necessitated. Italy, also a large importer, and a state whose treasury is in difficulties, imposes nearly as high a duty on wheat as Spain—one dollar and forty-five cents a quintal.

There are five countries in Europe producing an excess of wheat beyond their own needs: Russia, Hungary, Roumania, Bulgaria, and Servia. All these countries combined, it has been estimated, have in an ordinary year a surplus product of 26,500,000 hectolitres (75,000,000 bushels) available for export, or only what would make good the needs of Belgium, Switzerland, Holland, and the Scandinavian countries, leaving unsatisfied the far larger wants of the great consumers of wheat—the United Kingdom, France, Germany, Austria, and Italy—whose combined demand is placed at 152,000,000 hectolitres (430,700,000 bushels) beyond their own production. Even in the best of years Europe, then, is not self-sufficient in wheat.

Merely to compare supply and demand will not give a proper idea of the importance of the wheat question to Europe. From the measures of two of the leading commercial nations—France and Germany—the political aspect is made clear. To be supplied as far as is possible from their own production is the aim of their statesmen, and the problem of accomplishing this end has been enormously complicated by the rise of wheat-growing countries over the sea. Instead of accepting the situation as England did, and welcoming supplies of the highest grades of food produced at a very low cost, France and Germany have sought to neutralize this outside competition by customs duties more or less protective in their effect. As these duties were intended to quiet political restlessness at home, the non-economic aspects are important. Indeed, agrarianism in these two countries suggests silver and prohibitive duties rather than a movement to improve the condition of the farming population.

The economic position of France is peculiar. It is the land of the small proprietor, and in no neighboring country has the division of land (*petit morcellement*) been carried so far. It claims to be agriculturally independent. Its population has ceased to grow in due proportion to its own need or to the surrounding peoples, and this indication of some social distemper is disquieting the economists and statesmen of the nation. The people are industrious, frugal, and on the whole prosperous. Yet France depends, and must depend, upon foreign supplies of coal, iron, lead, petroleum, or copper. More than fifty-six per cent of its exports are of manufactured articles, and only fifteen per cent of its imports answer that description. The imports of raw materials constitute 56.5 per cent of the total imports, and on them is based the great industries of France.

While industrially dependent upon foreign supplies, France is in a better condition as to food. About one third of the value of all imports is represented by articles thus described. Of the $230,000,000 represented, almost one half is composed of coffee, wines, sugars, and tropical fruits, and only one eighth of grain, meats, and dairy products which could compete with the domestic product. While the proportion varies slightly from year to year, it is remarkable how uniform the demand for foreign wheat has been. Since 1875 in only three years have great differences from the average movement been shown. In 1879 and 1880 the effects of six bad seasons were reflected in the largest imports ever made—22,000,000 and 20,000,000 metric quintals respectively—and in 1891 with its 19,000,000 quintals. Throughout this period the extent of territory under wheat was almost unchanged, the year 1891 alone giving a notable decrease, which was made good in the following year, but the product naturally varied with the good and bad seasons. This uniformity of area has arisen from two causes: the conservatism of the French peasant, and the liberal encouragement from government. Not only has this combination maintained domestic production so far as that can be measured by mere extent of land devoted to wheat, but it has also restrained foreign competition in the French markets.

The table on the following page shows the area, product, and imports of wheat from 1875 to 1896. In 1897 the area sown was 6,294,490 hectares, and the crop gathered was only 88,120,840 hectolitres.

If the entire period be equally divided into two periods of eleven years each, it is seen that the average area in the first eleven years was 6,920,690 hectares, and in the second 6,879,790 hectares, a reduction of only 0.6 or six tenths per cent, evidently due to the exceptional year 1891. The production in the first period was 101,556,000 hectolitres on an average, and in the second 108,262,000 hectolitres, an increase of more than six per cent. The higher average was brought about by the remarkable returns of 1894, 1895, and 1896.

The fair promise thus held out was not maintained, as the country suffered heavily from the bad season of 1897.

Year.	Area. Hectares.	Production. Hectolitres.	Total imports. Metric quintals.	Imports from the United States Metric quintals.	Import price per quintal. fr. c.
1875.........	6,946,981	100,634,000	3,493,711	6,029	25.
1876.........	6,859,458	95,439,000	5,281,459	121,612	27.
1877.........	6,976,785	100,145,000	3,397,462	202,636	30.5
1878.........	6,843,085	95,270,000	13,873,473	5,631,097	30.
1879.........	6,941,675	79,355,000	22,170,966	13,205,436	30.
1880.........	6,879,875	99,471,000	19,999,437	12,439,501	30.5
1881.........	6,959,114	96,810,000	12,852,054	6,330,307	30.
1882.........	6,907,792	122,153,000	12,946,981	5,396,475	28.75
1883.........	6,803,821	103,753,000	10,117,673	3,627,304	24.92
1884.........	7,052,221	114,230,000	10,549,219	2,969,077	22.24
1885.........	6,956,765	109,861,000	6,457,821	1,490,211	19.15
1886.........	6,956,167	107,287,000	7,097,486	2,508,769	21.61
1887.........	6,967,466	112,456,000	8,967,143	4,149,152	26.5
1888.........	6,978,134	98,740,000	11,357,123	1,759,034	22.4
1889.........	7,038,968	108,320,000	11,417,592	2,061,740	22.3
1890.........	7,061,739	116,916,000	10,551,014	1,810,087	20.9
1891.........	5,754,844	77,658,000	19,601,834	8,155,505	23.35
1892.........	6,986,628	109,538,000	18,842,470	10,062,892	22.
1893.........	7,073,050	97,792,000	10,031,629	2,876,386	15.50
1894.........	6,991,449	122,469,000	12,496,188	3,233,230	14.
1895.........	7,001,669	119,968,000	4,507,304	282,734	13.5
1896.........	6,867,572	119,742,000	1,584,751	779	16.4

The agriculture of France presents an interesting study because of a steady and continuous effort on the part of the Government to make it sufficiently profitable to assure adequate home supply. As the only means of giving profit to one industry is through a restriction on foreign competition, it is the Government that has intervened to ward off this competition; and as the cost of foreign wheat has tended steadily downward, the interference of the Government has become more frequent and extreme. In this policy it has been supported and encouraged by two very large elements of the agricultural interest—the grain and the wine growers. At first glance the interests of these elements might seem to be opposed to one another, as the one exports and the other is facing an importation. The vineyards of France long possessed a position which fashion and prejudice almost made a monopoly. French wines constituted one of the leading items in the export trade. In 1873 more than 398,000,000 litres of wine were sent to foreign countries, representing a value of 281,300,000 francs. This was the highest return ever made, before or since that year. The visitation of the phylloxera, which impaired the wine industry of entire provinces, and the introduction of Spanish and Italian wines under commercial arrangements believed to be more favorable to the foreign than to the domestic producer, brought the wine growers to the aid of the farmer in demanding higher protection against the encroachments of foreign grain, meat, and wine products. For nine years the joint efforts were made to effect this, resulting in the denouncement of commercial treaties and the framing of a tariff in 1892. "Accordingly, the Government constructed two tariffs, a maximum tariff for the countries with whom France should have no convention, and a minimum tariff, about twenty per cent lower, for the countries with whom France should conclude one. Duties upon agricultural produce were never to be subject of a convention or to be admitted into the conventional tariff. And it was laid down as a principle that the conventions of the future should be conventions for a short period, and that they should be terminable at a year's notice. By this device the Government hoped to secure more industrial control, more stability, more elasticity. It would go, for instance, to the Government of Switzerland and say, 'Reduce your duties and take our minimum tariff.' There would be no complicated haggling; the brilliant diplomat could not sacrifice the commercial interests of the country to a political *coup*. Switzerland would have to choose between either the minimum or the maximum rate, and both rates were fixed by the Chambers." * In practice this scheme has not been found practicable, as under the constitution the President could conclude a commercial treaty on his own authority.

This policy of expressly excluding agricultural products from any concessions in duty by treaty was significant of the feeling of the agricultural population of France, and a fair measure of its immense political influence. Before 1884 the "agrarians" had hardly sufficient strength to make themselves felt locally. The question of wheat growing in France had even then become important, for prices began to fall in 1882. The peasant had noticed that wheat had shrunk in value from twenty-two francs a hectolitre in 1881 to eighteen francs in 1883, and 17.7 francs in 1884. But it was as yet an economic problem, and not connected with political factors.

A government commission was constituted, and from one of the reports presented in 1884 may be taken some bits of prophecy as gratuitous as that already quoted from the English presentation. M. Rissler, director of the National Agricultural Institute, expressed an opinion that the wheat trade of America had arrived at the extreme limit of its development, because the fertility of virgin soils is becoming exhausted, and more expensive farming is necessary; and because wheat is now grown in more remote districts, and could not continue to be carried at unremunerative freights. India, like America, was unable to produce wheat profitably at current prices. In Australasia he thought labor was too high priced to permit it to be turned to wheat cultivation at the prevailing price. Although

* Fisher. The Protectionist Reaction in France. Economic Journal, September, 1896.

the home price of wheat had fallen below the minimum rate returning a profit to the farmer twenty francs the hectolitre, he did not look for a continuance of that rate.

After fifteen years it is simple to test such predictions, but it is only necessary to say that in only one year since 1884 has the price of wheat in France touched twenty francs the hectolitre—in 1891—and for the other fourteen years has ruled much under that rate. Nor did the Government accept the conclusions of its commission, for it imposed a higher duty on imported wheat, raising the rate from sixty centimes the quintal, at which rate it was prior to 1884, to three francs a quintal, and in 1887 to five francs a quintal. These moves were based upon the growing restlessness of the peasant proprietor, on whom fell the brunt of competition in wheat growing from Russia and the United States. He had seen the price falling, and had been subject to bad seasons as well as a loss of market from importations. He had run into debt through the failure of his crop, and he had incurred losses by entering speculative "companies" of one kind or another, that promised high returns and then failed disastrously. He found it difficult to accommodate himself to wheat selling from nineteen to seventeen francs a hectolitre, but was successful in the attempt, as was proved by his refusal to obtain a further increase of duty on wheat in 1892, when a revision of the tariff occurred. Secure in his own holding, and protected from any concession by way of reciprocity to his neighbors and rivals, he was yet slowly fomenting an agitation that was to plead now for higher duties on all agricultural products and now for a rehabilitation of silver. The year of famine (1891) led to a temporary reduction in the duty from five francs to three, but the exceptional conditions leading to this concession to the consumer of wheat soon passed.

A glance at the table of production and imports given above does not betray any influence of these successive changes in the rates of duty on imported wheat. The price of wheat was controlled not by conditions in France, but by conditions acting throughout the commercial world. It was even asserted that the cost of producing a hectolitre of wheat in France had risen in recent years, and now stood at the high figure of twenty-six francs. The market price obtainable was only 17.87 francs in 1892, 16.55 francs in 1893, and 15.21 francs in 1894, and abundant crops at home and abroad threatened even lower prices. With such pressure of competition the agrarian party acquired strength and influence, and in February, 1894, obtained an increase in the duty on foreign wheat to seven francs the quintal. In less than fifteen years the duty had thus been raised from a nominal rate of sixty centimes to seven francs the quintal.

M. Charles Lesage proves that when wheat paid an import duty of three francs, the Frenchman paid three francs seventy centimes more on his wheat than did his neighbor of England; and when the duty was raised to five francs, the price of wheat in France was again six francs ten centimes higher than in England. "Thus the three-franc duty cost the country 300,000,000, and the five-franc duty 500,000,000, while it brought in 60,000,000 only to the treasury." * In a country where the cost of government is advancing by leaps and bounds, and the population is stationary or nearly so, the question of additional burdens of indirect taxation is a serious one for the legislator. But this form of taxation is one of the simplest and readiest means of offering encouragement to agriculture through a restriction of foreign competition, and the remarkable stability of wheat area in France is at once proof of the conservative qualities of the peasant and the general distribution of wheat cultivation throughout the country. Of the eighty-seven departments into which France is divided only four produced more than 2,500,000 hectolitres of wheat. Reporting in 1896, the official representative of the agricultural districts complacently remarked that the home crop was about equal to the home consumption—a complacency rudely disturbed in 1897, when large importations became necessary.

France is an excellent example of a combination of circumstances favoring the culture of wheat in the face of unfavorable conditions. Wheat is a necessity, and is grown everywhere as a usual and almost necessary crop, apart from its commercial aspect. The farmer puts down each year a certain amount of land under wheat for his own consumption, and would continue to do so even if it happened (a most unlikely supposition) that wheat should sell for one third its present price. With this personal and necessary crop the farmer obtains food, a stock for seed, and usually a small surplus for sale, even from the smallest of wheat farms. It has occurred many times that a slightly higher price for wheat has called out unexpectedly large quantities from the hands of the small farmers of France, quantities that have been saved through indifference to sales or through supposed necessities, now set aside by the chance of reaping a profit. And what has happened before will happen again among so thrifty a nation of land cultivators as are the French.

In addition to this necessity for growing wheat the division of land must be counted as a favoring factor. Recent returns on this head show that in France the total area under cultivation is 49,561,861 hectares, divided into 5,672,000 plots or farms. Even on a general average this area and division will afford a small farm to each holder, one suited to intensive operations only. But nearly

* Economic Journal, September, 1896.

thirty-eight per cent of the number of farms are of less than one hectare, and this thirty-eight per cent includes only 2.2 per cent of the entire area, mere dots of land, more suited for residences than farming. The holdings from one to ten hectares included 46.5 per cent of the number and 22.9 per cent of the area; those from ten to forty hectares, 12.8 per cent of the number and 29.9 per cent of the surface; and the larger farms, of more than forty hectares, only 2.5 per cent in number and forty-five per cent of the area. So that 84.7 per cent of the number of farms covers just one fourth of the total area under cultivation. When this feature of land holding is combined with very careful and intelligent agricultural methods, another proof of strength is developed. Stress is laid by observers on the continued increase of the yield per acre of wheat, due to the application of better methods and science, and, as is believed, to the use of better fertilizers, which had rendered the soil less sensitive to atmospheric variations. To this march of scientific agriculture there is no end, and with the more general use of discoveries it is possible to conceive that France in wheat will be able to hold her own.

In the production of wheat the position of France is peculiar. Other countries of Europe, like Holland and Belgium, obtain a larger yield per acre, and even Germany gives a higher yield; but no country produces so many bushels in proportion to its population, or approaches the record of France—more than seven bushels per capita. The second in rank is Italy, with only five bushels, and the neighbors of France on the north, Belgium and the Netherlands, grow only 3.5 and 1.3 bushels respectively. France is therefore more independent of foreign supplies of wheat than her continental rivals in trade and industry, Russia and Hungary excepted. It has been a conviction with French statesmen that, possessing no command over the sea, it would be suicidal to permit France to become dependent for food upon foreign and possibly rival powers. This conviction has influenced the commercial policy of France, for the Government has ever given a ready ear to the demands of the agriculturist, and has now adopted protection to the farmer as a settled policy. Where duties on imports have not been granted, bounties on production are given, and only in the great raw materials of industry, like wool, have the proposals of duties, revenue or protective, been set aside. It remains to be seen whether the colonial policy of France will modify this tendency of legislation. In Algeria she holds a country capable of great development in wheat, but Algeria is not tempting to the French farmer, who prefers his smaller holding at home. The more distant colonies as yet play no part in supplying France with this important grain, but are rather dependent upon the mother country for everything—a penalty involved in the exploiting of a country for purely commercial advantage. As yet in no year has so large a quantity as 1,250,000 metric quintals been obtained from Algeria, and the import shows little tendency to increase. It may be noted that even England obtains little assistance from her colonies in the supply of this one article. In 1896 only one twelfth of the wheat imported came from her possessions, and, eliminating India and Canada, she could obtain hardly enough to meet her wants for a single day. Nowhere is colonial empire closely connected with the question of wheat raising and supply.

There is no more instructive lesson in history than a government struggling with the economic inevitable. That this experience is more fraught with failure than with success is not surprising, for the social problems come slowly forward and are well under way to accomplishment before the symptoms are noticed or a diagnosis attempted. The discovery is made by those who have no proper appreciation of the true remedy. It is some interest that feels the pinch, the increasing pressure of the change that always accompanies a social movement. The wish and effort are directed to maintain the conditions as they were, conditions to which the operations of industry or commerce were accommodated by long usage. This interested effort, ever conservative, opposes the progress of development on new lines, and too often makes a blind use of whatever instrument of defense is at hand. The protection of Government is invoked to stave off the inevitable, and a greater and greater exercise of that protection is invoked as the weight of the necessary change becomes greater. Industries have been wiped out, commerce destroyed, governments overturned, and peoples impoverished by this unreasonable contest with what is inevitable. Natural conditions, the product of land tenures, habits, and national character, have thus far been sufficient to preserve the French farmer from that intense crisis through which the English landlord has passed; but the end is not yet. France to-day holds an almost unique position in wheat among the nations of Europe, and it is only misapplied political agencies from within or more intense competition from without that can shake her in this eminence.

William Pengelly, the Devonshire (England) geologist, who is perhaps best known by his exploration of Kent's Hole, Torquay, while seated one day on a settle at a wayside inn, answered some questions asked him by three day laborers, and got them so much interested in a conversation on stone-breaking that the landlord took notice of the matter. The next morning he addressed the geologist: "I hope no offense, sir: but ef you'd stop 'ere for a foo days or a week, and talk to the men in the evenin's, you shud be welcome to meat, drink, washing, and lodging free gratis. I'm sure lots o' men wud come and hear 'ee, and I should zell an uncommon sight o' beer."

THE WEST INDIAN BRIDGE BETWEEN NORTH AND SOUTH AMERICA.

By Dr. J. W. SPENCER.

Mutability of Oceans and Continents.—A glance at a map of the American continent, inclosing the West Indian seas within its mass, suggests that these basins are sunken plains, submerged to only a moderate extent, but the soundings show depths reaching to more than three miles. "It is not too much to say that every spot which is now dry land has been sea at some former period, and every part of space now covered by the deepest oceans has been land." * This enunciation still held place among the latest writings of the great geological teacher—Sir Charles Lyell. As the earlier geologists had not the means of measuring the amount of terrestrial movements, the doctrine of mutability of continents and seas, as taught by Lyell, was doubted by many who later substituted the hypothesis of their permanency from the most remote times, although subjected to ceaseless changes of form. The hypothesis of permanency of continents and seas was largely based upon the littoral character of sedimentary formations, although the evidence of the abysmal or oceanic origin of the widespread chalk deposits could not be easily disposed of. Again, the development and distribution of animal and plant life have been skillfully used as evidence against certain great changes in insular and continental connections, beyond limited proportions. The amount of the concession has varied greatly among the different advocates, so that even under the general hypothesis of permanency, the configuration of the West Indian region has undergone great changes, yet not sufficient to bridge over the seas between the two Americas.

The biological evidence alone, in favor of the permanency of continents and oceans, sometimes suggesting the most startling evidence to the contrary, is insufficient to base theories upon, unless supported by physical indorsement. Indeed, some of the most interesting questions concerning the distribution of biological forms in the West Indian seas can only be explained by the recent discoveries of the physical changes of the region. Some of the smaller oscillations of land and sea have often been measured, but the determination of many of those of stupendous proportions, while occasionally hinted at, was not accomplished until the standard value of the great yardstick was found in the West Indian seas. The discovery of the Antillean bridge between North and South America, which is the

* The last edition of Lyell's Principles of Geology.

theme of this communication, is also important in establishing methods for determining similar great changes of land and ocean in other regions in late geological times.

Growth of the Science of Geomorphy.—The methods of inquiry belong to geomorphy, or the study of land forms. Geomorphy is the outgrowth of topography, which was made a science fifty or sixty years ago by Prof. J. P. Lesley and his coworkers. Its birth is graphically described by the author himself: * "That the European Jura . . . had to wait for its elucidation until the American Appalachians had been mapped may seem strange, but it admits of easy explanation. In Pennsylvania, paleontology and detailed local stratigraphy were impossible; we were untrained in both. . . . The country was no ground for mineralogy; no rare and curious minerals exist in it; it is a waste of sand, mud, iron, and limestone strata of various textures and color in endless repetition; to know one was to know all; to know it here was to know it everywhere. Nothing remained to study but dynamic forms; and these so numerous, so grand, so variously grouped that they excited our perpetual enthusiasm, and led to infinite research; they supplied the place of fossil forms, of forms of crystals, and of variations of mineral elements; they were a world of the exhibition of the natural forces by itself, and as such we took possession of it and settled in it as our fathers did in the valleys themselves, and thus became not mineralogists, not miners, not learned in fossils, not geologists in the full sense of the term, but topographers; and topography became a science, and was returned to Europe and presented to geology there as an American invention. The passion with which we all studied it is inconceivable, the details into which it led us were infinite. . . . They trained us to that fertility of fancy which precedes the ripening of the constructive or geometric faculty, made to act upon the more difficult problems of geology; while its generalizations were so vast . . . that customary European local research . . . seemed tedious. . . . The moment, therefore, that one of us beheld the ranges of the Jura, with their combs and offsets, their vast escarpments, and far-glittering white gaps, he was at home among friends, where geologists, born among them, felt that they were strangers. For the valleys of the Jura were filled with later formations full of fossils, which the Appalachian valleys never are. There much is hidden, here all is told. Fossils themselves in the Jura distracted study from the topography."

Geomorphy, like its antecedent, the science of topography, is

* Manual of Coal and its Topography. By J. P. Lesley. 12mo, pp. 1–224. Published by J. P. Lippincott, Philadelphia, 1856.

an American innovation, and for the same reasons. We have here better opportunities for studying both the newer and older topographic forms, developed over broader geographical domains, and surmounting geological formations commonly of wider extent, so that the evolution of geomorphic features from the simple to the complex form is more easily understood. The explorations of the submerged topography are also along more favorable lines than in the older world. The many repetitions of the middle geological formations in western Europe, and the favorable opportunities they afford for studying certain fossils and minerals, have also distracted from the development of geomorphy there, while in America the investigations of the physical features are now occupying the most prominent place among geologists.

Former Changes of Level in the West Indies.—The Lesser Antilles, or Windward Islands, have often been regarded as a chain of sunken mountains, and the Greater Antilles as having been connected with the mainland. But the dissimilarity of their features, compared with those of our northern continent, and the almost general absence of the higher types of animal life in the islands, caused many to question such connections in late geological times. However, more analytical methods have brought about different conclusions.

The doctrine of the permanency of the ocean basins in the West Indian region received its *coup de grâce* by the discovery of radiolarian earths upon the highest land of Barbadoes, which was elucidated in the classic treatise of Messrs. A. J. Jukes-Browne and J. B. Harrison.* Radiolaria are minute organisms with beautiful silicious shells, which are now forming geological accumulations at only great oceanic depths. Similar deposits also occur in Trinidad, Cuba, Hayti, Jamaica, and probably other islands. They furnish testimony of the upheaval of the floor of the ocean from depths of two miles or more. The age of the radiolarian earths in the West Indies appears to have been about the early Miocene period, which was considerably prior to the building and completion of the West Indian continent. These deposits are most interesting, as they show, upon biological evidence, the uplifting of the bed of the ocean, and later on we shall show that an equally great terrestrial movement occurred in the opposite direction, upon the sinking of the Antillean continent in Pleistocene times.

Modern Changes of Level Measured.—Such great earth movements are slow pulsations extending over large continental

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* The Geology of Barbadoes. Quarterly Journal of the Geological Society of London, vol. xlviii, pp. 170–226.

areas, but they do not belong to the phenomena of thrusts which give rise to mountain structures, nor are they the effects of volcanic forces. The land rises or sinks so gently that usually these movements do not disturb the courses of the drainage of the rivers, although barriers sometimes do appear across valleys. The modern changes of level illustrate these gentle oscillations. Islands and farms, which were located upon the low coast of New Jersey in the early settlement of the country, are now reduced in size, and are partly converted into salt marshes. The rate of sinking in this locality has been estimated by Mr. Mitchell * at only two feet in a century. The depression of land about the mouth of the Mississippi has lately been measured by Mr. E. L. Corthell, who finds that the sinking there is at the rate of five feet in a century.† For these low lands this subsidence promises to become a serious economic question in the not distant future. On the other hand, certain northern regions are rising. Thus, in the district of Niagara Falls, the rise is a foot and a quarter in a century, or perhaps a little more. In the St. Lawrence Valley, upon the northwestern flanks of the Adirondack Mountains, the upward movement, for the last fifteen hundred years at least, has been from four to five feet per century. Such gentle changes, accelerated or retarded, and continuing sufficiently long, are capable of transposing the ocean floors and mountain heights.

Recent Elevation of the Eastern Coast of America.—Numerous soundings, chiefly for the use of navigators, but occasionally taken for scientific purposes, have been made off the American coast and in the West Indian seas. In order to insure mariners against the occurrence of sunken rocks, the surveys have often been carried from the coast all the way to oceanic depths. Upon the submarine coastal plains the extensions of some of the great rivers have long been known. From data thus collected, Lindenkohl traced the Hudson River across the submerged banks off the New York and New Jersey coasts to a depth of nearly three thousand feet.‡ Later, the writer # gathered evidence from the drowned St. Lawrence, Delaware, Susquehanna, and other rivers as far as the Mississippi, and it became apparent that the whole of the eastern coast of America in recent times stood three thousand feet higher than now, with suggestions of a still greater elevation which he then hesitated to follow up on account of their startling character. The existence of the

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* Of the United States Coast Survey.

† Geographical Development of the Lower Mississippi. Read before the Toronto meeting of the British Association.

‡ Appendix XIII, Report of the United States Coast Survey for 1887 (1889), pp. 270–273.

\# High Continental Elevation preceding the Pleistocene Period. Bulletin of the Geological Society of America, vol. i, 1889, p. 65.

deeper submarine valleys was thus still left unexplained, as if they were either unimportant phenomena or as if they had been formed by causes not in operation at the present time.

CHARACTER OF LAND VALLEYS.—Ordinarily speaking, valleys are produced by the chemical and physical action of the rains, rills, and rivers denuding the surfaces of the land, while the character of the rocks gives rise to modified features. Streams flowing through old valleys are usually insignificant, if compared with the size of the valleys. When a stream commences its work, it gradually deepens its channel until it is reduced to the base level of erosion—that is to say, when the slope of the floor of the valley rises so gently from the sea level, or from some other barrier, that it does not permit any further deepening of the river channel. In the first stage, the stream only excavates the narrow gorge or cañon. Upon the base level being reached, the rains and rills widen the valley, while the work of the river itself is chiefly that of carrying away the mud washed off the neighboring lands by the rains, or of undermining an occasional bank. The process continuing, the valley may become dozens of miles in width. With the subsequent rise in the land, a lower base level is formed, and accordingly the process is repeated from the cañon-making stage to that of mature valleys, as illustrated in Fig. 1.

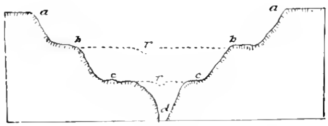

FIG. 1.—Cross-section representing a broad valley, *a b r b a*; with base level lowered, the valley (*b c r c b*) was produced. Another rise of the district causes the stream to make a new cañon (*d*) too recently for the valley to become mature. The terraces at *b b* and *c c* show the positions of former base levels.

With the land rising at intermittent epochs, the valley becomes a series of steps, as illustrated in Fig. 2. Each of the steps is being cut slowly backward, but, owing to the character of the rocks, the

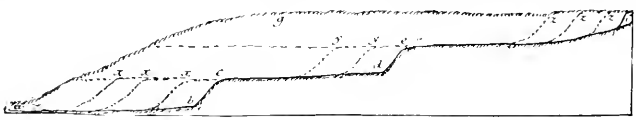

FIG. 2.—Longitudinal section of a valley dissecting a plateau (represented by broken shading along a line *a g x*), showing three base levels, with the front of the platforms (*b c* and *d e*) characterized by waterfalls.

lower platforms may be worn away faster than the upper, so that in time the steps will disappear as the valley becomes mature, when its whole floor is as low as it is possible for the stream to deepen it.

If upon the completion of a portion of a valley the country subsides, the lower reaches may become submerged, as shown in

Plate I, when the newly formed bay gradually becomes filled with mud or the washes of the land.

Valleys even in mountain regions are almost independent of the undulations of the strata, in that the courses of the streams fre-

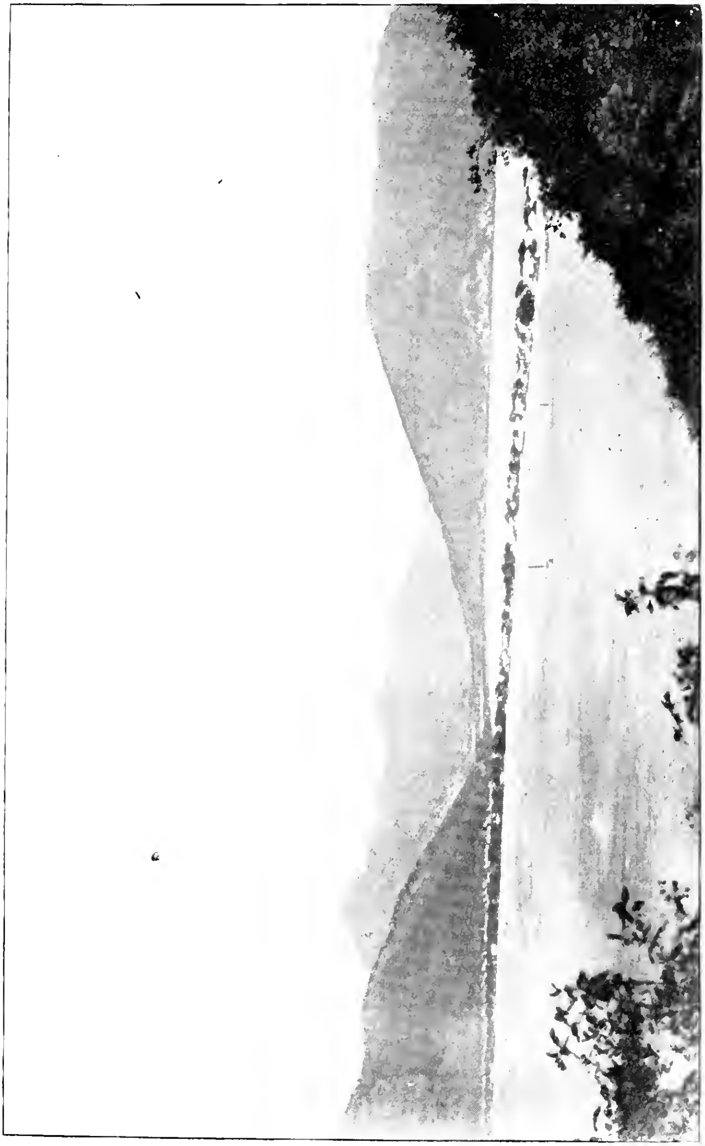

Plate I.—Valley at Philipsburg, St. Martin. Lower portion occupied by shallow salt ponds, beneath which more than thirty feet of mud have already been deposited. Beach in front of ponds formed by wave action.

quently occupy the crests of folds, while the geological troughs are represented by features in bold relief, as is illustrated in Fig. 3. It is easily shown that valleys, even among mountains, whether parallel to the ridges or breaking through them, are the result of the denudation of the rock surfaces of the country, and accordingly, when similar forms occur beneath the sea, they suggest the same origin.

On the Magnitude of Land Valleys.—Concerning the magnitude of land valleys, they vary from the smallest ravines to valleys such as the Mississippi, whose flood plains are from thirty to eighty miles wide for the lower five hundred miles of its length. Several comparatively short rivers, crossing the coastal plains of the south-eastern Atlantic States, have valleys from two to four miles wide, even at a hundred miles from the sea, and upon nearing the coast

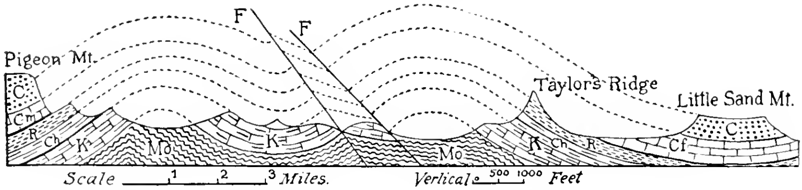

Fig. 3.—Cross-section of a complex valley in the southern Appalachians, showing it to be independent of the geological structure, which is represented by the shading. Dotted lines mark what was the upper limit of strata which have been denuded away. The straight lines (*F*) illustrate some of the faults affecting the region.

they may be from five to ten miles wide, bounded by only broken hills. All the rivers crossing the coastal plains are flowing over deeply buried channels. That of the Savannah River is buried beneath two hundred and fifty feet or more of superficial deposits, and the old Mississippi Valley is now known to reach one thousand feet below sea level at New Orleans. These buried channels prove that in recent times the continent has sunken to a great extent. The valley of the St. Lawrence River differs from that of the Mississippi in being drowned but not subsequently filled with the mud brought down by the streams. In its lower reaches it is seventy miles wide. These examples of continental valleys are greater than any of the drowned ones to be considered in this paper. The examples cited are those of valleys crossing extensive plains at no great elevation above the sea, with their lower reaches depressed even below high tide.

The Colorado River of the West flows from table-lands eight thousand to ten thousand feet above the sea. Its cañon section is about two hundred and twenty miles long. This is not a simple gorge, but a broad valley from five to twelve miles wide, bounded by walls rising two thousand feet above its floor. This floor was an old base level of erosion formed at no considerable altitude, so that the streams meandered sluggishly over it, and the rains and rills widened it to broad proportions; but, owing to subsequent elevation of the region, the river has cut down its channel to a still lower base level, and in doing so it has been deepened thirty-five hundred or four thousand feet more, with the production of a narrow gorge having precipitous walls, not yet widened into a mature valley. Channels like that of the Colorado also occur crossing submarine plateaus.

PLATE II.—VALLEY OF THE ROSSEAU, DOMINICA. A short, deep valley, heading in an amphitheater and dissecting a denuded plateau.

The short tributaries of these high plateau valleys may be likened to gigantic washouts. Such short, deep valleys commonly form at their heads amphitheaters, which may be a few miles in length, as is illustrated in Plate II. These are sometimes so precipitous that they can not be scaled. The depths vary from a few hundred feet to a couple of thousand feet, or even more. The same features are found beneath the sea.

On the Declivity of Land Valleys.—The declivity of the greater land valleys crossing regions of continental extent is usually very gentle—a foot per mile, more or less. Smaller valleys may have a declivity of five or ten feet per mile. In the short amphitheaters, descending from the high plateaus, the gradients may be two hundred or even five hundred feet or more per mile. The valleys dissecting recently elevated table-lands, such as those of Mexico, have not uniform slopes, but the descent is characterized by a great series of steps, the surface of each often appearing nearly level to the eye, but with abrupt margins. The vertical heights of such steps vary from five feet to even five hundred feet. The character of the slopes is illustrated in Fig. 4. If stretches of several miles be taken, so

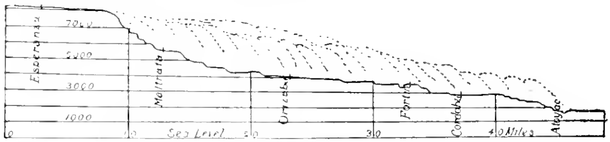

Fig. 4.—Longitudinal section of a Mexican valley (above Atoyac), showing the descent in steps.

many gradation plains occur that the mean declivity of the valley may be from seventy-five to one hundred and fifty feet per mile. Each of these represents pauses in the elevation of the region, while the streams were flowing at levels so low that they could not further deepen their channels, but were widening them out into broad valleys or plains—that is to say, the gradation plains represent base levels of erosion. The valleys on the surface of the table-lands have usually low gradients, which may be as small as those of rivers crossing continental plains. Similar gradation steps are found in valleys beneath the sea.

Submarine Plateaus.—The low coastal plains of the Southeastern States do not terminate at the seashore, but pass beyond, forming shoals and banks, and eventually submarine plateaus, overlooking the edge of the continent, which is fifteen miles eastward of Cape Hatteras, but three hundred miles distant from the coast of Florida. (See map, Plate III.) They extend to and include the Bahamas and other islands. These submarine plateaus have various depths. An elevation of one hundred to three hundred feet would greatly enlarge the Southeastern States, and raise the Bahama banks into broad plains (in reality a continuation of the coastal plains of the Southern States), separated from Cuba and Florida by only narrow channels. A lower broad plateau occurs in this same region, at

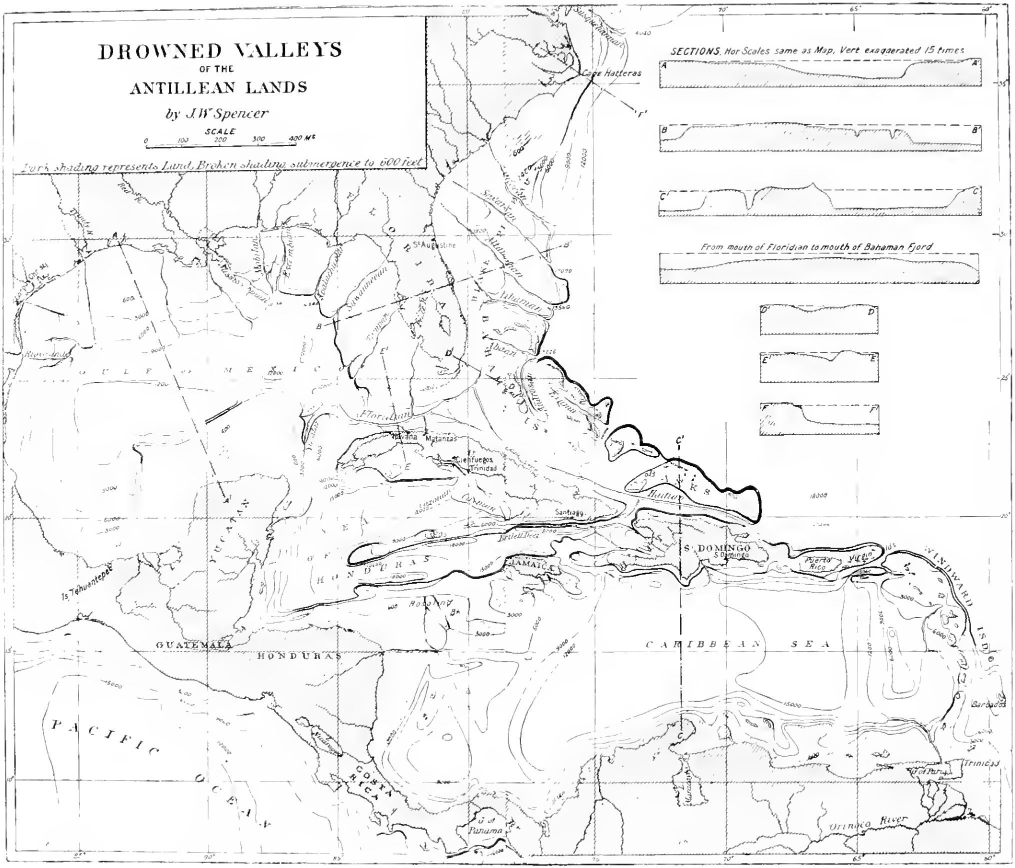

PLATE III—The soundings are given in feet.

depths from twenty-five hundred to thirty-five hundred feet. From its margin the edge of the continent drops abruptly to depths of twelve thousand feet or more. On the western side of Florida the drowned plains gradually slope down to about three hundred feet, beyond which there is an abrupt descent to the abyss of the Gulf of Mexico. The Yucatan plains extend as broad submerged banks to about three hundred feet beneath the sea, and the sea floor then falls rapidly to that of the Gulf of Mexico, at twelve thousand feet. Such slightly submerged plains of great breadth occur on the banks between Honduras and Jamaica. The Windward Islands are fragments of a plateau which an emergence of less than three thousand feet would unite into one body of land. Both to the east and west of Jamaica there are plateaus depressed to between three thousand and four thousand feet. Still lower plateaus are indicated in the Caribbean Sea, which reaches to a depth of fifteen thousand feet.

From the existence of these submerged plateaus it becomes apparent that a change of elevation of from two thousand to four thousand feet would not merely unite Cuba and Florida, but would greatly enlarge the West Indian lands, and almost connect North and South America. Such a change of elevation would nearly barricade the Antillean water into three basins—the Caribbean Sea, the Sea of Honduras, and the Gulf of Mexico. The Sea of Honduras, between Cuba and Jamaica, reaches to the phenomenal depth of twenty thousand feet, in the form of a long, narrow channel. The structure of these sea basins, at various depths, has been mapped by many writers, but the character of the channels which dissect the drowned plateaus had been almost entirely passed over until the appearance of the writer's previous papers.*

The Drowned Valleys or Fiords.—The greater number of the submerged valleys discovered are found to be continuations of buried channels of modern rivers. In some cases the valleys have been so completely submerged that even the divides between those trending in opposite directions have also been drowned—as, for example, the straits of Florida. These drowned valleys have been traced across the submarine plateaus and terminate in enlarged embayments indenting the margin of the continental mass. A few great submarine valleys are found parallel with the mountain ranges. The continuation of many land valleys beneath the sea, and others completely submerged, is shown in the accompanying map (Plate III), and attention may now be called to a few notable examples.

* Terrestrial Submergence Southeast of the American Continent. Bulletin of the Geological Society of America, vol. v, pp. 19–22, 1893. Reconstruction of the Antillean Continent. Ibid., vol. vi, pp. 103–140, 1894.

The Savannah Valley, deeply buried on reaching the present seashore, crosses the submarine coastal plains at a depth of sixteen hundred and fifty feet lower than the floor of the plateau itself, which is already submerged at that point to nineteen hundred and fifty feet beneath the surface of the sea. The cañon becomes still deeper upon nearing the edge of the continental shelf. The Altamaha becomes a cañon with a depth of fifty-three hundred feet at the point where the continental shelf is submerged twenty-five hundred feet. Its length is about three hundred miles. It terminates in an embayment thirteen thousand five hundred feet below the surface of the sea. Among the Bahama Islands, and between them and Cuba, there are several similar fiords or drowned valleys, reaching to depths of from two thousand to twelve thousand feet or more. The straits of Florida, and the fiords extending from them, have afforded special opportunities for studying the submerged valleys. The shallowest parts of the straits of Florida are two thousand and sixty-four feet beneath the surface of the sea. From this *col*, or divide, the Floridian channel extends for a distance of three hundred and fifty miles to a point where it has a depth of ten thousand three hundred and fourteen feet, upon nearing the floor of the Gulf of Mexico. From the same divide the deep Bahaman valley trends in the opposite direction, skirting the northern side of the Bahaman group, and becomes a fiord reaching to a depth of about twelve thousand feet near the edge of the continental shelf. The Abacan channel, crossing the Bahama banks, may be followed to a similar depth. (See map, and Figs. 5 and 6, page 21.)

The valley of the Mississippi (buried to a depth of one thousand feet before reaching the present mouth of the river) is well marked across the submerged plateau to near the floor of the Gulf of Mexico. The drowned valleys of many other Southern rivers are similarly traceable to the floor of the Gulf of Mexico. The same is true of the submarine channels dissecting the drowned plateaus of the Honduras and Caribbean Seas, as shown on the map.

Many of the submerged valleys have tributaries converging from all possible directions, as, for example, those of the Floridian channel. There are also numerous short fiords, tributary to those of greater proportions, but these come from the abrupt margins of the continental shelves or islands, like the amphitheaters indenting the high table-lands.

Of the numerous submarine valleys discovered, a considerable number is shown upon the map, but only a few are cited in the text; by far the larger proportion lie along directions transverse to the trend of the coast lines and mountain ranges, and consequently they

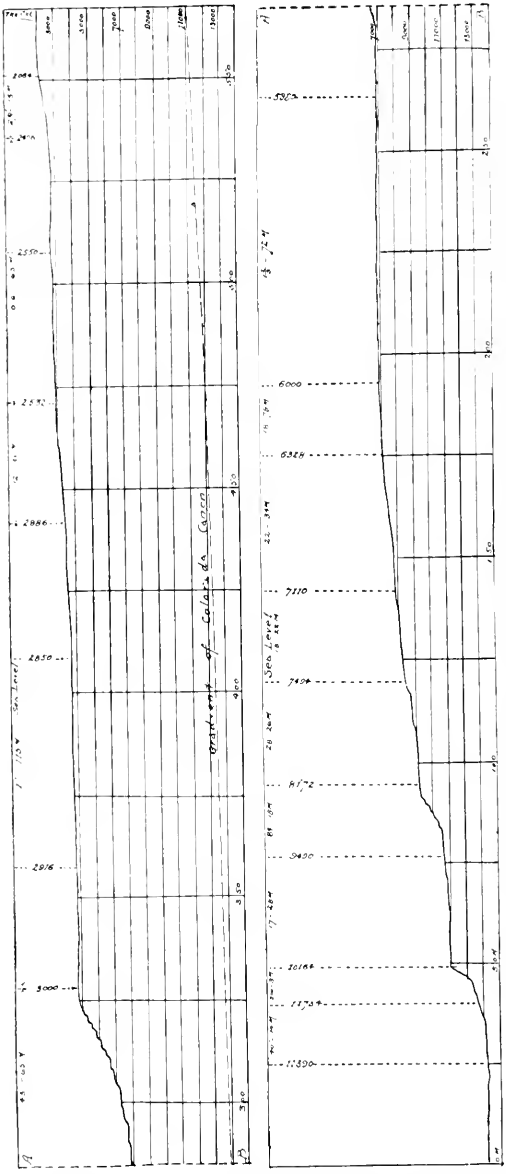

FIG. 5.—Longitudinal section of the Floridian valley (the two parts should be joined at the broken lines, A B).

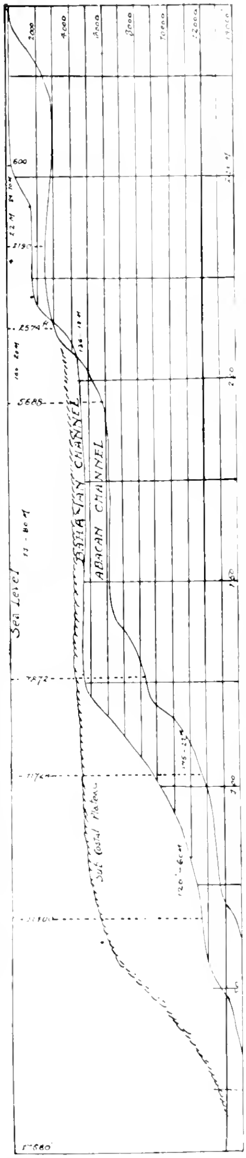

FIG. 6.—Longitudinal sections of the Bahaman and Abacan channels.

These sections, Figs. 5 and 6, illustrate gradation plains and steps between the *col* of the straits of Florida and the floors of the Mexican and Atlantic basins. The cañonlike character is shown by the dissection of the continental shelf, whose floor is seen in broken shading. The gradient of the Colorado Cañon is also shown in Fig. 5. The depth of submergence is given in feet; and the mean slopes in feet for distances of a given number of miles.

were not depressed by the terrestrial movements which elevated mountain zones or depressed ocean basins. A few of the submarine valleys are parallel to the mountain ridges, and may have been deepened by earth movements, although such is not apparent in the many tributaries. It has been found that the greatest amount of upward warping is in the mountain regions, and the greatest depression is supposed to be along the margins of oceanic abysses. Such movements would have a tendency to somewhat increase terrestrial and submarine declivities; but if transverse upward warping became exaggerated, the valleys would become barricaded so as to form basins, like that of Lake Ontario, or even greater sea basins. Such, however, is not the case with the valleys crossing the submerged coastal plains.

Comparison of Land and Drowned Valleys.—Since the submarine valleys, wherever traceable to the shores, are found to be continuations of the buried valleys crossing the coastal plains, they have considerable magnitude where first detected in the soundings. Parenthetically it may be stated that during the late minor oscillations of the continent the old valleys have become filled with sand, etc., for some distance seaward; but beyond this fringe they are always found where the soundings have been taken sufficiently near together. Submerged valleys gradually increase in size until they enter the oceanic embayments indenting the margins of the continental mass. These embayments have been found to vary from perhaps ten to forty miles in width, or within the limit of size shown in the modern Mississippi and St. Lawrence Valleys. Even the upper cañon of the Colorado River has a width of twelve miles. Consequently, the breadth of the drowned valleys

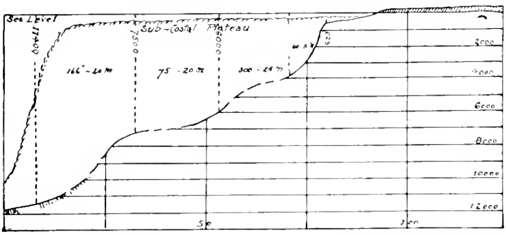

Fig. 7.—Longitudinal section of the Cazonan channel (south of Cuba), showing a similar but shorter fiord dissecting the land mass, the submerged floor of which is shown by the broken shading.

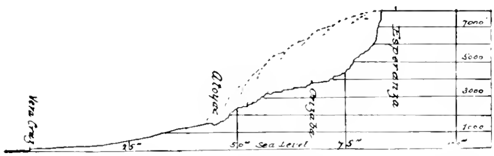

Fig. 8.—Longitudinal sections of the Atozac Valley, descending from the Mexican plateau (eight thousand feet above the sea), on the same scale as that of the drowned valleys, but which is here too small to show the numerous steps, except the mean declivity for comparison with that of the abrupt slopes of the submarine steps.

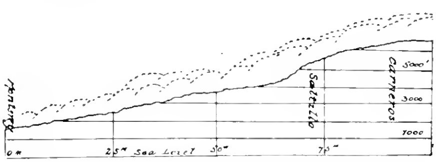

Fig. 9.—Longitudinal section of a similar valley south of Monterey in Mexico.

crossing the submerged coastal plains is no greater than that illustrated by those of the land.

The resemblance between the terrestrial and submarine valleys is even more striking in the case of their tributaries, which come from various directions. Where there are short tributaries descending from submerged plateaus, they have also the form of amphitheaters like those dissecting the margins of table-lands.

The slopes of the submarine channels consist of a series of steps, like the gradation plains descending from high table-lands. These steps represent long pauses in the elevation of the plateaus. For comparison of the declivity of the drowned valleys with those of the land, sections are given on pages 21 and 22 in Figs. 5 to 9, all drawn to the same scale. The declivities of some of these gradation plains do not exceed a foot per mile—that is, these slopes are as low as those of continental valleys which are reduced to the base level of erosion. While much is yet to be learned of the detailed features between the submarine steps, we already know that their mean declivity is less abrupt than that of land valleys descending from the Mexican plateaus. The submerged steps appear to have the same origin as those on the border of table-lands—that is to say, they were formed during the pauses in the terrestrial oscillations when the now drowned continental plateaus formed table-lands.

The deep channels crossing the submerged plateaus for a distance of two hundred or three hundred miles, with a depth of from two thousand to six thousand feet—and among the Bahama banks to even greater proportions—show a close resemblance to the Colorado Valley and Cañon.

The Geological Yardstick and West Indian Bridge.—From the apparently complete analogy between the characteristics of the land and submarine valleys or channels—namely, (1) the submarine valleys being continuations of those of the continent or islands; (2) both having tributaries converging from every possible direction; (3) both classes of valleys having their magnitude of corresponding proportions, with (4) similar great cañons and amphitheaterlike tributaries; (5) both terrestrial and submarine channels with similar gradation plains and steps characterizing their slopes; (6) without obstructing barriers—the conclusion is reached that the depths of the submarine channels may be used as yardsticks to show that the land lately stood nearly as high as the valleys are deep.

Applied to the West Indian region and adjacent parts of the continent, it would thus appear that these regions stood from ten thousand to twelve thousand feet, or in some localities fourteen thousand feet, higher than now. The West Indian bridge reached a height of from two to more than two and a half miles, while the floors of the Gulf of Mexico and the Caribbean Sea, to which depth the drowned valleys can be traced, were continental plains, like those of the Mississippi or Amazon of the present day, with perhaps some shallow lakes or small seas. The backbone of this West Indian bridge was near the Atlantic side, and remains of it are seen in the ridge dissected during the epoch of high elevation by the rapidly descending streams, which now constitute the chain of the Windward Islands.

The plains now forming the floors of the Gulf of Mexico and the Honduras and Caribbean Seas were apparently drained into the Pacific Ocean across the Tehuantepec Isthmus, Honduras, Nicaragua, Panama (see map, page 000), and other low depressions farther south. The writer's recent explorations in the Tehuantepec Isthmus confirm this hypothesis. Plateaus of Mexico and Central America, rising to from six thousand to ten thousand feet, are there reduced in height for a distance of more than sixty miles, so that we find half a dozen passes as low as eight hundred feet above the sea. During the earlier period of the elevation of the Antillean region the Tehuantepec Isthmus was a strait in which a deep-water fauna was living. Later the strait was transformed into land troughs, fragments of the old base-level floor of which are still extant, and through them narrow geological canals were formed when the low Mexican plains had again sunk beneath the gulf waters. This question of the elevation of the Mexican and Central American barriers would carry us beyond the limits of the present paper, so that all that can now be said of them is that they were elevated at a very recent date, corresponding to the subsidence of the West Indian region, to heights reaching from six thousand to even more than ten thousand feet. This elevation was a sort of compensation in the terrestrial balance.

The Date of the Continental Bridge.—Over the West Indian region there are many widely distributed geological formations which were acumulated in early Miocene times. During the following late Miocene and Pliocene periods these formations were lifted above the sea and became lands of great extent. This elevated condition continued so long that the country became enormously denuded, and was reduced to valleys and low base-level plains, some of which now appear to constitute the gradation plateaus beneath the sea. On the sinking of the land, after the Mio-Pliocene period of elevation, new deposits (the Lafayette) were accumulated in the valleys, the age of which is provisionally placed at the end of the Pliocene, although some might regard it as early Pleistocene, for there is no sharp line of demarcation characterizing the limits of these formations. But these deposits immediately underlie those of the Glacial period of the north. Subsequently the land of the West

Indian region rose, and this time to its greatest height, so as to allow the excavation of the very deep valleys and cañons through the then existing table-lands which now form the submarine plateaus. This high elevation was characterized by such deep sculpturing as to give rise to some of the boldest physical features of the lands with which we are familiar. With the subsequent depression of the West Indian bridge, the fragmentary islands became much smaller than even now, and upper portions of the drowned valleys were again partly filled with a still newer formation (known as the Columbia of the Southern States). This last has since been elevated a few hundred feet, with some minor changes of level continuing to the present day. The Columbia formation belongs to a mid-Pleistocene epoch. Consequently, the time of greatest elevation and development of the West Indian continent was during the early Pleistocene period—more popularly called the Ice age. These great and recurring changes of level of land and sea, in later geological times, have produced remarkable and startling revolutions in the physical geography of the region, which might seem incredible but for the great array of evidence which is now being accumulated on every hand.

Relationship between the Distribution of Life and the West Indian Continent.—The elevation of the Antillean bridge is a question of dynamical geology, but the consequent changes of the physical geography naturally affected the distribution of life; accordingly, the biological aspect should be called upon as evidence of the physical changes.

The commingling of the littoral fauna of the Pacific Ocean with that of the Antillean waters confirms the recent separation of the two seas by the elevation of the Central American region.

The character of the deep-sea fauna is very important. The elevation of the West Indies to less than three thousand feet would exclude the Atlantic waters from the Antillean seas, except through two or three shallow straits, and one channel of enormous depth, between the Virgin Islands and St. Croix. According to the late Dr. Brown Goode, the deep-sea fishes belong to modern forms, apparently overflowing through the Caribbean Sea into the Gulf of Mexico. There is no relationship whatever between the deep-sea fishes of these basins and those of the adjacent waters of the Pacific Ocean. The seemingly recent introduction of much the larger proportion of deep-sea fishes from the Atlantic naturally indicates the existence of barriers between the different basins—in other words, an elevation of the region by a few thousand feet. Furthermore, the general modern character of the fish fauna, with the exclusion of the Pacific forms, suggests the inundation of the floors (including possibly a few small sea basins) of the Caribbean and Honduras Seas and the Gulf of Mexico in times so recent as to correspond with the great sinking of the Antillean continent.

The land shells of the Bahamas, Puerto Rico, Haiti, Cuba, and Jamaica are generally related to each other, and are more or less connected with those of Yucatan and Florida, as was long ago pointed out by Mr. Thomas Bland, and more fully studied by Mr. Charles T. Simpson, who has shown that the land shells are poorly represented in the Windward Islands, but that they are closely allied to those of South America. The larger islands have been lately submerged so as to leave only their higher districts above the sea, but from these small remnants the land snails could be developed with local variations upon the re-elevation and enlargement of the islands. On this basis the connection of the islands is affirmed, and the remaining question is one of time, as we do not know in how short a period specific variations may be effected.

The occurrence of mammals is of more importance than that of other animals, as they are less likely to be distributed by adventitious circumstances than other groups. In the West Indies there is a remarkable poverty of mammalian life. In Cuba and Haiti, six living species of *Capromys* or *Hutia* occur (three in each island). These are small rodents, similar to a Pleistocene type found in Brazilian caves. One species of insectivore, *Selenodon*, occurs in Cuba, and another in Haiti; these are of a Madagascar type, as well as an iguana, a reptile found in several of the islands. The little agouti occurs in the Island of Trinidad. These few forms represent almost wholly the indigenous mammals of the West Indies. The monkeys of St. Kitts belong to the Old World, and appear to have been artificially introduced. The scarcity of higher life has given rise to the supposition that the islands have been separated from the mainland continuously, since a period before the appearance of modern mammals. But this generalization was made without considering the physical history of the islands.

In the Southern States, including Florida, there was an assemblage of many animals, such as the rhinoceros, mastodon, etc., which lived in the late Miocene or early Pliocene period (according to Professors Cope and Scott). This fauna became entirely exterminated without leaving any immediate successors. Nor have any been found in the West Indies. This, however, is not strange, when we consider how few localities are known on the continent where such remains have been discovered; and, further, how the broad lands of the Mio-Pliocene times were subsequently inundated by the sea at the close of the Pliocene period, thus reducing the region to a number of very small islands.

Belonging to the Pleistocene period, in the Southern States, the remains of an extensive mammalian fauna have been found, including animals of the tapir, horse, elephant, bison, deer, and other families. To this period also belong the giant sloths of the *Megalonyx* type. In the West Indies, the North American sloth (*Megalonyx*) and an extinct *Hutia* have been found in Cuba. Three species of rodents as large as the Virginia deer were obtained in Anguilla by Mr. Wager Ray, and determined by Professor Cope. The writer lately saw in Guadeloupe, in the possession of Mr. L. Guesde, the tooth of a small elephant, which had been discovered in the island. A tooth of the late Florida elephant has also been found in the Bahamas (Lucas). While these animals named are few in number, yet they show land connection between what are now the islands and the continent in the Pleistocene period. The subsidence in mid-Pleistocene days submerged not merely the continental bridge between North and South America, but caused all the lower land of the islands to be drowned, so that there was an almost complete extinction of mammalian life. Indeed, the tombs of this Pleistocene fauna are now largely beneath the sea.

Further biological testimony of the continental bridge is found among the extensive remains of mammals discovered at Port Kennedy, near Philadelphia, upon which Prof. E. D. Cope was engaged at the time of his recent death. These fossils belong to the old Pleistocene fauna, separated by submergence (the Columbia) from the more modern remains. Among these old Pleistocene species there occur South American types, most notably abundant remains of bears, that are not found among the fossils of the Western or Central States. but which appear to have migrated by way of the West Indian bridge.

Although a few of the higher animals might survive the general extinction caused by the submergence of the Antillean continent by escaping into the higher lands of the few remaining islands, yet these migrations—as, for example, from savannas to mountain forests—would tend to complete their extermination. Besides the restriction of areas, the changes from elevated temperate to low tropical climates would further bring about the destruction of many animals.

Finally, it may be said that the distribution of animal life requires the Pleistocene connection between North and South America; and consequently the biological and physical evidence, so far as known, coincides in bearing joint testimony of the late West Indian bridge.

Conclusion.—The late West Indian continent is a geological feature which belongs to the period which just precedes the modern, and it was the breaking down and sinking of the bridge which brought the physical geography of that region into its present form While the presence of man upon the West Indian and eastern American plateaus is not even suggested by remains of him, yet at that time there roamed over the savannas and through the forests several animals identical with and many closely related to the existing species; and this is as near as we may hope to connect the sunken lands with human associations.

The application of the deep-sea channels to the measurements of the subsidence of the land is a recent innovation. The elevation of mountain regions to great heights has long since passed beyond the bounds of doubt, but their forms have only recently been used for interpreting their history. The reason for this lies in the fact that many of the necessary topographical and geological explorations have not been made until recent years, and because geologists were chiefly engaged upon problems of greater antiquity than modern land features, especially on fossil remains which told something of the history of the sea basins; so that their interest in these questions caused them to largely overlook the history of the land.

If we look at the Alpine plateau surmounted by the sublime Matterhorn, we may be told by geologists that, somewhere in the Alps, the Tertiary formations have been found at heights of ten or twelve thousand feet; in the Himalaya Mountains similar marine strata occur to an elevation of twenty thousand feet. We are still left in ignorance of the geographical history of the region, in spite of the geological youthfulness of the formations. Since the comparatively recent Tertiary period much of the molding of the physical features has been effected. If we observe the Matterhorn, as shown in Plate IV, any one may see a gently sloping plain dissected by a valley thousands of feet deep, which has almost passed the cañon stage, but is yet very immature. Now the geomorphist or scientific geographer will almost at a glance interpret the story recorded in these forms. The plateau is the remains of a base level of erosion, and bears testimony of its formation at a level of nine thousand or ten thousand feet lower, or near sea level, and the marine fossils found in the district will tell since what geological epoch the low plains were formed which have since become elevated into the high plateau. The Matterhorn itself, in spite of the faults, is largely a remnant of a higher mountain mass, which was worn down to a base-level floor by the insidious action of the rains and rills. The valley bears record of an elevation so recent, in spite of the hardness of the rocks and the slowness of degradation, that it has not yet entirely passed its youthful stage. The actually slow excavation of such a great valley, since the last geological period preceding the modern, certainly impresses us with the enormous duration of geological time. It is such magnificent land forms as these plateaus and great valleys, found submerged beneath the sea, which have furnished us with the means for measuring the terrestrial

Plate IV.—View of the Matterhorn, Plateau and Valley. From a painting by Mr. Charles J. Way.

movements in the opposite direction which have reduced the West Indian region to a group of islands.

As to the causes of these terrestrial movements, at present little can be said. Changes of level of land and sea, similar to those found in the West Indian region, have commonly occurred over perhaps most parts of the earth's surface, only the evidence has not been so fully collected. Such oscillations have greatly affected the migrations of animal and plant life, and have produced changes of climate. These physical changes are in themselves sufficient in a great measure to account for the glacial phenomena of the Pleistocene period.

WITCHCRAFT IN BAVARIA.

By Prof. E. P. EVANS.

THE earliest recorded instance of the infliction of the death penalty for witchcraft in Bavaria occurred on June 18, 1090, when the villagers of Völting seized three women suspected of being in league with the devil, dragged them to the neighboring town of Freising, and, after endeavoring in vain to extort from them confessions of guilt by torture, burned them alive on the banks of the Isar. Before being put to death, they were bound hand and foot and thrown into the river, and the fact that they sank and were nearly drowned ought to have been conclusive proof of their innocence, but this result of the superstitious ordeal did not accord with the wishes and fixed purpose of the fanatical mob and was therefore repudiated. In the account of this extraordinary and cruel application of lynch law, contained in the contemporary *Annales St. Stephani Frising*, and evidently written by a priest of Weihenstephan, the unfortunate women are spoken of as martyrs (*martyrizatæ sunt*). It is also significant of the attitude of the clergy at that time that the charred remains, after having been collected by relatives, were buried in consecrated ground with religious ceremonies, at which a priest and two monks officiated. Their conduct in this case was perfectly consistent with the views hitherto officially promulgated by the Church. In the *Canon Episcopi*, adopted by the ecclesiastical council of Ancyra in 900, the belief in witchcraft is expressly declared to be a pagan delusion; and in the so-called "Corrector," issued by Burkhard, Bishop of Worms, about a century later as a guide for confessionalists, a year's penance is imposed upon any one who believes in the nocturnal assemblies and orgies known as the sabbat, or who holds that storms can be produced, property appropriated and destroyed, or the minds of men influenced and their dispositions changed by magic arts and conjurations. Curiously enough, in the sixteenth and seventeenth centuries papal inquisitors denounced and persecuted as heretics all who did not believe these things. This strange transition from the repudiation and punishment of superstitions as survivals of paganism to their acceptance and enforcement as Christian and Catholic articles of faith is brought out very clearly by Dr. Sigmund Riezler in his recent *Geschichte der Hexenprozesse in Bayern* (Stuttgart, Cotta, 1896). This work, which may be regarded as a sort of sequel to the author's well-known *Geschichte Bayerns*, in three volumes, is the first complete history of witch trials in Bavaria ever published. In using the epithet "complete" we would by no means imply that every prosecution of this kind within the limits of the duchy, and afterward electorate, of Bavaria is mentioned. Many protocols of such proceedings have been lost and many others lie hidden in municipal and especially in ecclesiastical archives hitherto inaccessible to scientific investigation; but all the essential features of these trials are here so fully presented and portrayed that no publication of isolated acts or individual instances will add materially to our knowledge of the subject.

The oldest mention of witchcraft in Bavarian law is the imposition of a fine of twelve shillings (about twenty cents) upon persons who injure the harvests by magic arts; in addition to this fine the sorcerer is also made pecuniarily responsible to the owner for loss of property. Penalties of a like character were also inflicted upon such as foretold future events, produced storms, or caused horses and cattle to disappear by means of diabolical machinations. In Arbeo's Life of Corbinianus, the first Bishop of Freising, it is related that as he was one day riding up to the castle he met an old woman reputed to be a witch, accompanied by men bearing meat and one of them leading a live animal. On asking whence they came and what they were doing, he was told that the duke's son had been vexed by demons and that she had healed him. This information so excited the wrath of the bishop that he leaped from his horse and gave the old hag a sound beating; he also took away the gifts which she had received for her services and distributed them among the poor at the gate of the city. This incident occurred between 718 and 724. One of the capitularies of Charlemagne, issued more than sixty years later, soon after the final subjugation of the Saxons and designed to Christianize the conquered people, punishes with death "any one who, blinded by the devil and following heathen devices, may believe any persons to be witches and to devour human beings, and who may burn them for this cause or give their flesh to be devoured or devour the same." The capitulary also provides that practices of divination and of sortilege shall be handed over to the Church and to the priests in order that they may be turned from the error of their way and instructed in the Christian faith.

Additional examples of this kind might be cited, but those already given suffice to show that after the conversion of the Bavarians and other German tribes to Christianity in the eighth century, the belief in witchcraft was regarded by the clergy in general as a remnant of paganism, which it was their duty to eradicate by catechetical instruction or by the imposition of ecclesiastical penance, but not to punish as a crime. Indeed, the annals of Bavaria during the middle ages, so far as they have been preserved, do not furnish a single well-authenticated instance of the institution of judicial proceedings against wizards or witches either by the Church or the State. Even in the above-mentioned case of mob violence at Freising in 1090, the women, who suffered death, were objects of compassion to the clergy, who looked upon them as the unfortunate victims of popular frenzy, innocently slain by a sudden outburst and aberration of the repressed forces of ancestral superstition; and this view of witchcraft seems to have been the prevailing one in the metropolitan and diocesan synods of Bavaria as late as the sixteenth century. From this standpoint it was perfectly natural for the Synod of Regensburg in 1512 to treat of heresy and sortilege in the same decree, and to condemn, together with schismatics, all vain superstitions, soothsayings, sorceries, and evil arts of witches,* "who address infamous prayers to the altars of idols and, deluded by Satan, imagine that they can thereby attain good things and ward off evil." In order to extirpate "this pestilential brood" it was enjoined that every one addicted to such practices, whether cleric or layman, should be sent to the bishop or his vicar to make confession and receive absolution; but if the said person did not, within nine days, heed the admonitions of his spiritual guardian and renounce his errors, he should be excommunicated. Similar measures were taken by the provincial synod of Salzburg in 1569, with an additional injunction calling upon all who had any knowledge of "familiarities, conventions, pacts, or confederations with the devil" to report them to the bishop or his official. The informers were also assured that they would have nothing to fear, inasmuch as their names would be kept secret. Here we have the beginning of that system of espionage, anonymous denunciation, and private inquisition which played so prominent a part in the subsequent history of witchcraft by making every man

* *Artesque maleficas Phitonissarum*: evidently a slip for Pithonissarum, or more correctly Pythonissarum. Another queer corruption is the allusion of tortured witches in their confessions to Filius Zabres—i. e., Virgilius Zauberer, Virgil the magician. In the middle ages the author of the Æneid acquired a popular reputation as a wizard which wholly eclipsed his fame as a poet. The first mention of him in this character is by John of Salisbury in the Policratius in 1159; but many tales and traditions of his power as a sorcerer were current, especially in Naples, long before the twelfth century.

a spy upon his neighbor. The bishop, however, is directed to endeavor "with prudence, zeal, and all love" to convert the accused, but, if unsuccessful, to proceed as provided by the canons of the Church. This procedure evidently involved only the infliction of canonical punishments such as penance, excommunication, and, in the case of a clergyman, degradation or suspension from the performance of sacerdotal functions. A priest who has learned through the confessional, or otherwise, that any person may believe in such things, is to teach him with fatherly affection that they are "nothing but diabolical delusions"; but if the said person should be "notoriously tainted with wizardry" and should obstinately resist good counsel, then the priest is to apply to the bishop or his penitentiary for power to absolve the sinner. It is difficult to determine to what extent the Bavarian clergy, while officially declaring witchcraft to be a hallucination, believed in the reality of it. Doubtless the opinions on this point were divided, the more enlightened ecclesiastics discarding all stories of satanic compacts and concupiscence as mere illusions, while the lower and more ignorant orders of priests and monks were inclined to accept them as actual occurrences. In the decrees issued by the diocesan councils of Augsburg (1452), Freising (1440), Regensburg (1377 and 1512), and Salzburg (1420, 1490, and 1569), they are either not mentioned at all or characterized as errors and delusions, terms which would imply that they have no foundation in fact. But whatever theory of these strange aberrations may have been entertained, it is certain that the means employed for correcting them were remarkably humane and even rational as compared with the horrible atrocities and incredible absurdities which characterized the witch trials of the following century.

The first authentic cases of witch trials in Bavaria occurred under Duke Albrecht V in 1578. With the accession of Wilhelm V, surnamed the Pious, in 1579, persecutions and prosecutions of this kind increased in frequency and severity, and soon becoming epidemic, continued to rage for more than a century in every part of the country. The chief agents and instigators of this dreadful carnival of cruelty were Dominicans and Jesuits acting under instructions from Rome, and often opposed by the Bavarian clergy so far as such opposition was possible without coming into direct collision with the Holy See. As early as the third century, Minutius Felix, in his apology for Christianity entitled "Octavius," and written in the form of a dialogue, makes the pagans accuse the Christians of being worshipers of Satan, and this charge was afterward brought by the Church against gnostics, Manicheans, Cathari, Albigenses, Waldenses, German Protestants, Knight Templars, and other heretics and schismatics who had become obnoxious or inconvenient to the Roman hierarchy. The same policy was pursued by the inquisitors who were sent to Bavaria as the plenipotentiary emissaries of the Pope, and who found the association of heresy with sorcery the most effective weapon for the punishment and suppression of the former. In Bavaria, however, this crimination was not so available and therefore never so strongly urged as in North Germany and in the southern provinces of France, where heretical opinions were more prevalent and had obtained a stronger foothold.

There is a general tendency among recent defenders of the Romish faith to resort to all sorts of shifts and subterfuges in order to relieve their Church from any direct responsibility for witchcraft persecutions. Goethe's cynical remark that writing history is one way of disavowing the past and repudiating its errors, applies with peculiar pertinence to the efforts of these apologists to cleanse the official robes of his Holiness from such an ugly stain. Thus Johann Diefenbach, in his volume *Der Hexenwahn* (Mainz, 1886), says: "Catholics can look back on this sad historical picture with a quiet conscience; individuals were soiled by the delusion of their time, but the Church remained immaculate." Again, he declares it to be "absurd and ridiculous to make the Church responsible for witch trials." The ecclesiastical historian Hergenröther, of Würzburg, and Professor Kaulen, of Bonn, take the same view. The assertion made by these authorities that the Church "never invoked the arm of secular justice for the bloody punishment of sorcery" is a mere verbal quibble, worthy of Thomas Aquinas: the papal inquisitors kept themselves free from blood-guiltiness, in the literal sense of the term, by burning their victims alive or in exceptional cases by strangling them before committing them to the flames. The idea of shedding human blood was so abhorrent to these pious souls that they appeased their consciences and vindicated the claims of divine justice by roasting the witch or wizard at the stake. These falsifications of history are so palpable that it would be superfluous to expose them were it not for the brazen-faced persistence with which they are repeated. The instructions and injunctions contained in the bull *Summis desiderantes affectibus*, issued by Pope Innocent VIII, on December 5, 1484, should alone suffice to show the speciousness of such palliative pleas. It is also a notorious fact that the chief promoters of prosecutions for witchcraft were, with rare exceptions, members of the monastic orders directly commissioned by the Pope. We need only mention the Dominican friars Institoris and Sprenger, authors of the *Malleus Maleficarum* (Witches' Hammer), justly characterized by Dr. Riegler as "the most preposterous and at the same time most pernicious book ever printed"; and the Spanish Dominican Nicholas Cymericus, who composed a systematic manual for the use of persecutors entitled *Directorium Inquisitorum* (first printed at Rome in 1503); and a treatise, *Tractatus contra Dæmonum Invocatores*, in which he maintained that sorcery is heresy and should be punished by the Court of Inquisition. Works of a like character were *Flagellum Hæreticorum Fascinariorum*, by the Dominician Nicholas Jaquier; *De Strigiis*, by the Dominican Bernard of Como; *De Strigimagarum Dæmonumque Mirandis*, by the master of the holy apostolical palace and general of the Dominicans, Silvester Mazzolino Prierias; *Novus Malleus Maleficarum* (New Witches' Hammer), by the Dominican Bartholomew de Spina; *Disquisitiones Magicæ*, by the Spanish Jesuit Martin Delrio; and *Processus Juridicus contra Sagas*, by the Munich Jesuit Paul Laymann.*

Equally untenable is the statement that no person was ever burned as a witch in Rome. The Roman chronicler Stefano Infessura, in his *Diarium Urbis Romæ*, describes the burning of a witch named Finicella, for having "in a diabolical manner killed many creatures and injured others." The execution took place on June 8, 1424, and "all Rome went to see it." Again, in the *Chronicon Generale* of Andreas von Regensburg it is recorded that during the pontificate of Martin V a cat killed several infants in their cradles. A shrewd man wounded the cat with a sword, and, following the traces of its blood, discovered that the animal was really an old woman, who lived in the house of a chiromancer and changed herself into a cat in order to suck the blood of children and thus prolong her own life. This anticipation of the modern theory of the transfusion of blood caused the old hag to be tried for witchcraft and burned at the stake. The Munich occultist and alchemist Dr. Johann Hartlieb, in the thirty-third chapter of his *Buch aller verbotenen Kunst, Unglaubens und der Zauberei*,†

* One of the severest charges brought by the Dominican friar Father Concinna against "Luther, Melanchthon, and their confederates" was that they did not believe in the existence of witches; unfortunately, the accusation is untrue, but it proves the strong desire of Catholic writers of the sixteenth and seventeenth centuries to claim for the papacy the sole honor of being sound on the witchcraft question. In the early part of the sixteenth century the jurist Franz Ponzimibius wrote a treatise, in which he ventured to utter opinions of his own concerning witches. Bartholomew de Spina, in the work above mentioned (page 202), takes him to task for his impudence. "That a mere lawyer," he says, "should discuss a theological subject and set himself in opposition to profound theologians, such as the inquisitors commonly are, betrays extreme arrogance and can excite only the scorn and derision of all persons of discernment. I wonder at the effrontery of this man, and shudder."

† This book, written in 1456, has been handed down to us in three manuscripts, one in Wolfenbüttel, a second (incomplete) in Dresden, and a third in Heidelberg. This last consists of seventy-eight sheets in octavo, and bears the date 1558; at the end is the name of

states that in the sixth year of the reign of the Pope Martin (i. e., in 1423) the belief that certain women and men were wont to transform themselves into cats and kill children was quite prevalent in Rome, and relates the case of a man who, having been harmed in this manner by a woman in his neighborhood, had her arrested and brought to the Capitol, where she exclaimed aloud, "If I only had my salve, I would travel off." Hartlieb, who was present, had his curiosity greatly excited by this remark, and would have gladly given her the salve to see what she could do with it. But a doctor, in whom the spirit of scientific investigation was less strongly developed, stood up and said that she ought not to have the salve, since there was no knowing what mischief the devil might devise. The woman was then condemned to be burned, and Hartlieb witnesed the execution, although he evidently regretted that she was not permited to try the experiment of salving and saving herself with witches' ointment. If it be true, he adds, that old women can transport a man through the air on a calf or a he-goat, there is no doubt that the devil has to do with it. In this connection he raises the query why there are so many more witches than wizards. To this question, he says, the "masters" or inquisitors reply that woman being, as a rule, more frivolous and credulous, is therefore more accessible and amenable to Satan than man. How enormous and atrocious this disproportion of the sexes was may be inferred from the witchcraft prosecutions at Schöngau and Werdenfels in Bavaria from 1589 to 1591, where, of one hundred and fourteen persons condemned to be burned or beheaded, one hundred and thirteen were women. The true explanation of this strange and shameful phenomenon is the false and contemptuous conception of woman growing out of the ascendency of ascetic and scholastic ideas in the mediæval Church. In the eyes of th religious celibate woman was the personification of seduction, and had been from

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the Augsburg nun, Clara Hätzerlin, who made a business of copying manuscripts. She is chiefly known as the compiler of a *Liederbuch*, now in Prague, a collection of poems, some of which are decidedly indelicate, and prove that the cloistered virgins of that time were not prudes. Riezler prints in the appendix to his volume an extract from Hartlieb's work, taken from the Heidelberg manuscript; indeed, the whole of it should be published as a valuable contribution to the witchcraft literature of the fifteenth century. Interesting is the use of *Unglauben* (unbelief) for *Aberglauben* (superstition) in the title. The latter woid was first introduced into the German language by Luther, who as a schismatic and heretic felt the need of a nicer discrimination between heresy, superstition, and sorcery, which the Catholic Church had hitherto lumped together as forms of unbelief and lapses from the true faith due to the seductions of Satan, the arch-apostate. The reformer fully believed in the existence of pacts with the devil, but refused to admit dissent from the doctrines and renunciation of the authority of the papal hierarchy as proofs of a covenant with hell. The neologism *Aberglaube* is the memorial of this protest, so interesting historically and theologically.

the beginning the satellite of Satan, the arch-seducer, and his facile instrument in bringing sin into the world with all its woe. This notion often crops out where one would least expect it, as, for example, in Albrecht Dürer's engraving of four naked women, bearing the date 1491 and the enigmatical letters O. G. H., which probably mean *Odium Generis Humani.* The female figures doubtless represent witches. Patristic and scholastic writers from Chrysostom to Thomas Aquinas vie with each other in their denunciations of woman, and the authors of the *Malleus Maleficarum* fairly overwhelm the reader with passages from these sources in proof of her flagitiousness. They also derive *femina* from *fe* and *minus*, signifying a creature of little faith. To this astounding etymology, which from the use of the word *fe* (faith) would seem to be of Spanish origin, they add an equally conclusive argument from physiology, declaring that "only an imperfect animal could have been formed out of a crooked rib." How could a being with such an origin be straightforward or exert any other than a perverting influence upon man, and, as Milton says, "by her charms draw him awry"? On the other hand, we are seriously assured that God's selection of man, in distinction from woman, as the form of his earthly incarnation, has tended to preserve the male portion of the human race from satanic influences and especially from "the scourge of sorcery." "Praise be to the Most High for this gracious immunity!" exclaim these devout Dominicans. It is hardly conceivable that such wretched twaddle, which would have been silly enough if uttered in jest, should have been put forth by Christian metaphysicians and moralists in justification of barbarous cruelty inflicted for centuries upon the most helpless members of society. Perhaps the queerest feature of this foolish and fanatical crusade against woman is that it should have been preached by the ardent adherents of a Mariolatrous religion, in which the adoration of the Virgin Mother had already superseded the worship of her divine Son.

Hartlieb, to whose book we have just referred, was a physician, humanist, diplomatist, a man of the world with knowledge and experience gained by travel, well versed in literature and with a scientific turn of mind, and yet this representative of the highest culture of his time firmly believed in the reality of witchcraft and attributed it to the direct agency of the devil. He seems to have been especially interested in the art by which old hags produced hailstorms and showers of rain, and took every opportunity to get at the secret of it. In 1446, while he was on a mission from the Bavarian duke to the Count Palatine at Heidelberg, a notorious sorceress had been arrested and cast into prison. As a special favor he obtained from the sovereign permission to visit this witch and the promise that her life should be spared if she would teach how these meteorological phenomena could be effected, but the process involved such denial of God, the Virgin Mary, and the saints, repudiation of the holy sacraments and dedication of soul and body to sundry devils, that Hartlieb declined to become her pupil, and broke off the interview in horror at what he heard. The poor woman, who appears to have imagined that such things were possible, was given over to the executioner and burned.

It is hardly necessary to describe in detail the epidemic of witch persecution, which raged in Bavaria especially from 1589 to 1631. It ran its fatal course and was characterized by the same exhibition of credulity, cruelty, and gross perversions of justice as in other European countries. How any person possessing the least common sense or the most superficial knowledge of human nature, to say nothing of legal training, could expect to extort a confession of the truth by physical torture is to us an insoluble psychological problem. No sooner did the zeal of the authorities begin to relax than it was stimulated anew by the religious orders and the secular clergy, and especially by the chaplains and confessors of the rulers. One of the most bigoted and brutal of these ghostly functionaries was Mathias von Kemnat, court preacher of Friedrich I of the Palatinate. His chronicle of the reign of this monarch is an important but hitherto scarcely heeded contribution to the witchcraft literature of the fifteenth century, and anticipates many of the absurdities and atrocities of the *Malleus Maleficarum*. He witnessed with extreme satisfaction the burning of many witches in Heidelberg and other places, and records the most disgusting mass of drivel concerning the orgies of Satan and his female worshipers in what he calls the "synagogue of the sorcerers." Each novice, he says, as she joins this diabolical congregation, is instructed how to invest her staff with necromantic qualities by smearing it with a salve prepared from the fat of roasted children, venomous serpents, lizards, toads, and spiders. The witches kill people by rubbing them with this ointment, and with a powder made from entrails they produce epidemics and cause great mortality. "This is the reason," adds the learned divine, "why pestilence prevails in certain villages, while the inhabitants of other villages in the neighborhood remain strong and healthy." In view of these facts he urges that many fires be kindled and kept burning. Meanwhile he advises people to "carry with them quicksilver in a tube or quill as a good preservative against sorcery." *

* The recently canonized Jesuit Canisius wrote in 1563 to Laynez, the friend and associate of Loyola, complaining of the increase of witches in Bavaria and accusing them of

Another still more fervid zealot of this work was the Jesuit Jeremias Drexel, court preacher of Duke Maximilian I of Bavaria from 1615 to 1638. He was somewhat celebrated as a pulpit orator, and waxed eloquent in describing injuries done to crops and kine and human beings by the maleficence of witches. "Thousands of this hellish brood have been burned at the stake," he exclaims, "and shall we accuse their judges of an unjust sentence? Nevertheless there are such extremely frigid (*frigidissimi*) Christians, who are unworthy of this name, and who resist with might and main the extirpation of this crew, in order, as they say, that, forsooth, the innocent may not suffer. Oh, out upon these enemies of the divine honor! Does not the Holy Writ expressly command, Thou shalt not suffer a witch to live? I appeal to God's behest and call, as loud as I can, on bishops, princes, and kings to destroy with fire and sword this worst of human pests."

Duke Maximilian I was in many respects a remarkable man, with uncommon keenness of intellect, strong sense of duty, untiring energy, deep religious feeling, and rare appreciation of the fine arts, but these superior qualities did not prevent him from being a fanatical witch persecutor. This perversion of so many excellent endowments was due chiefly to his early education. His preceptor, Johann Baptist Fickler, a theologian who had dabbled in law, was the author of a book entitled *Judicium generale de pœnis maleficarum, magorem et sortilegorum utriusque sexus,* in which the combined erudition and casuistry of the jurist and the divine are used in justification of the utmost rigor in punishing sorcery and sortilege. In 1589, when the prince was only seventeen years of age, he was commissioned by his father, Duke Albrecht V, surnamed the Magnanimous, to witness and report the torture and burning of alleged witches at Ingolstadt, and his letters, now preserved in the Bavarian archives, reveal an amount of crass credulity and callousness of soul in the presence of human suffering wholly inconsistent with the good sense and susceptibility for which this youth was otherwise distinguished. With such a preparation for the performance of his duties as sovereign, it is no wonder that his reign, extending from 1597 to 1651, should embrace the period of Bavarian history in which the greatest number of witch prosecutions occurred, and the proceedings were most systematically and relentlessly conducted by both secular and ecclesiastical tribunals. The duke pursued this course with greater energy and persistency

devouring children. He was also held in high repute as an exorcist, and in 1569 cast ten devils out of Anna Bernhauserin, a servant in the famous Fugger family at Augsburg. The tenth devil, however, proved to be a very obstinate one, and was expelled only in the presence and by the aid of the wonder-working image of the Virgin at Altötting, near Munich.

because his personal feeling was strongly involved, inasmuch as he firmly believed that the barrenness of his first wife Elizabeth was due to magic influences. The court exorcist, a Barnabite named Marrano, tried his powers of disenchantment, but did not succeed in breaking the satanic spell, since the duchess died childless.

A tragi-comical feature of these witch trials was the prominence they gave to the hangman or headsman. Usually this public functionary was despised as a pariah, with whom no respectable person would associate; but in these topsy-turvy times he became one of the most conspicuous and influential members of the community. Thus Meister Jörg Abriel, the executioner of Schöngau, is described in contemporary records as driving three horses tandem through the country, like a fine gentleman, accompanied by his wife and two apparitors as attendants. Everywhere he was warmly greeted and hospitably entertained, and on one occasion on leaving Garmisch his health was drunk in eight gallons of wine. The reason for this distinction was that the executioner as an expert in the detection of "witch marks" on the bodies of the accused held the fate of hundreds of persons in his hands, since it depended upon his decision whether they should be tortured or not. Once he remarked that he had found no "devil's signs," but that the woman had "the look of a witch," and this observation sufficed to have the woman thrown into prison and put to the rack.

A new era of enlightenment began in Bavaria with the founding of the Academy of Sciences by the Elector Max Joseph on March 28, 1759, the aim of which, as he expressed it, was to "purify all departments of philosophy from unprofitable pedantries and prejudices." The motto of the institution, "*Tendit ad æquum*," would imply an endeavor to be not only just and equitable, but also level-headed generally; in other words, it was the intention to cultivate the moral and mental characteristics, in which the foremost men of learning had hitherto shown themselves lamentably deficient. Although the character of the academy forbade the discussion of matters of faith, this prohibition was fortunately so interpreted as not to include the question of witchcraft, which seems to have been placed by common consent in the category of "prejudices." Accordingly, on October 13, 1766, one of the academicians, Don Ferdinand Sterzinger, the superior of the Theatine Cloister in Munich and an acknowledged authority in ecclesiastical history, delivered an address on the common prejudice concerning witchcraft: *Von dem gemeinen Vorurtheil der wirkenden und thätigen Hexerei*. "Our enlightened times," he began, "in which the sciences seem to have reached the highest point, no longer tolerate any prejudices." He confesses, however, that he himself had not begun to doubt the reality of witchcraft until about a dozen years before. The popular prejudice which he thought it now high time to eradicate was the tendency to ascribe to the agency of witches "all injuries, diseases, and bodily infirmities which neither the doctor, nor the smith, nor the headsman may be able to recognize or to cure." * As regards the production of storms by sorceresses, he asks: "Can we reconcile it with the infinite goodness and wisdom of God that he should permit the course of Nature to be disturbed in order that an old woman may revenge herself on her neighbor?" The tales of transportation through the air on broomsticks, tongs, forks, and other domestic utensils transformed into fiery steeds, he dismissed as "the ridiculous gossip of old crones over their washtubs." But if witchcraft be a delusion, why did a kind and just Providence permit thousands of persons to be, on this account, cruelly tortured and put to death? In order to escape this dilemma, Sterzinger replies: "Do not those deserve death who blaspheme God, invoke and worship the devil, kill innocent children, and exhume corpses for the purpose of injuring their neighbors?" This question assumes the truth of the accusations usually brought against supposed witches, and proves that Sterzinger had not freed his mind from many of the absurdest prejudices of his time. The chief significance of his discourse consisted in the fact that it was delivered by an ecclesiastic before the Bavarian Academy of Sciences under the auspices of a sovereign whose immediate predecessors had been fanatical witch persecutors. It is a curious circumstance, showing how slight was the intellectual intercourse then between Catholic and Protestant Germany, that Sterzinger makes no allusion to Christian Thomasius, of Halle, who had still more effectually exposed the folly of the belief in witchcraft more than sixty years before. Sterzinger's standpoint is sufficiently characterized by the paragraph in his discussion of "Apparitions" (*Gespenstererscheinungen*), where he asserts that "to deny the devil is unbelief; to ascribe to him too little power is heresy; but to concede to him too great power is superstition." But once admitting diabolical agency as an actual and efficient factor in human affairs, it is impossible to draw a line at which the influence of Satan ceases, and credulity finds no stopping place until it reaches the misty plateau of the Blocksberg, or joins in the disgusting orgies of the sabbat.

Nevertheless, the discourse, with all its lack of logical force and

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* This mention of "Arzt, Schmied oder Freimann" as regular practitioners of the healing art would indicate that medicine, at least, was not one of the sciences which had reached the highest point at that time. The use of the word "Freimann" for executioner seems to have been confined to Munich.

consistency, produced an immense sensation and led to a fierce controversy, in which some of his academical colleagues took part as the zealous defenders of witchcraft, appealing to Holy Writ, Thomas Aquinas, the bulls of the popes, and canon law as their principal authorities. One of them, an Augustine friar named P. Angelus Merz, admitted that storms are due to natural causes, but added that spirits have a clearer and keener insight into these causes than men, and can make them operative in much shorter time than would be the case in the ordinary course of Nature. The most characteristic argument, however, was used by a Benedictine of the Bavarian cloister of Scheiern, P. Angelus März.* "Our cloister," he says, "can boast of having the largest piece of the true cross, stained with the blood of Christ, in all Germany. So great is the adoration of it and so strong is the faith in it that it has been necessary to make little crosses of brass or silver, which are brought into contact with the sacred relic and then disposed of to the worshipers." He states that often as many as forty thousand of these crosses are sold in a single year, and that they serve to protect their possessors against lightning, thunder, and tempest, and especially to heal bewitched cattle. But, he concludes, "if witchcraft is an old wives' fable, a prejudice, then are we, the father friars of Scheiern, infamous cheats, liars, and jugglers." An *oratio pro domo* of this sort might be suitably delivered by a monk to his fellow-monastics, but sounds strangely enough in the mouth of an academician addressing his learned associates in scientific research.

Opposition of this kind only served to enlighten the public mind, and the secularization of the cloisters in Bavaria by Maximilian Joseph, in 1803, destroyed the last lurking places of the witchcraft delusion, of which the mendicant friars were the most persistent promoters. This measure was followed in 1806 by the complete abolition of judicial torture,† and on October 1, 1813, by the publication of Anselm Feuerbach's new criminal code, in which heresy, witchcraft, and sorcery found no place, and the secular arm ceased to be the instrument of a mediæval hierarchy for the punishment of religious superstition. But a long-cherished and deeply rooted delusion is not easily eradicated, and although witch-

* Owing to the similarity of their names, the Augustine and Benedictine have been frequently confounded, but they were two distinct persons and both prominent members of the Academy of Sciences. Scheiern was originally a castle belonging to the ancestors of the Wittelsbach dynasty, the present royal house of Bavaria. In 1108 it was converted into a cloister, which was secularized and sold in 1803. It was bought, restored, and richly endowed by Ludwig I, who intended to make it a place of burial for the royal family. The Benedictines took formal possession of it again with great pomp in 1838.

† Other German states anticipated Bavaria in this beneficent reform, Prussia having abolished judicial torture in 1740, Baden in 1767, Saxony in 1770, and Austria in 1776.

craft disappeared from the Bavarian statute books, and by being thus removed from the jurisdiction of both secular and ecclesiastical tribunals was robbed of its most baneful character, it has not ceased to haunt the imaginations of men, and the belief in it continues to be fostered by the Catholic Church both in papal encyclicals and in popular literature.* Perhaps the most recent instance of this survival of mediævalism in one of the chief centers of modern civilization and scientific culture occurred on March 15, 1897, at Munich, Bavaria, where a Catholic priest of St. Benedict's Church solemnly went through the ceremony of exorcising a demon that haunted a house at No. 24 Park Street in that city. It seems that the evil spirit had disturbed the pious inmates of the dwelling by groaning, sighing, and making such a racket generally that it was impossible for them to sleep, and was seen one night by a child passing through the room in the disguise of an old woman dressed in black, evidently a survival of the race of ugly and ill-starred hags who have played such a melancholy part in the tragic annals of witchcraft. On receiving this information the parish priest and his acolytes went at once to the house with aspergills and censers to expel the infernal intruder by the supernal power inherent in holy water and consecrated incense. The event caused considerable sensation in the Bavarian capital and excited mingled feelings of indignation and disgust in the minds of even many good Catholics.

Lest we should pride ourselves on our superior enlightenment and freedom from the thralls of mediæval supernaturalism, it would be well to remember that on January 6, 1897, Satan was burned in effigy in New York, to the loud shouting and singing of jubilant Salvationists. Of the two performances, we must confess that the low-toned and almost unintelligible mutterings of the sacerdotal exorcist in Munich, arrayed in gorgeous ecclesiastical robes and armed with the approved apparatus of incantation, was by far the more dignified and impressive, and, considered merely as a pageant, had a certain picturesqueness which was wholly absent from the crude and vulgar exhibition at the headquarters of the Salvation Army in West Fourteenth Street.

One curious and questionable feature of such survivals of mediævalism as that just witnessed in Bavaria, is the kind of evidence on which they rest. In most cases it is some child who sees the apparition and reports it, and whose word is accepted as conclusive. In the forest at Planegg, near Munich, is a little church

* See, for some examples of this tendency, the Popular Science Monthly for December, 1892, and October and November, 1895.

known as *Maria Eich*, or Mary of the Oak. It is built round an oak tree, which stands just behind the altar, and is visited every year by thousands of pilgrims, who seek at this wonder-working shrine redemption from sin and relief for bodily infirmities. Here, too, the chapel in the woods, now so popular as a place of pilgrimage, owes its origin to the freak of a couple of boys, sons of a blacksmith, who in 1710 placed an image of the Virgin of Loreto in the bark of an oak, where it remained for a long time unnoticed and was gradually overgrown, until only the face could be seen apparently peering out of the trunk of the tree. This strange phenomenon now began to attract attention and soon came to be regarded as a supernatural apparition, and this belief was confirmed by rumors of miracles wrought by it. The sacredness of the spot, however, did not prevent the tree from being struck by lightning and partially destroyed on August 13, 1805, so that now nothing is left of it but a dead stump. With the predilection for logical *non sequiturs* peculiar to hagiologists, the fact that no one was killed by this accident was ascribed to the special protection of the Virgin, and this inference added greatly to the reputation of Maria Eich. Why she should have permitted the hallowed oak, which had borne her own image, to be smitten by a bolt from the sky, could not be satisfactorily explained, but was readily accepted as a divine mystery. According to the official record extending from 1732 to 1800, she showed herself gracious seven hundred and seventy-nine times during this period of sixty-eight years; since the beginning of the present century the tokens of her favor have been innumerable, in proof of which the skeptic is pointed to the mass of votive tablets and thank-offerings. That the rules of evidence here applied should suffice to convince ignorant peasants is natural enough. But how is it with the priests, who have had a university education, and are therefore supposed to be competent to see through such shallow and transparent fallacies? Are these men honest or not? Do they really believe what they affirm, or do they uphold these absurdities merely because such teachings foster piety and strengthen the power of the Catholic Church? Doubtless some of these ecclecias-tics are hypocrites, but it would be unjust to assume that the majority of them are practicing dissimulation and deceit.

The true answer to these puzzling questions is to be found by pointing to the kind of institutions of learning in which the clergy receive their education. Take, for example, as a favorable specimen, the Academy of Münster in Westphalia, which comprises only two faculties, one of theology and one of philosophy, but which, as regards the instruction imparted in these departments of study, claims to be on a par with German universities in general.

The Prussian Government also exercises a certain control over the appointment of the professors. As an illustration of the sort of knowledge and intellectual discipline acquired in this academy, which has nearly five hundred students and about fifty professors, we may cite a course of lectures delivered in the summer semester of 1897 by Prof. Joseph Bautz on *Die Lehre von den letzten Dingen,* or the doctrine of the last day, including the dogmas of the Romish Church concerning the final judgment, purgatory, heaven, and hell. On each of these subjects Professor Bautz has already published a little volume, issued at Mainz with the approbation of the bishop, and therefore containing views accepted by the highest ecclesiastical authorities as orthodox. His positive knowledge of the topography of the infernal, purgatorial, and celestial regions is most remarkable, and can hardly fail to excite the amazement and admiration of the young candidates for holy orders who listen to his academical lectures. Purgatory, he tells us, is three stories high and all aglow with flames, which, however, are rather light-colored and pinkish in contrast with the dark-red and lurid fires of hell. The lower story of purgatory borders on hell, while the upper story is near the gates of heaven. Thus the same fire, although in different intensity, serves to torture the damned and to purge the just. This arrangement, he adds, is such as we should naturally expect from the all-wise God, who avoids superfluities and chooses the simplest and most economical way of accomplishing his eternal purposes; and it is also confirmed by the testimony of Mechthild of Magdeburg, St. Brigitta, and of a vision recorded by the Venerable Bede. The professor's so-called "facts," which he is constantly and copiously citing in proof of his theses consist almost wholly of what he terms "visions and private revelations," or what the carnal-minded scientist would dismiss with contempt as the wild dreams and morbid imaginations and "airy nothings" of ecstatic saints and hysterical nuns. Thus, as regards the duration of purgatory, he says, Catharine Emmerich speaks of souls compelled to remain in that place for centuries; according to Marina of Escobar, the average time seems to be at least from ten to twenty and fifty years or more; but Francisca of the Holy Sacrament was visited by pious Carmelite nuns, who had been in purgatorial fires for sixty years and expected to abide there much longer. A little girl, who died when she was eight years old, had been in purgatory sixteen years when last heard from through "the apparition of 1870"; this same authority, frequently adduced by the learned professor, states that some souls are not released from purgatorial punishment until the end of the world.

How material fire can affect disembodied spirits, and whether souls in purgatory are directly tortured by the devil, are questions, he says, which are quite pertinent in this connection, but somewhat difficult to answer. Whatever doubts may arise, however, are removed by the testimony of eyewitnesses, such as the blessed Maria Anna Lindmayr, to whom her friend Maria Becher and the mother of the latter appeared and left on her feet scars which were produced by contact with their persons, and were not only visible but quite painful for weeks afterward. Another instance, tending to edify the faithful and to confound the skeptical, occurred on November 16, 1859, at ten o'clock in the morning in the cloister of the nuns of St. Clare at Foligno, where a recently deceased sister appeared enveloped in smoke and earnestly entreated the superior, Anna Felice, to intercede in her behalf; in token of her presence she left the imprint of her hand burned into the door. The tourist in the Tyrol, who visits a little church in a place of pilgrimage near Innsbruck, will be shown by the sexton a similar mark of a man's hand on a wooden door. The deceased, we are informed, had been noted for his piety, and his widow could hardly believe the woeful tale of his purgatorial sufferings as he related them to her on one occasion, begging her at the same time to hasten his release by having additional masses said for his soul. In order to convince her of the truth of his statements, he pressed his hand against the door and left his "sign manual" there for all time.

Professor Bautz is equally certain as regards the locality of hell, which, he says, is not in Mars or in the moon or in the sun, but in the innermost parts of our own globe; volcanoes are its flues and earthquakes are produced by the movement of its fiery waves when it is especially active owing to the arrival of a large number of the damned. When the ground begins to tremble under our feet and the habitations of men "nod from high and totter to their fall," we now know the reason why. The seismometer thus acquires a new and most appalling significance as a means not only of measuring the concussions and vibrations transmitted in the material of the earth's crust, but also of registering the intensity of the sufferings endured by the denizens of hell. In the light of this doctrine we see the smoke of their torment ascending from every volcanic crater, and discern in the earthquake a moral admonition and spiritual meaning of which "science falsely so called" has not the slightest appreciation.

Professor Bautz tells us, furthermore, that souls in hell are beyond redemption and therefore without means of grace. In purgatory, on the contrary, sacred rites are performed and sanctuary privileges are enjoyed. The "poor souls" go to church (perhaps as a part of their punishment), and the services are conducted by deceased priests or, on extraordinary occasions, by holy angels sent for that purpose. The feasts and fasts prescribed by the Catholic Church are observed there; in this respect "the most perfect order prevails in purgatory." Indeed, he seems to think that in no spot on the surface of the earth are the offices so well done and the conduct of the worshipers so earnest and exemplary as in this subterranean place of expiation on the very confines of hell. It is no wonder that under such circumstances there should be "kindled in their glowing breasts an ardent longing for mansions in the skies."

In speaking of the final judgment, Professor Bautz refers to the resurrection of the Virgin Mary and her ascension to heaven as incontestable historical facts and describes these events in all their details. The apostles, he informs us, were caught up into the air, wherever they happened to be, and transported to Jerusalem, the scene of her "glorious departure." On their arrival they saw angels and heard the celestial hosts singing psalms. The body of the Virgin Mother was buried at Gethsemane and escorted thither by apostles and angels, the latter continuing to sing at her grave for the next three days. On the third day Thomas also made his appearance, this delay being due probably to the difficulty attending his aërial transportation on account of the heavy burden of doubt resting upon the mind of the inveterate skeptic. He was welcomed, however, by the other apostles, who took him to the tomb in order to show him the body of the deceased, when lo! it was no longer there; only the shroud lay on the ground and "emitted an indescribable perfume."

It would be tedious, as well as superfluous, to cumber our pages with further citations. These few examples will suffice to show the kind of academical instruction and intellectual discipline imparted to young men in such institutions of learning as the one at Münster, in which Professor Bautz is a bright and shining light. What wonder, then, that priests, who have been prepared for their sacred calling by having their minds crammed with stuff of this sort, and who have been taught to accept Tertullian's test of truth, "*Credo quia absurdum*," as the highest law of evidence and to make the absurdity of any statement the ground of its credibility, should be full of superstitious notions, especially as regards our relations to the invisible world and the agency of the devil in human affairs!" *

* Since this article was written, a distinguished Catholic theologian, Dr. Hermann Schell, Professor of Apologetics in the University of Würzburg, has published a book entitled Der Katholizismus als Prinzip des Fortschritts, in which he ascribes the Catholic clergy's "inferiority in the independent exercise of their reason" to the same cause—namely, the per-

Professor Bautz makes no claim to originality in his views, but merely gives a general exposition of the opinions held by many fathers of the Church and the great majority of mediæval theologians. Tertullian and other patristic authorities believed volcanic eruptions to be the outbursts of hell fire, and in the middle ages Hecla was regarded with peculiar awe as one of the principal vent-holes of the infernal regions. The queer thing is that such antiquated and childish notions should be revived and taught in a German seminary of learning in the last decade of the nineteenth century.

KITE-FLYING IN 1897.

By GEORGE J. VARNEY.

ONE of the most noticeable movements of the present time in popular science is kite-flying, while its practice as a pastime is having a large increase. Its interest to our reader, however, is almost wholly in its scientific aspect.

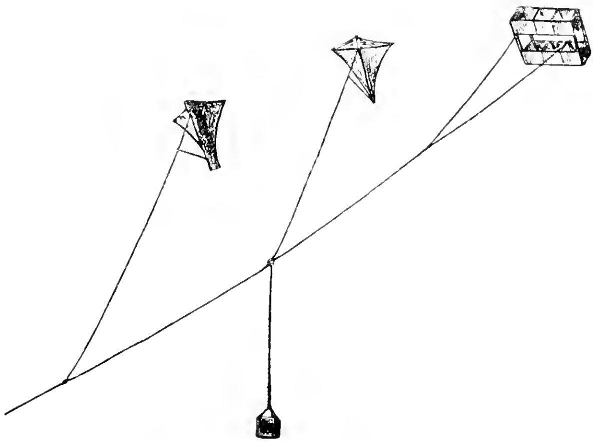
To the question, What is really the use of all this practice with kites? Mr. H. H. Clayton, superintendent at Blue Hill Observatory (in the suburbs of Boston), once replied nearly as follows: "We are living in an atmosphere of which we practically know very little. Our position is like that of crabs at the bottom of the sea. It is expected that such knowledge will be gained in these aërial explorations as will enable the meteorologist to predict hot and cold waves and the various kinds of storms more accurately and much earlier than has been done heretofore. The observations have already become serviceable in this direction, while the knowledge gained has modified opinions found in the text-books."

Truly there are mountain tops three, four, and nearly six miles high, but these are remote or inacessible; besides, the atmosphere enveloping them is mainly of the same stratum which rests upon the surface of the earth elsewhere, only a little rarefied, chilled, and broken in upon slightly in storms, when the stratum is shallow, by the more rapidly flowing stratum next above; so that usually what may be found on the mountain peaks is merely the crest of a billow of the lower atmosphere.

nicious character of their theological training, involving the sacrifice of the intellect to the dictates of ecclesiastical authority. In this connection he refers to the "revelations of Miss Diana Vaughan," and the credulity with which they were received by the clergy, as a recent illustration of the results of such teaching. The ease with which the representatives of the Romish hierarchy, from the infallible Pope and his cardinals down to the humblest country vicar, fell into the snare laid by Leo Taxil and his confederates, ought to serve as a serious warning and lead to educational reform.

The pioneer in scientific kite-flying in America, in the recent period, is the Blue Hill Observatory, in the suburbs of Boston; and here, too, the highest flights have been made.

It is not asserted that there have not been other successful experiments with kites, but that the results of those at Blue Hill are in advance of all others in the field of meteorology. Mr. E. Douglass Archibald, in England, has made experiments with a kite and anemometer, and is the inventor of the improved tail, which has



A TRAIN OF TANDEM KITES BEARING A METEOROGRAPH.

cup cones instead of bobs; while Mr. Hargrave, an Englishman in Australia, there invented the valuable type of kite which bears his name. In America, Prof. C. F. Marvin, Mr. A. W. Potter, and others, of Washington; Mr. William A. Eddy, of New Jersey; and Mr. G. T. Woglom and others, of New York, have all done valuable service. Professor Marvin is the author of the two pamphlets of valuable technical investigations in relation to kites, issued by the United States Weather Bureau. Mr. Woglom, also, has published a valuable treatise on parakites, while Mr. Eddy has devised the excellent kite connected with his name.

The first attempts at Blue Hill were with the Malay kite—the prototype of the Eddy kite. Mr. Eddy claims, however, that his bird-form kite is the result of his own study and experiment, before he had exact knowledge of the form used by the Malays and Javanese.

The descriptive term, bird-form, has reference, not to the outlines of a bird of any kind, but of the proportions of width to length in a kite, as comparable to the length of body and spread of wings in a bird. In the Malay kite the cross-stick is almost as long as the backbone; in the Eddy kite it is slightly longer. The Malay cross-piece is permanently formed to the shape of a Cupid's bow, the central arch to the wind, thus pressing out the covering in a wide keel; in the Eddy kite the cross-piece is slightly bent by a cord, like the simplest form of archer's bow. All kites of the Malay and Eddy type are intended—unlike the common kite—to fly without a tail.

It was doubtless in the island of Java and in the Malay Peninsula that kite-flying had its earliest and greatest development. The practice appears to have spread from these countries to China and Japan, where the forms are greatly varied and the uses extended.

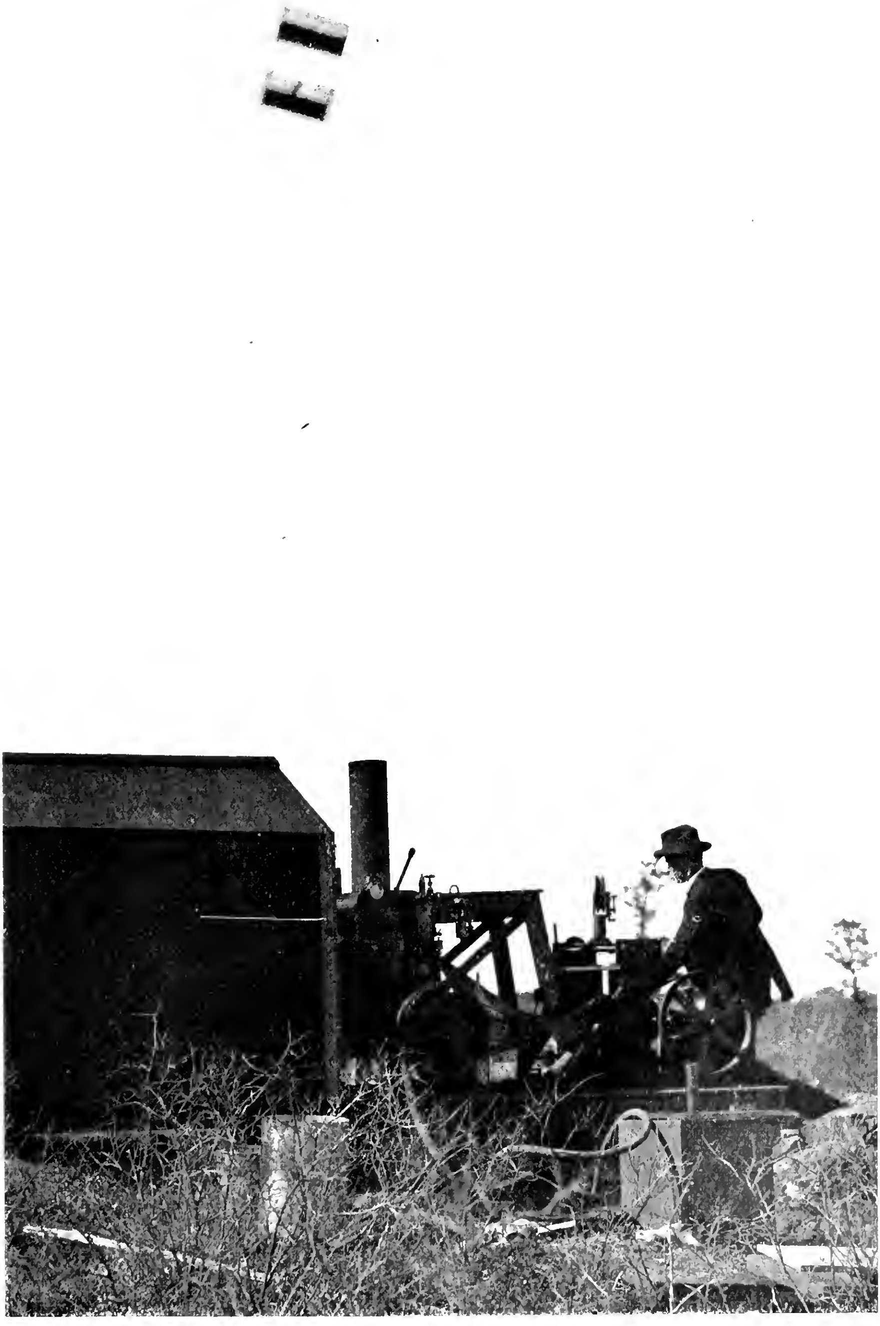
In China the notable forms are the dragon kite and the bird kite. The first is composed of a large painted disk representing a horrible head, drawing two lines of smaller disks diminishing to the tail, where they unite in a tuft of some sort; each disk being also connected with one opposite in the parallel row. This basal form is diversified by various treatment.

The frame of the Chinese bird kite is generally made up of bamboo splits in loops, joined in rude, conventional imitation of the body, spread wings, tail, and head of a bird. This kite is often provided with a musical attachment in the shape of a hollow section of bamboo pierced with holes, or furnished with reeds that are vibrated by the wind. When mounted high in air, the tones proceeding from it resemble those of an æolian harp, and can be heard at a great distance.

Chinamen have a superstition that both these forms of kite are a protection to the family against evil spirits—the first, by frightening them away; the latter, perhaps, by abashing them by its harmonies, as those which infested Saul were influenced to depart from him at the sound of David's harp. Sometimes these kites—the cord being securely fastened—remain aloft for several days and nights; the family meanwhile enjoying an unusual sense of security.

Kite-fighting is also practiced in the vicinity of the cities and larger villages. This sport consists in tearing the kite of a rival or cutting the line; the first, by means of long wooden knives attached to the assailant's kite; the latter, by small fragments of glass mixed with glue, as a coating for the upper portion of the line. All Chinese kite-flying, though skillful, is in some feature barbaric.

In Japan the kite-forms indicate a more practical character in the makers. The kites are shaped to represent many kinds of animals—quadrupeds, birds, and fishes. When in the sky, these kites might convey information quite a distance to acquaintances who could recognize them and thus know what family was represented at the other end of the string; for in Japan the sport is



Kite Reel, operated by Steam Engine.

largely social. A recent announcement comes as a surprise to everybody, that the Japanese records prove that six hundred years ago kites were used by this people in war time for carrying up observers to detect the position of an enemy's forces.

After all, America must be credited with the first application of the kite to scientific investigation; Ben Franklin—as all intelligent persons know—being the experimenter from whose discoveries large results in electrical science have proceeded. Numerous experiments in this direction followed his initiative, in France and, with less fervor, in England; while in Russia a zealous scientist lost his life by his temerity with a metallically equipped kite in a thunderstorm.

Perhaps this catastrophe was the cause of the abandonment of this method of investigation of the upper atmosphere, for nothing that attracted much attention was again accomplished by kites until the year 1894, when the Blue Hill investigations began.

The first year's work at this observatory (a private institution, established and sustained by Mr. A. Lawrence Rotch, from public spirit) made little addition to the knowledge previously acquired by amateur fliers; but the succeeding years show marked advances.

At present it is usual, in flying flat kites, to send up several on the same main line. Generally a small kite is first sent up, and, when this is securely mounted, a larger one, attached to the main line perhaps a hundred feet below by about that length of its own string, is started after its leader.

As the number of kites in the tandem increased, more strength was required at the lower end of the line to withstand the pull; so the reel quickly became an important part of the apparatus. The labor of winding was such that the reel was provided with a crank, and mounted more and more strongly, and a recording wheel and dial were soon added to measure the line as it ran out. The apparatus was then made portable by combining it with a sort of wheelbarrow.

Not only the number of kites but the height of their ascent increased the strain on the wheel, and one after another—though of solid oak—were crushed by the drawing of the concentric layers in winding in, especially after the change was made to a metal string.

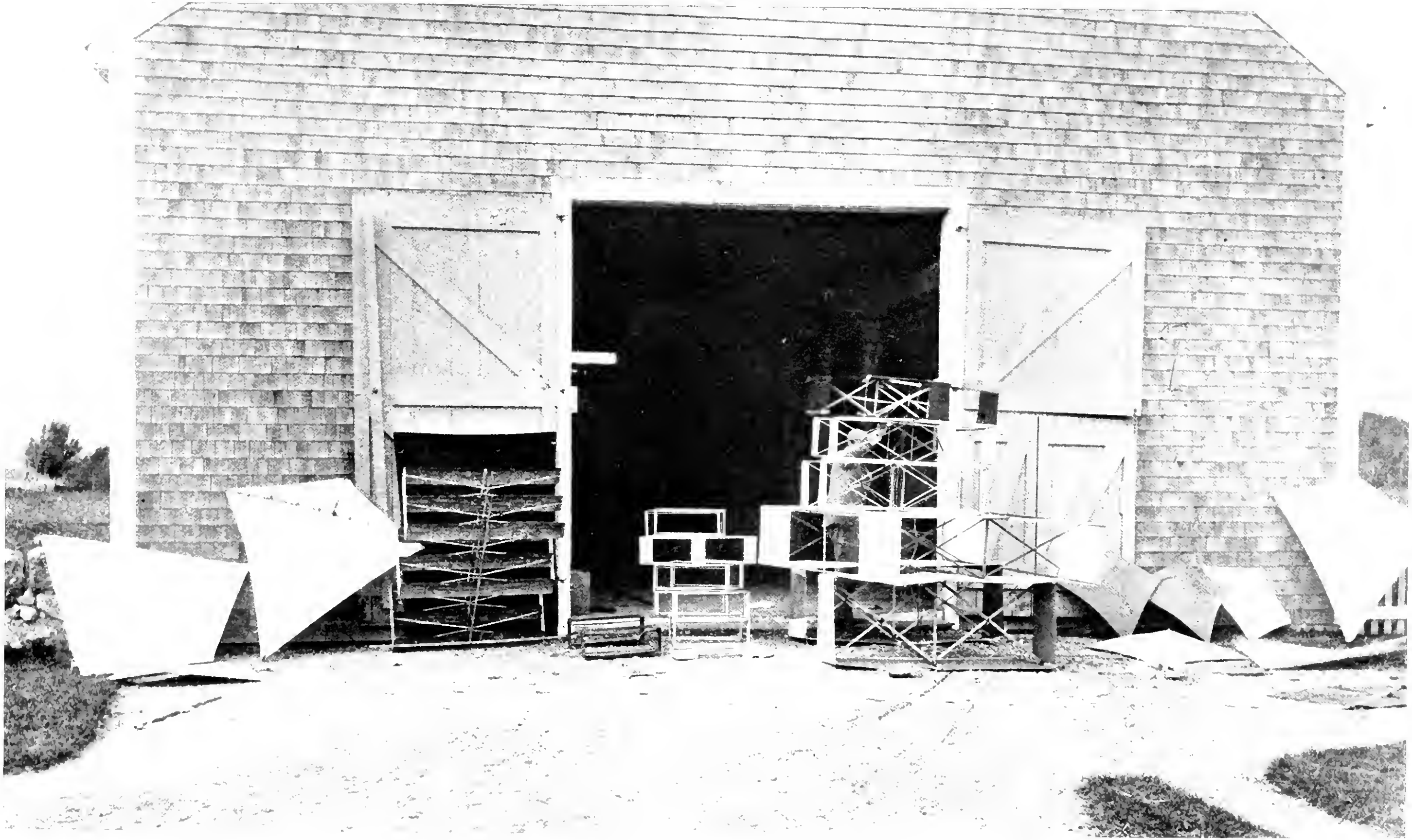
Last season (1897) a unique reel was introduced in which a two-horse power steam engine took the place of human muscle for winding in. Steam is supplied by a boiler heated by oil spray as fuel, these and the reel proper being mounted on the same portable base. Included in the winding apparatus is a strain-wheel around which the wire passes four or five times, running from this to the drum of the storage reel—on which it is wound lightly and evenly by automatic action. The wire comes in from and goes out to the kites over a pulley, which turns so as to deliver it in any direction to them. There is also a wheel which records the pull of the line, and a provision for recording the measurement of length. Thus the relation of wind pressure to pull, and several other matters, can at any minute be figured out.

The purpose of the observatory from the first was to secure by means of kites a more elevated plane of observation than could be obtained by other means. As soon as the corps had acquired skill in kite making and flying, a self-registering thermometer was sent up; afterward they were able also to add a barometer, these being carried on a base, covered by a wire basket, and attached to the line as high among the kites as it could be sustained.

But the two instruments did not furnish a record of all the elements; and finally a complete "meteorograph" was devised. Externally, this was a cage of wire one foot in height, the same in width, and half that in the other dimension. The weight of a similar one used in Washington is two pounds and a half. The combination within consists of a thermometer, barometer, hygrometer, and anemometer—all making record on a sheet of paper wound on a cylinder that is revolved by clockwork. As the direction of the wind is ascertained by the drift of the kites, each flight furnishes the observers with five meteorological elements. No doubt they will be able ere long to determine the electrical conditions at different heights with equal accuracy.

Every well-constructed kite has a fixed capacity for ascending to a certain height—not more than a few hundred feet usually, because of the increase in the weight of the line and the wind's pressure on it; therefore, in order to reach a greater altitude, it became necessary to connect another kite to aid in the lifting. Still higher flights required a further addition of kites, until sometimes a dozen, ranging in size from five to twelve feet, were up in the same tandem, requiring a small rope to hold them. A large and divided wind surface was necessary, else in lulls the kites would descend and the instruments with them; so the obtaining of observations was at great cost of time, labor, and money. In a fresh wind the vigorous efforts of three strong men were required for two or three hours to bring a large tandem down. Several times, in strong winds, the kites have broken away, only reaching the ground two, four, and nearly six miles distant; yet nearly every time they have been recovered without having sustained much damage.

For the reason mentioned on a previous page, some two years since, No. 14 steel music wire (the size of small piano strings) was substituted for the line of vegetable fiber. A mile of this wire weighs from twelve to fifteen pounds, which is much lighter than

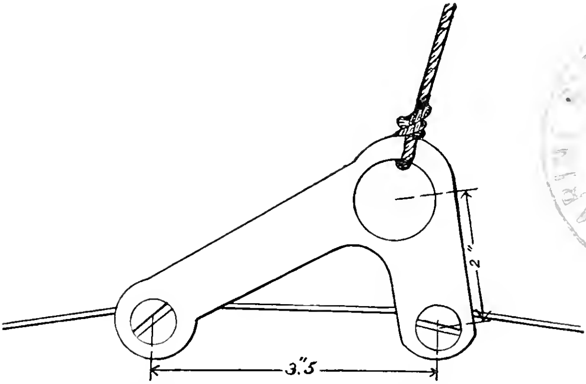


Eddy Kites. Multicell Kites. Hargrave Kites. Blue Hill Bird Kites.

KITES FLOWN BY MR. J. B. MILLET, Sharon, President of Boston Aeronautical Society.

the bulky flaxen cord previously used, and it offers so much less resistance to the wind that two kites on a wire line will bear the instruments to as great a height as six of the same size on a flaxen line. Still, owing to weight and wind, the droop in the wire is so great that about two miles of it are required for one mile of ascent.

The wire had also some disadvantages, one of which was rust. This has been overcome by an arrangement by which oil is dropped upon it as it is wound in. Another difficulty last year was the startling shocks the men holding the line got from the electricity it

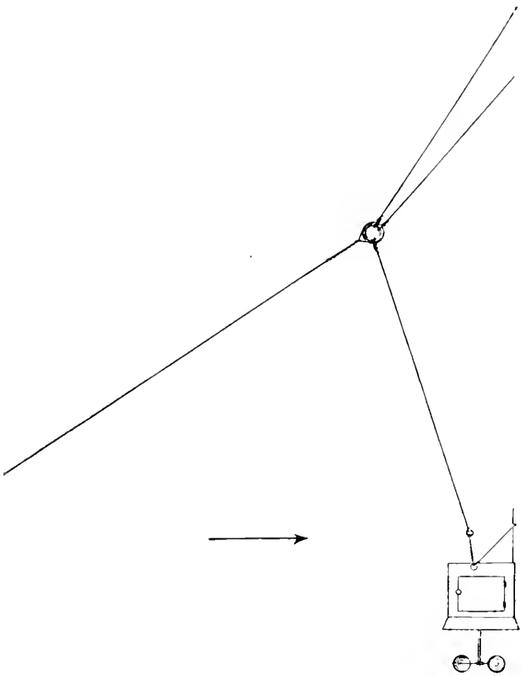


Aluminum Clamp, which attaches kite string to wire of trunk line in a tandem.

brought down from the sky; but no handling is now required, and the machine carries all the sparks harmless to the ground.

No attempt is yet reported on the part of the Blue Hill people to investigate specially the electrical phenomena since those by Mr. Alexander McAdie at this observatory in the summer of 1885, and again in 1891 and 1892; but certain gentlemen near New York, assisted by Mr. W. A. Eddy, on the night of November 13th, sent up by means of kites an electrical collector (presumably a plate or wire net of copper), a small copper wire forming the conductor. The first spark was obtained between fifteen and twenty-five minutes after the kites were sent up, and when the collector was at a height of three hundred and eighty-one feet. The time was between ten o'clock and midnight. The temperature at the earth's surface at the time was 38° Fahr., while a self-registering thermometer sent up on the kites showed 37° at an elevation of four hundred and twenty feet—the sky being clear, or nearly so. Quite likely the records of electrical phenomena at Blue Hill are more full and explicit than this at Bayonne, but neither these nor the theories on the subject have been given to the public.

The first practical use of electricity obtained by means of kites, so far as I have learned, is in the wireless telegraph system of Signor Marconi, in which the collectors at the poles are kites of thin copper, these being connected by small copper wires to either the receiver or the transmitter, on the ground. Though Marconi claimed to have sent readable signals twelve miles, Superintendent Preece, of the English Government Telegraph System, in endeavoring to duplicate these successes, was unable to obtain a satisfactory result at a greater distance than two or three miles.


Showing ring at the upper end of the wire line to which are attached the strings of two kites, also the cord bearing the meteorograph. The two round objects at the bottom represent the two round cups of the anemometer.

The experiments at Blue Hill have shown a difference in electrical conditions at different heights, and in different conditions of the atmosphere in respect to temperature, humidity, and movement; and there seem good reasons for confidence that ultimately this element will yield valuable results in more than one direction.

It is not improbable that if metallic kites could be sent up to the verge of some higher stratum of the atmosphere, where the contact of the diversely moving strata sometimes evolves noticeable auroras, some considerable electric charge might be obtained for telegraphic or telephonic transmission, and, possibly, by storage, for light and power.

In considering the various phenomena of kite-flying, however, we must not neglect the kites themselves. The effort of the scientists has from the first been to find a form which would give readiness of ascent, steadiness in flight, lifting power, and capacity of reaching great altitudes, together, of course, with mechanical stability and endurance under all conditions. Because of their necessary slenderness, and their delicacy of adjustment for balance and pull, all flat kites have been found precarious; consequently, not meeting requirements except in the best weather; besides, so large a number are necessary in light winds to carry up the instruments to the desired elevation, involving labor and time, that the cellular kites are becoming the chief reliance for meteorological observations aloft.

The antetype of all these is the Hargrave pattern, invented by an Englishman of that name in Australia in 1894. All are remarkable for their lifting capacity, and generally for their ready ascent. The Hargrave consists of a light frame, outlining a box, about which, at each extremity, is a wide band of cloth, the frame being bare at the middle section. In proportions, a rectangular cell six feet long is usually about the same in width, and one fourth as deep as it is wide. There is much variation in most features of the box kite, as made by different fliers. The bridle is attached to the two lower corner bars nearly midway of the length or the four lower corners of the uncovered section, or otherwise, according to form and use.

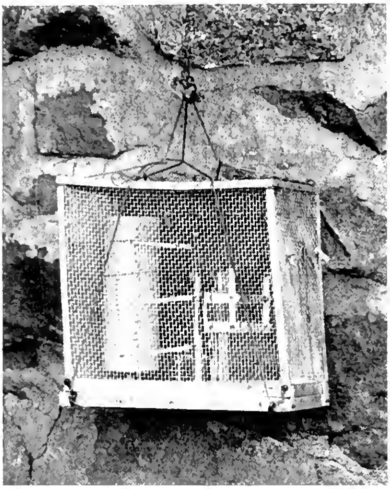
For use at Blue Hill, observer Clayton devised a modification of the Hargrave, consisting chiefly in the narrowing of the box, and a different framing.

Another form of the cellular type is the diamond kite of Mr. S. A. Potter, of Washington, D. C., whose device has a square instead of an oblong aperture, and has the bridle on one of the longitudinal angles, so that it flies with a corner, instead of a side, downward. To this another Washington inventor has attached a pair of triangular wings, which is said to increase the lift very much. Neither of the forms of Hargrave type bears even a suggestive resemblance to the common kite.

Still another cellular kite is that constructed by Mr. J. B. Millet, president of the Boston Aëronautical Society. Except by a diagram, an idea of this kite may be best conveyed by saying that, in the main, it is a Hargrave cell doubled, or having a third wall inclosing a superimposed cell; a development which might be carried on indefinitely. It is nearly the same form as the flying machine, carrying and operated by a small steam engine—the invention of Professor Langley, of the Smithsonian Institution.

I am not aware that the lifting capacity of any kite has been submitted to so striking a test as on the Hargrave until the present season. Two of these, on November 12, 1894, in Australia, are reported to have borne the inventor up sixteen feet; and in 1895, by the same number, he is said to have been lifted forty-five feet. Subsequently, Captain H. Baden-Powell, of the Scotch Grays, in England, was carried up one hundred feet by a tandem of the same type. On January 21, 1897, Lieutenant Hugh D. Wise, of the Ninth Infantry, United States Army, was lifted in a boatswain's swing suspended from four Hargrave cells to a height of forty-two feet above New York Bay.

The later instance referred to is thoroughly verified and reliable. It is the ascent made by Mr. Charles H. Lamson, near Portland, Maine, on June 19, 1897, to an elevation of fifty feet with a single kite of the form devised by him. In most other exploits of this kind the aëronaut has been drawn up by a pulley to kites already well poised aloft; but Mr. Lamson started with his kite, running along on the ground as it was drawn forward, and going up with it when the initial impulse had been gained. The Lamson kite is constructed on an original idea, though it is a combination of the flat and the cellular types.



Meteorograph.

The gain in height of ascent by kites since experiments began at Blue Hill has been at the rate of about one thousand feet each year. The highest ascent previous to 1897 was made by a six-foot kite of the Malay or Eddy pattern, on October 8, 1896. The elevation attained was 9,400 feet above tide-water, 9,300 feet above the surrounding country, and 8,770 feet above the top of Blue Hill, which is 635 feet above the sea—in full view from its summit. The meteorological instruments made records up to a height of 9,375 feet.

A higher ascent was made early in the autumn of 1897 at Blue Hill, when the leader of a tandem, a Lamson kite, reached an elevation of 11,060 feet (two and a tenth miles), where it was broken by the strong wind. The observatory people now hope that, with the Lamson kite as a leader, they will be able to send their instruments to a much greater height.

The elevation of the kites is determined by the same means used for mountains—the pressure of the atmosphere as recorded in the barometer, and calculations with the angle the kites make with the extremities of a base line. The string has too much indeterminate sag to furnish an accurate measurement.

It has been found that with an increase of altitude a constantly lowering temperature is encountered, except rarely, when there is an overlying warm stratum, ushering in a spell of unseasonably warm weather. At the approach of these warm tides, when the kites ascend they find, as usual, a decreasing temperature for a while, but it suddenly rises as the instruments enter the radiating waves of caloric—sometimes as many as seventeen degrees. In advance of and during cold waves the temperature falls uniformly and rapidly in the ascent. Observations at Washington, New York, and Blue Hill coincide in showing that approaching warm and cold waves are perceived, at a height of a thousand feet or more, from six to twelve hours earlier than their prevalence at the surface of the earth. One reason for this is that the air moves freely and rapidly at the height of a few thousand feet, while it meets with many obstacles below.

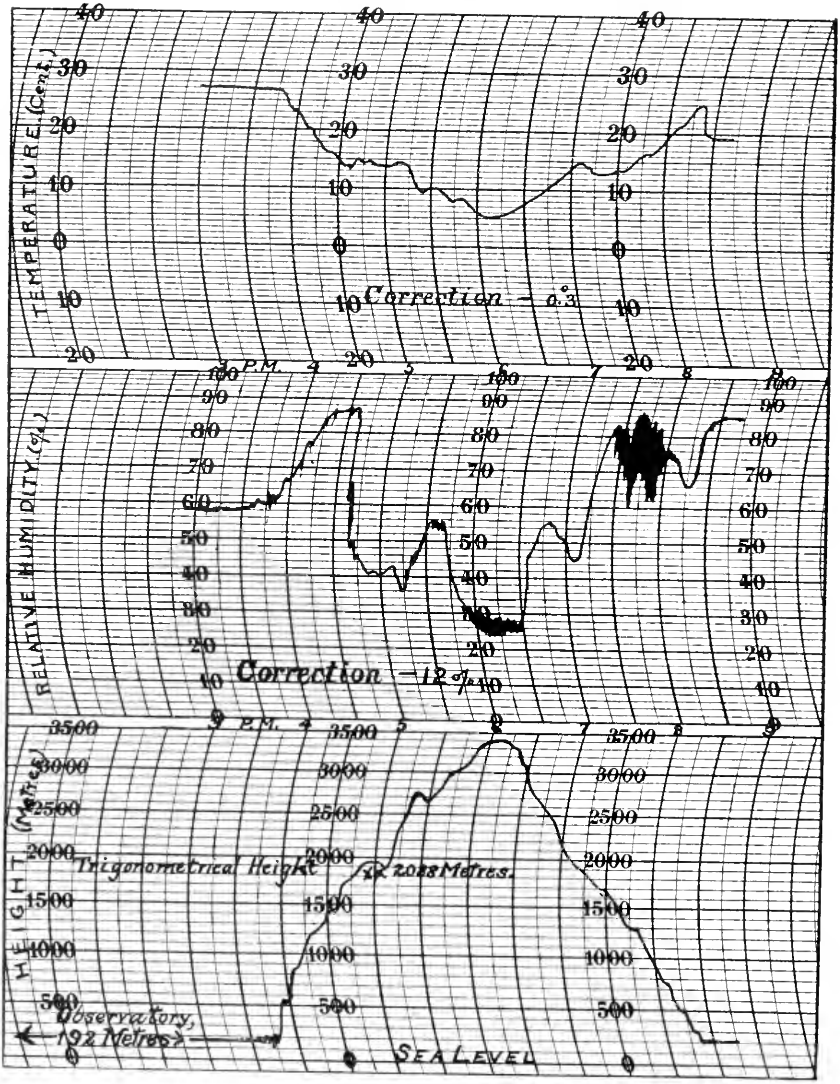
There is an interesting bit of information from the kites for us in regard to Boston's much-denounced east wind—though in the heated term it is generally quite a relief. It has been ascertained at Blue Hill that these chilling inflows begin at the surface and thrust themselves wedgewise under the local stratum, working upward. At their greatest expansion, however, these eastern winds rarely have a depth of more than twelve hundred feet.

At the surface of the earth, as every one knows, there is usually a marked increase of the temperature during the day, and a decrease at night; but at an elevation of three thousand feet this variation disappears entirely, the days being there as cold as the nights. The changes of temperature aloft are very large, but they are not diurnal. At this height, also, the days are marked by a damp atmosphere, while the nights are dry. This is simply a phase of the dewfall, and to a degree also of the clouds and the rainfall.

The behavior of kites in the vicinity of cumulus clouds is peculiar. When one of these tracts of snowlike baseless hills sails calmly over, the kites ascend more or less rapidly toward it, often following as far as the line will permit. Every observer has remarked the rounded shapes of these fair-weather clouds, like high upheavals of condensed steam; and it has long been held that they were the result of—or, at least, attended by—upward eruptions of air, perhaps from heat expansion.

The nimbus cloud, from which most of our rainfall comes, has little effect on the kites other than disqualifying them for flying because of wet. Kites usually find little or no obstacle in the stratus. Among the memoranda of flights is noted, of one such passage in summer, the emergence of the kite above a cloud of this kind of a computed depth of five hundred feet. The hygrometer showed that in the midst of the cloud the humidity was one hundred per cent—full saturation; so that a slightly cooler wave of atmosphere would have caused precipitation; yet above the cloud the atmosphere was quite dry.

In the colder seasons of the year the kites would usually have come back from such passages beautifully iced in minute crystals. In an observation made in October, 1896, the box of instruments, at the height of three quarters of a mile, entered a cloud from which



KITE METEOROGRAM OF OCTOBER 15, 1897.

it emerged at an elevation of about a mile. The record showed that close under the cloud the temperature was just below freezing; above the cloud the atmosphere was very dry; and at the limit of the ascent (9,375 feet) the temperature was twenty degrees below freezing.

Probably the most striking thing in recent kite-flying is the making of photographic views by a camera in the sky, borne up by kites. Mr. William A. Eddy has claimed to be the pioneer in this field, having taken views from kites on May 30, 1895; while Messrs. G. T. Woglom and George E. Henshaw, of New York city, claim that the first good picture from a camera sustained by kites was made by them on the afternoon of September 21st, following.

There are several ways in which a camera could be carried up, and operated from *terra firma*. Mr. Eddy sends it up with its bearer attached to the strings of as many as three kites. The apparatus consists simply of two spars about the length of a trout rod, and of about its size at the butt, the end of one spar being joined firmly to the middle of the other; and on this junction the camera is mounted. A cord looped along the trunk line controls the slide of the camera. Many excellent pictures have been made by these means.

Kites have been used, also, for sending up colored lights for signaling; while by an ingenious use of a large and somewhat modified camera, views of objects at a distance have been presented to observers on the ground, when such objects would have been otherwise invisible to them. Thus the operation constitutes a sort of artificial mirage, which, very likely, will not always be without its uses.

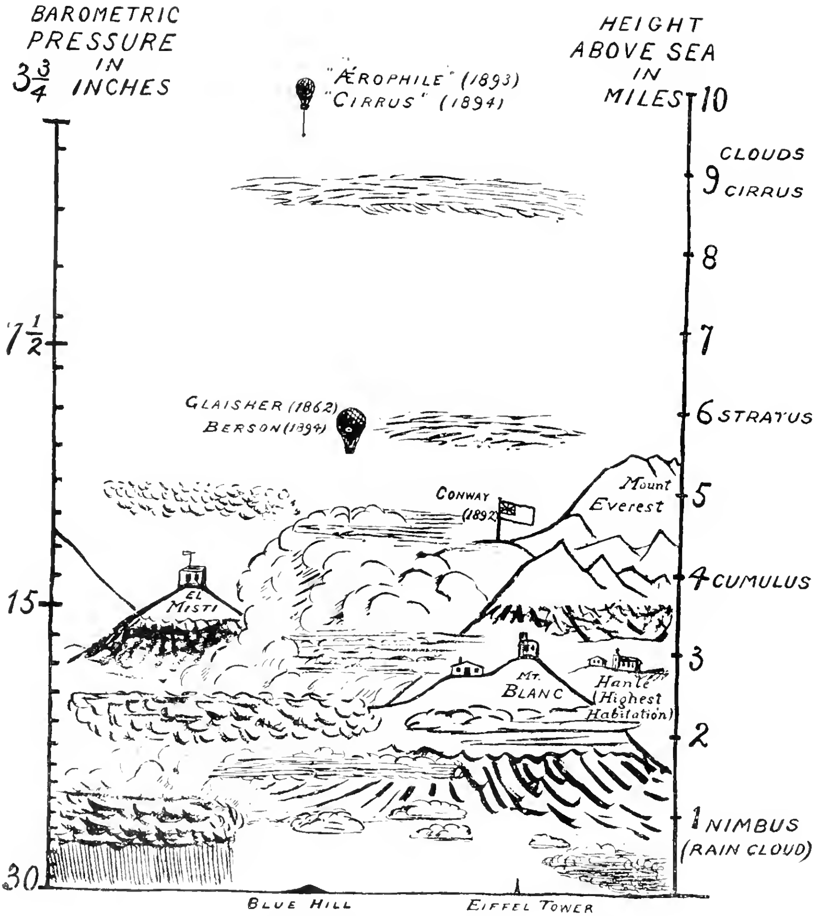
It may reasonably be expected that kite-flying will, in the early future, become one of the most common pastimes, as it has already become a scientific pursuit at many places; being specially adapted to certain situations, as islands and upland regions.

On the Isles of Shoals, off the New Hampshire shore, during the last season there was a very elegant kite carnival. Nearly one hundred kites were there, mostly in the hands of children. The larger number were of the Clayton cellular pattern, but of small size. On one occasion sixteen of them were flown to a great height in a single tandem. Each kite was differently marked, by color or other means, so that these alone afforded a very pleasing spectacle, without regarding the delighted children and their maturer companions beneath.

Kites in tandem, unlike members of equine and other tandems, are rarely if ever in line, but diverge irregularly, like the branches of a tree. This is owing to variations in the flow of the atmosphere, which appears to be less uniform than the currents in a river, having eddyings, swervings, and evanescent accelerations and retardations.

Aside from the charming groups watching their progress, there is pleasure for any observer in a flight of these ethereal forms, various in color, dispread from the trunk line as though they were huge leaves or high-flying butterflies on the tips of invisible branches.

The flat kites of the Malay or Eddy type are not less pleasing than their tailed cousins, the common kites of various shapes, and are more like living creatures, because of their incessant action. The mounting up of one after another with irregular movement, now turning to right or to left or downward, then catching an upward-going zephyr and soaring with it at an angle of seventy or



COMPARATIVE ALTITUDES.

eighty degrees far up after its happy mates, will be watched by the leisureful looker-on with absorbing interest.

Behold them, at length, poised high in air; the position of the far-away leader discoverable only by following with the eye the faint spider thread of drooping line. Ceasing from progress and retrogression, poised like humming birds before a flower, tipping momentarily now one side and then the other in rhythmic movement, changing their tint with every motion, the casual observer has an impression that he is gazing at a flock of real birds, with a notion of white, gray, pink, blue, and purple gulls, uncommonly wide of wing and unusually fascinating.

Now and then one or another sails away from its place and poises itself for a few moments, then returns nearly to its former position; while another takes a sudden dive downward, ending in a graceful parabola which brings it to a new point on its original level. Sometimes one kite will move almost directly at another, which shyly sidles away; when the first ceases its movement, droops, and sinks down, until, just in the nick of time, a strong young zephyr catches it and buoys up its faltering pinions.

The cause of all these apparently purposed movements being invisible to the beholder, some degree of reflection is required to rid one's self of a lurking idea that these are animate things.

Elements of the Hargrave Kites.

From the Tables of Blue Hill Meteorological Observatory.

No.	Width of kite: Metres.	Length of kite: Metres.	Depth of Cell: Metres.	Width of Cell: Metres.	Lifting surface: Square metres.	Cross-section of sticks: Square millimetres. Lateral.	Longitudinal.	Total weight of kite: Kilogrammes.	Weight per sq. metre of lifting surface: Kilogrammes
1....	1.52	1.80	0.57	0.58	3.58	240	320	2.47	0.69
2....	1.12	1.32	0.46	0.41	1.84	200	200	1.56	0.85
3...	0.91	1.22	0.41	0.41	1.49	40	80	0.82	0.55
4....	1.22	1.82	0.46	0.46	2.13	110	110	1.64	0.77

The lifting surface of these several kites is assumed to be the total surface of the side planes (upper and lower). The sticks have a rectangular or elliptical cross-section.

The kites are very stable, and fly in recorded wind velocities of from six to twenty metres per second. The angular attitudes reached by the first two kites average between forty-five and fifty-five degrees, and those reached by the last two average between fifty and sixty degrees. The pull in a recorded wind of ten metres per second averages about five kilogrammes per square metre of lifting surface.

The Blue Hill method of testing kites is to fly them with a short line, usually from fifty to one hundred metres long, and to make frequent and regular observations of the angular attitude and of the pull. The instruments employed are a surveyor's transit and a spring balance. Tests are usually made under widely varying conditions of wind velocity, and the kites flying at the highest angles and those exerting the greatest pull are easily selected. The work in view consists of raising a meteorograph of known weight under varying conditions.

PRINCIPLES OF TAXATION.

By DAVID A. WELLS, LL. D., D. C. L.,
CORRESPONDANT DE L'INSTITUT DE FRANCE, ETC.

XVIII.—THEORY AND PRACTICE OF INCOME TAXATION.

COMMENCING with first principles, the general taxation of incomes is theoretically one of the most equitable, productive, and least exceptionable forms of taxation. What can be fairer than that each citizen should annually contribute an equitable and just portion of his net gain or income for the support of the government or State under which he has elected to live, and in default of which he would not be likely to have either gain, income, or property? and such a method of supporting a government would therefore seem to be in accord in the highest degree with those canons or maxims of taxation which are regarded by nearly all economists and jurists as the highest embodiment of human wisdom on this subject.

And yet the proposition is hardly open to dispute that a general income tax, with such administrative features as are essential to make it desirable as a revenue measure, can not be successfully administered under a free and popular form of government. On this point the comparatively recent experience of the United States, which few now remember, ought to be most instructive. Thus, in 1869, under a Federal law assessing all incomes in excess of $1,000, and with a corps of trained officials to execute it, only 259,388 persons out of a population in that year of about 37,000,000 acknowledged the receipt of any taxable income; and in 1872, when the exemption had been raised to $2,000 and the population had increased to over 39,000,000, the number of persons who had an income tax ran down to 72,949—leaving a presumption that every one of those who did not pay and was made subject to inquisition by the officials in respect to his income, made oath that he was not in receipt, from wages, salary, interest, or profits, of an income liable to taxation in excess of $2,000. From an economic point of view it would be a misnomer to call such a result "taxation"; from a moral point of view its characterization as "appalling" would not be inappropriate.

Another point which may also be accepted as theoretically beyond dispute is, that if all were willing to live up to and carry out the correct and rational theory of an income tax, there would be little use for tariffs, customhouses, internal revenue departments, and excises. But that is exactly what human nature, as we find it, will not agree to have done in the one case, or to do in the other. In fact, there is hardly any other one thing which human nature so much dislikes to do as to pay taxes, although it is capable of demonstration, even to a most obtuse intellect, that there is no one act which can be performed by a community that brings in so large a return to the credit of civilization and general happiness as the judicious expenditure for public purposes of a fair percentage of the general wealth collected under an equitable system of taxation.

Now, an income tax is the very essence of personal taxation, and although in respect to a specialty of application it has been decided by the Supreme Court of the United States not to be a direct tax, it comes to the ordinary taxpayer most directly; and this is the first or one of the most influential reasons why human nature, as ordinarily constituted, does not like it. The world's experience is to the same effect in respect to a "poll" or "head" tax. This in a popular sense is almost universally regarded as a direct tax, and altogether personal in its incidence. It has accordingly always been most unpopular. Its collection has been the occasion of great civil disturbances in the world's history, and it has been denied a place by popular vote or constitutional provision, in the tax system of most of the States of the Federal Union.

A second and more important reason why a general income tax powerfully antagonizes popular sentiment is that its efficient administration, or revenue productiveness, requires that every person liable to taxation in respect to his annual net gains, profits, or income shall make to a Government official an exhibit of the financial condition of his estate, business, or profession; for, in default of such an exhibit, any basis for assessment must be a mere matter of conjecture on the part of the assessor, with a result devoid of any pretense to correctness or equality. But such an exhibit, necessarily disclosing to a greater or less degree his financial condition to his business competitors, and to a curious, gossiping public, no man will willingly make; and he naturally regards it as in the nature of an outrage on the part of the government that seeks to compel him to do it. Hence the successful administration of an income tax involves and requires the use of arbitrary and inquisitorial methods and agencies, which, perfectly consistent with a despotism, are entirely antagonistic to and incompatible with the principles and maintenance of a free government.

Practically, as John Stuart Mill has expressed it, "the fairness which belongs to the principle of an income tax can not be made to attach to it in practice"; and, "while appparently the most just of all modes of taxation, it is in effect more unjust than many others that are *prima facie* more objectionable." And again he says, "The tax, on whatever principles of equality it may be imposed, is in practice unequal in one of the worst ways, falling heaviest on the most conscientious," and "should be reserved as an extraordinary resource for great national emergencies, in which the necessity of a large additional revenue overrules all objections."

Mr. Gladstone, speaking in 1853, also said, "I believe it" (an income tax) "does more than any other tax to demoralize and corrupt the people." And Mr. Disraeli subsequently in Parliament expressed his agreement with Mr. Gladstone by saying, "The odious features of this tax can not by any means be removed or modified"; and with these opinions nearly all educated financiers and economists are in complete unison, except a comparatively few persons who, educated in Germany, have embraced the idea that because income taxes are effectively collected in countries having a despotic form of government, they can be equally collected in countries under a popular government.*

In support of these conclusions attention is asked to the following historical evidence. It is well known that one of the principal causes which led to the great French Revolution was the inequality (class exemptions) and multiplicity of taxes; and one of the first acts of the National Assembly of 1789 was to repeal all inquisitorial and arbitrary taxes of every name and nature; and this repeal was based on the report of a committee of some of the most eminent members of the Convention—La Rochefoucauld and Talleyrand being of the number—which commenced with the following proposition: "Every system of taxation which necessitates personal and arbitrary inquisitions for its execution is inconsistent with the maintenance of a free people." And although, from that day to this, France, by reason of a national debt greater than that ever borne by any other nation, has been compelled to resort to almost every expedient for obtaining revenue, it has, theoretically at least, endeavored to maintain a system of general taxation not inconsistent with the above principle.

Under the head of indirect taxation, however, which includes the general direction of the stamp tax, "domainal public land" revenues, customs, duties on imports, salt and sugar taxes, and monopolization of the manufacture of powder and the sale of tobacco and matches, the so-called communes of France have a right to "levy a tax of three per cent on the annual income (interests, dividends, etc.) of personal property, such as French or foreign securities, shares, bonds issued

* As the opinions of English authorities (above referred to) have been disparaged on the ground that they represent old-time utterances and imperfect fiscal experiences, attention is here asked to the following extract from a letter of Prof. Thorold Rogers, late member of the British House of Commons and Professor of Political Economy, University of Oxford, under date of August 25, 1884: "Nobody defends the income tax. It was first imposed on the tyrant's plea that the administration can not do without it, and it has been continued for the same reason. Every Chancellor of the Exchequer has condemned it in principle and has continued it in practice. It is not wonderful, therefore, that, fortified by these avowals, people who can evade the tax do so."

by departments, industrial establishments, independent of the stamp or transfer tax, but not affecting the bonds of the state (or rentes), nor associations of partnerships in a collective name, nor private obligations, mortgages, and the like." "Religious societies are taxed five per cent on the income of their capital." In 1886 the revenue derived from the above taxes was returned at 47,200,000 francs ($9,400,000), representing in 1886 a capital of 1,500,000,000 francs, of which 131,000,000 francs represented properties situated in France.

Again, it is not generally known that Alexander Hamilton, as a member of the conventions which framed the Constitution of the United States and the first Constitution of New York, gave all his influence in favor of the restriction of all internal or local taxation to visible, tangible objects, and to the assessment of these specifically, and by some uniform and simple rule. The language used by him in one of his papers (The Constitutionalist) on this subject is as follows: "*The genius of liberty reprobates everything arbitrary or discretionary in taxation. It exacts that every man, by a definite and general rule, should know what proportion of his property the State demands. Whatever liberty we may boast in theory, it can not exist in fact while (arbitrary) assessments continue.*"

The following sentiment or legal principle, laid down by the United States Supreme Court in the case of Boyd *vs.* United States (116 United States Reports, 631, 632), though often apparently little regarded by the legal profession, would, however, seem in itself to constitute a complete and insuperable barrier against any resort in the United States to the prosecution of arbitrary or inquisitorial inquiries, which must of necessity be instituted and prosecuted by tax officials for the obtaining of any personal and warrantable data for the correct assessment of an income tax, the language of the court being as follows:

"*Any compulsory discovery, by extorting the party's oath or compelling the production of his private books and papers to convict him of a crime or to forfeit his property, is contrary to the principles of a free government. It is abhorrent to the instincts of an Englishman. It is abhorrent to the instincts of an American. It may suit the purposes of despotic power, but it can not abide the pure atmosphere of political liberty and personal freedom.*"

So much, then, for what may be termed the philosophy of an income tax. Consideration of some of its most instructive experiences is next in order.

The old Romans, who never gave much place to sentiment in their laws or policy, had an income tax in the days of the empire, and they overcame all difficulties connected with its administration in the following manner: They authorized their tax officials, in cases where the citizen did not in their opinion make a satisfactory payment, or was suspected of false statements in respect to his income or property, to administer torture; and the historian Gibbon, in writing about this feature of Roman history, justifies it in a measure in the following language:

"The secret wealth of commerce, and the precarious profits of art and labor, are susceptible only of a discretionary valuation; and as the person of the trader supplies the want of a visible and permanent security, the payment of the imposition, which in the case of a land tax may be obtained by the seizure of property, can rarely be extorted by any other means than corporeal punishment."

That the Roman income-tax system was successful as respects revenue is probable, but it was also destructive of the state; for the testimony of history is that its people finally welcomed the inroad of the barbarians as a lesser evil than the continuance of their tax system.

As has been already intimated, there has been nothing corresponding to a general income tax, with personal inquisitorial features, in the fiscal system of France since the Revolution of 1789, In place of it, taxes are levied on the *indicia* or signs which each citizen presents of his possession of income or personal property; and the rents or rental value of the premises he occupies for residence or business, and the doors and windows of buildings, are regarded as such signs or *indicia*. This tax applies to the doors and windows into streets and courtyards and gardens of houses or workshops. In general, all openings giving light or air to houses and buildings for human habitations, shops, workshops, sheds, warehouses, etc., are taxable, whatever their shape, dimensions, or fastening may be. Thus, all openings to afford light to the stairs, to a habitable room opening on a covered yard, of a habitable house used for rural purposes, or the door of a garden leading to a dwelling, all are taxable. The openings to new buildings become taxable as soon as they are habitable. If at the time of making the tax roll some rooms in a new house are not yet habitable, the openings of such rooms are for the time exempt. If the entire front of a room or *atelier* consists of windows, the number of windows to be taxed is determined by their solid divisions of either iron, wood, or stone. Exempt are the doors and windows to light or air of barns, sheepfolds, stables, cellars, etc., not intended for human dwelling. Further exempt are doors or gates not locked; also interior doors of communication from one yard to another. Doors as well as windows of manufacturing establishments are not taxable except to those in the dwelling part.

Again, what is called a *mobiliary* tax of France is governed by the amount of rent paid or the rentable value of the dwelling of the taxpayer. That portion of a house used exclusively for trade or a similar purpose and not for a residence is not counted in the valuation of the rentable value like a furnished house or a private chapel; but premises or dependencies of dwelling houses, courts, stables, and carriage houses of luxury, clubs, societies, and Masonic lodges are counted in.

In assessing the mobiliary tax it is not necessary that the figures taken as a basis for taxation should be the real rent; it is sufficient that the proportion of the assumed rent, the basis of the tax, and the real rentable value of the dwelling should be exactly the same for all taxpayers; so that a taxed citizen can convince himself whether he is overtaxed or not by comparing his own rent with that generally charged in his community.

The theory which underlies the French system of taxation is that the rent or rental value of the premises occupied by the taxpayer as a residence is proportioned to the amount of his property; and this generally speaking, would seem to be a not unreasonable assumption. At all events, it would seem to possess this great advantage—namely, that the rent payable by every citizen may be readily ascertained, while the amount of his means can not, if he chooses to conceal it.*

Russia seems to have abandoned the idea of an income tax, and in place of it would appear to have substituted what is known as a

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* The following epitome which has been recently made of the burdens of taxation imposed upon an honest taxpayer in New York as compared with that which is borne by a man possessed of the same means or income in the city of Paris is believed to be approximately correct:

"Let us assume that the property of such an individual, if out of business, consists of personal estate, such as railway bonds and stocks of the value of $100,000, that the net annual income therefrom is $5,000, and that the rent paid by such individual amounts to one fifth of his income, equal to $1,000, or that being engaged in business his average annual profits enable him to occupy an apartment of the same rental value. In Paris the party in question would have to pay as *contributions mobilières* about 400 francs, or, say, $80, or, including his door and window tax, which he pays through his landlord, say, $90. If engaged in business or practicing a profession, he would have to pay a license tax or *patente*, which varies from 100 to 1,000 francs (we are speaking, of course, of the mass of the people, and not of merchants or companies occupying very extensive and costly premises, whose *patente* may run up to several thousand francs, and whose taxes are payable out of the profits of their business, and not out of the income derived from their investments). Such householder thus pays on an average, say, 1,000 francs as the total of his direct taxes. Supposing him to pay the sum of 1,000 francs indirectly in the shape of *octroi* duties on the provisions consumed by himself and family in the course of the year (and this allowance we consider a very liberal one), we find the total amount of his annual taxes, direct and indirect, to be, say, 2,000 francs, or $400; while in New York a person similarly situated would have to pay, if he made an honest and full declaration of his property, about 2.6 per cent on his principal, making, in the present case, his tax amount to $2,600. Even if we assume that the Parisian pays an additional $200 per year on an average in the way of succession and other exceptional taxes, his contributions to the expenses of the Govern-

"hearth" tax, which is collected from each separate building inhabited, or used for any commercial or industrial purpose.

An income tax has existed in Austria-Hungary since the beginning of the nineteenth century. It was repealed in 1829, and re-enacted in 1849. This tax is divided into three classes. "Under the

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ment would be at the utmost only $600 in place of the $2,600 levied upon the unfortunate New-Yorker.

"In return for what he pays, the Parisian enjoys well-paved and well-cleaned streets, wide and unobstructed sidewalks, shade trees with benches under them for the weary, public gardens kept in beautiful order, etc., while the New-Yorker gets—well, the less said on this subject the better. May we not entertain the hope that honest men of all parties will soon unite to secure a better system of taxation and a more efficient administration of the government in the most populous and wealthy city of the model republic? or must we accept as a melancholy truth that universal suffrage inevitably results (at least in American cities) in rabid democracy, dishonesty, and dirt?"

NOTE.—M. Yves Guyot, in a report recently made on questions connected with proposals relating to the establishment of an income tax in France, regards the great fiscal wrong in that country to be the inequality of the assessments of real property in the different departments. This is increased by the fact that the French land tax is not levied at the same rate on all property, but the proportion of the whole amount which is to be paid by each department is fixed by the central authority; the departments allot the quotas to be paid by the several communes, and the communal authorities apportion their quota among the individual taxpayers. The tax is, to use the French technical term, one of *répartition* and not of *quotité*. If it were the latter, each taxpayer would pay in proportion to his property; the rate of the tax would be fixed by the Government instead of the amount to be raised from each department. The valuation on which this tax is levied is the net annual value, and was fixed unsystematically and imperfectly from fifty to seventy years ago; the value of real property has changed, but the original assessment is still in force. The result is that some departments pay from six to eight times as much as others in proportion to their real annual value.

M. Guyot advocates a tax on the capital in place of on the annual value. There is, as he points out, a manifest injustice in taxing the same amount of capital at different rates, according to the mode in which it is invested. In France a capitalist might invest his money in building lots or other land temporarily unproductive, but held for resale at a profit. The investment, yielding no income, would practically escape taxation. If the same sum were invested in safe securities yielding an income of three per cent, the tax would be levied on that income, while if placed in business where, though it might temporarily yield twelve per cent, the loss of the whole would be risked, the owner would pay four times as heavy a tax as in the previous case.

The same objections have been frequently urged against the income tax in England, but there a difficulty exists in the way of assessing the capital value of land—viz., that land is generally the subject of letting and seldom of sale. In France, however, not only are there nearly a million sales of land each year, but on every devolution by inheritance the capital value of the land is officially registered. The ascertainment of the capital value of the entire country would be an easy matter, and such an assessment would be of more durable benefit than an official estimate of the annual value, which, necessarily varying from year to year, would be a much more fluctuating and uncertain basis for taxation than the selling value.

The reforms proposed by M. Guyot would increase the land tax in those departments which are undervalued; and he estimates that a revaluation for taxation would cost ten million dollars, and that it would take ten years to complete. He thinks the complaint by landowners of overtaxation generally is unfounded; but he would nevertheless relieve them *first* class, the tax in force in 1887 was from eight and a half per cent to ten per cent of net income." Under this class the following income was taxed: income derived from all those trades and occupations which are subject to a license tax; the income of mining and smelting establishments, and the profit made by the tenants of agricultural lands. In the *second* class, which includes income from services rendered or labor performed in occupations not subject to a license tax, the rate reported is exceptionally high. Under the *third* class, which embraces interests from loans, from invested capital, savings banks, and life-insurance companies, the rate is reported to be ten per cent. The exemptions under this latter head are very extensive, and include the pay of officers and soldiers in active service, interest on deposits in savings banks, and a great number of public securities—as five per cent Austrian stocks and bonds, certain bonds of the Tyrol, bonds of all railroads subject to taxation, lottery loans of 1859 and 1860, and a large number of other corporation securities.

Servants are only taxed under the second class and in case their total income exceeds six hundred and thirty florins ($226.16).

In case a party subjected to an income tax makes either a false return or neglects to make any, thrice the amount of the tax is imposed, the payment of which, however, includes the tax itself, so that the fine proper is double the amount of the tax.

DENMARK.—The income tax of Denmark was recently fixed at two per cent of the taxpayer's income. The tax is collected by authorized agents, who are obliged to give ample security for the faithful performance of their duties, for which they receive a remuneration of two per cent on the amount collected, together with an allowance for house rent in return for the obligations imposed upon them of having residences and offices in the taxing districts. This income tax does not seem to be objectionable in the sense of undue burdensomeness, the only complaints made being in regard to the publicity of the pecuniary conditions of the individuals taxed.

SWITZERLAND.—A resort to an income tax for the purpose of defraying state expenditures seems to find especial favor in Switzer-

in the interest of free-trade principles from the vexatious and heavy duties on transfers, which, with legal expenses, make the cost of sales amount to ten per cent of the price paid. This heavy impost prevents sales, and its removal should be supplemented by establishing a simple system of transfer on the record-of-title principle. These reforms, which involve equality of taxation and free trade in land, are, in M. Guyot's opinion, essential to the well-being of France, whose greatest wealth consists in her land. Fifty per cent of the population are engaged in agriculture, and, without releasing them from their fair share of the public burdens, they should be placed in such circumstances as will permit land to pass into the possession of those who are most capable of working it to advantage. (*Rapport sur les questions relatives à l'impôt sur le revenu.* Par Yves Guyot. Paris: Guillaumin & Cie. 1887.)

land, though it does not seem probable that the systems adopted for its enforcement will ever be found satisfactory to the people of other countries. Thus, in the taxation of incomes, the average rate does not generally exceed four or five per cent, but in some cantons the rates rule as high as seven and even ten per cent. By a comparatively recent law established in the canton of Vaud, which in point of population and wealth ranks third in the Swiss confederation, progressive taxation has been established, and the property of the canton is divided into three classes which are taxed in the following proportions: One per cent 1,000 for estates under \$5,000 capital value; $1\frac{1}{2}$ per cent 1,000 between \$5,000 and \$20,000, and 2 per cent 1,000 for estates exceeding \$20,000 in value. Personal property is divided into seven classes, the lowest class being under \$5,000, the highest exceeding \$160,000 capital value. The rates of taxation on these classes are to be in the proportion of 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, $3\frac{1}{2}$, and 4 per cent 1,000. Incomes from earnings are also divided into seven classes, but in arriving at the net amount to be taxed, a deduction of \$80 is allowed for each person legally dependent on the head of the family for his support. The result of this is that while a bachelor earning \$1,000 a year would pay a tax of \$15, a married man with the same income and ten children would pay but fifty cents, and if he had twelve children nothing. The Vaudois law was carried by overwhelming majorities when submitted, as was necessary, to a "referendum" vote of the whole people, and at every subsequent stage of its progress.

The only one of the great governments of the world at the present time which can prefer a claim to a large measure of success in administering an income tax is that of Germany, and especially that of the kingdom of Prussia; and the methods by which such success has been attained, and which seem to be based on the precedents established by the old Romans so far as the changed conditions of civilization will permit, ought to be most instructive to those who think this tax can be administered and made notably productive of revenue in the United States. The tax in Germany is levied, as it were, in duplicate, or under two forms: first, by towns and cities, and termed "communal"; and, second, by the state, under the designation of "class" tax. An entire exemption from these taxes is granted only to the very poorest and humblest of the population.

"Petty hucksters with a small stock of potatoes, second-hand clothes peddlers, servant girls earning four dollars and twenty-five cents a quarter, pay the communal tax, and are also inscribed in the first (or lowest) grade of the class tax." *

* United States Consular Reports, Nos. 99, 100, p. 461.

Every foreigner staying in Prussia more than one year, but with no intent of becoming a permanent resident, must expect to be taxed on his income at the expiration of the first year, although none of the sources of such income may be within the territorial jurisdiction of Prussia. Up to the year 1891–'92 the income tax of Prussia was levied by a board of income-tax commissioners, one third of whom were appointed by the authorities and two thirds by the taxpayers. The assessing was done by the board on information and evidence obtainable; and in the absence of authentic proof as to the amount of annual income, "circumstantial and hypothetical evidence was accepted." Parties thus assessed might appeal from the conclusions of the board to another tribunal organized for that purpose, whose decision was final. Appeals are not often made to this latter board, as the methods adopted by it to bring unwilling or evasive taxpayers to terms are harsh and inquisitorial in the extreme and most peremptory. The *modus procedente* against delinquent taxpayers is very summary. If after three days' written notice payment fails to be made, a mandate is issued by the tax collector, and the property of the delinquent, especially his household goods, is seized and sold. By another curious provision in the German tax law the collector of taxes is made personally liable for any taxes lost by reason of his failing to mercilessly enforce the collection within a prescribed period. In 1891 some mitigation of the harsh proceedings involved in the assessment of the income tax in Prussia was made by the Government, and now every taxpayer is allowed to make a return.

Great Britain.—The idea of a general income tax as a means of raising revenue was first embodied in the form of a statute in Great Britain under the administration of Mr. Pitt, in 1798, and was proposed and advocated solely as a means for obtaining additional revenue for the prosecution of the war with France. It imposed a tax of ten per cent on all incomes in excess of £200 ($1,000). After the Peace of Amiens, in 1802, it was repealed on the ground that a tax of this character ought to be exclusively reserved for the exigencies of war; and for a like reason it was reimposed on a revival of the war during the following year. Subject to various modifications, it formed an important constituent of the fiscal system of Great Britain until after the battle of Waterloo and the peace of 1815, when it was again repealed. After this, nothing more was heard about it until 1842, when Sir Robert Peel reimposed it as a merely temporary measure—i. e., for a period of five years. It has, however, since remained a permanent feature of the British fiscal system, although its repeal has been promised and anticipated by various administrations, and in the general election of 1874 Mr.

Gladstone, in an address to the country, especially asked that the confidence and continued administration of the Government be given him on the ground that he contemplated an early repeal of the income tax. Circumstances, however, have prevented any such action, and in subsequent years of office Mr. Gladstone has not hesitated to raise the tax whenever the necessity of additional revenue for the Government became imperative. That he has regretted his inability to abolish it is evident from his saying, in his financial statement in 1853: "I think some happier Chancellor of the Exchequer may achieve this great accomplishment, and that some future poet may be able to sing of him:

> "*He took the tax away,*
> *And built himself an everlasting name.*"

From the outset the income tax has been more odious and unpopular in Great Britain than any other form of taxation. Among statesmen and economists there is hardly any dissent from the opinion that the tax is bad in principle, because unequal and unjust in its assessment, and incapable of being made equal and just; and this, too, although the administration of the revenue laws of Great Britain—owing to the comparatively small area of territory subjected to supervision, and the fact that the tenure of office on the part of officials is dependent solely on honesty and intelligence—is wonderfully efficient, far more so than can be expected under existing conditions in the United States. The annual reports of the British Commissioners of the Inland Revenue always mention extensive evasions of the income tax. For the year 1864-'65 the amount of such evasion was estimated to have been equal to about one sixth of the revenue collected under it. The demoralizing effects which are inevitably produced by the habit of making false returns respecting income are regarded by many British authorities as far more deplorable than those resulting from any inequality contingent on this form of taxation; as the transition from a fraud upon the Government to a fraud upon the public is comparatively easy. The reported product of the income tax of Great Britain for 1893-'94, was £15,200,000 ($76,000,000); an amount beyond the estimate.

Note.—The following incident, which has become a part of English political history, is curiously illustrative of the state of public opinion in England at the time of the first imposition of the income tax under the statute of Mr. Pitt, and is derived from the memoirs of John Horne Tooke:

Mr. Tooke was an Englishman who participated actively in British politics during the latter third of the last century. He early espoused the side of the Americans in their struggle for liberty, and was persecuted, fined, and imprisoned by the British Government for publishing an advertisement for a subscription for the widows and orphans of the Americans "murdered by the King's troops at Lexington and Concord." After his release from prison he naturally, and in connection with John Wilkes, made himself politically disagreeable to the Government, and the Government in turn made itself disagreeable to him; and accordingly the office of the commissioners for carrying into execution the act for taxing incomes addressed Mr. Tooke the following letter:

"*May 3, 1799.*

"SIR: The commissioners having under consideration your declaration of income have directed me to acquaint you that they have reason to apprehend your income exceeds sixty pounds a year. They therefore desire that you will reconsider the said declaration and favor me with your answer on or before the 8th inst.

"I am your obedient servant,

"W. B. LUTTLEY, *Clerk.*"

To this Mr. Tooke replied:

"SIR: I have much more reason than the commissioners can have to be dissatisfied with the smallness of my income. I have never yet in my life disavowed or had occasion to reconsider any declaration which I have signed with my name. But the act of Parliament has removed all the decencies which used to prevail among gentlemen, and has given the commissioners (shrouded under the signature of their clerk) a right by law to tell me that they have reason to believe that I am a liar. They have also a right to demand from me upon oath the particular circumstances of my private situation. In obedience to the law, I am ready to attend upon this degrading occasion so novel to an Englishman, and give them every explanation which they may be pleased to require.

"I am, sir, your humble servant,

"JOHN HORNE TOOKE."

A STUDY OF SNOW CRYSTALS.*

BY W. A. BENTLEY AND G. H. PERKINS.

MANY have admired snowflakes as they observed their exquisite outlines and varied forms, but few have ever given them careful study or distinguished the crystals of which a flake is usually composed.

Extended examination of snow crystals has hitherto been very difficult because, except in a very uncomfortable atmosphere, the delicate structures speedily disappeared, and their outlines could be preserved for study and comparison only by the aid of skillfully executed drawings. Even these must often be hastily made, and could show little of the internal structure which is so important a feature of most snow crystals.

Now, however, by any of the usual combinations of microscope and camera, these crystals can be easily and quickly photographed, and far more satisfactory representations obtained than were possible formerly. The term snow crystal is used because a snowflake may be a crystal or it may be, and usually is, a cluster of crystals.

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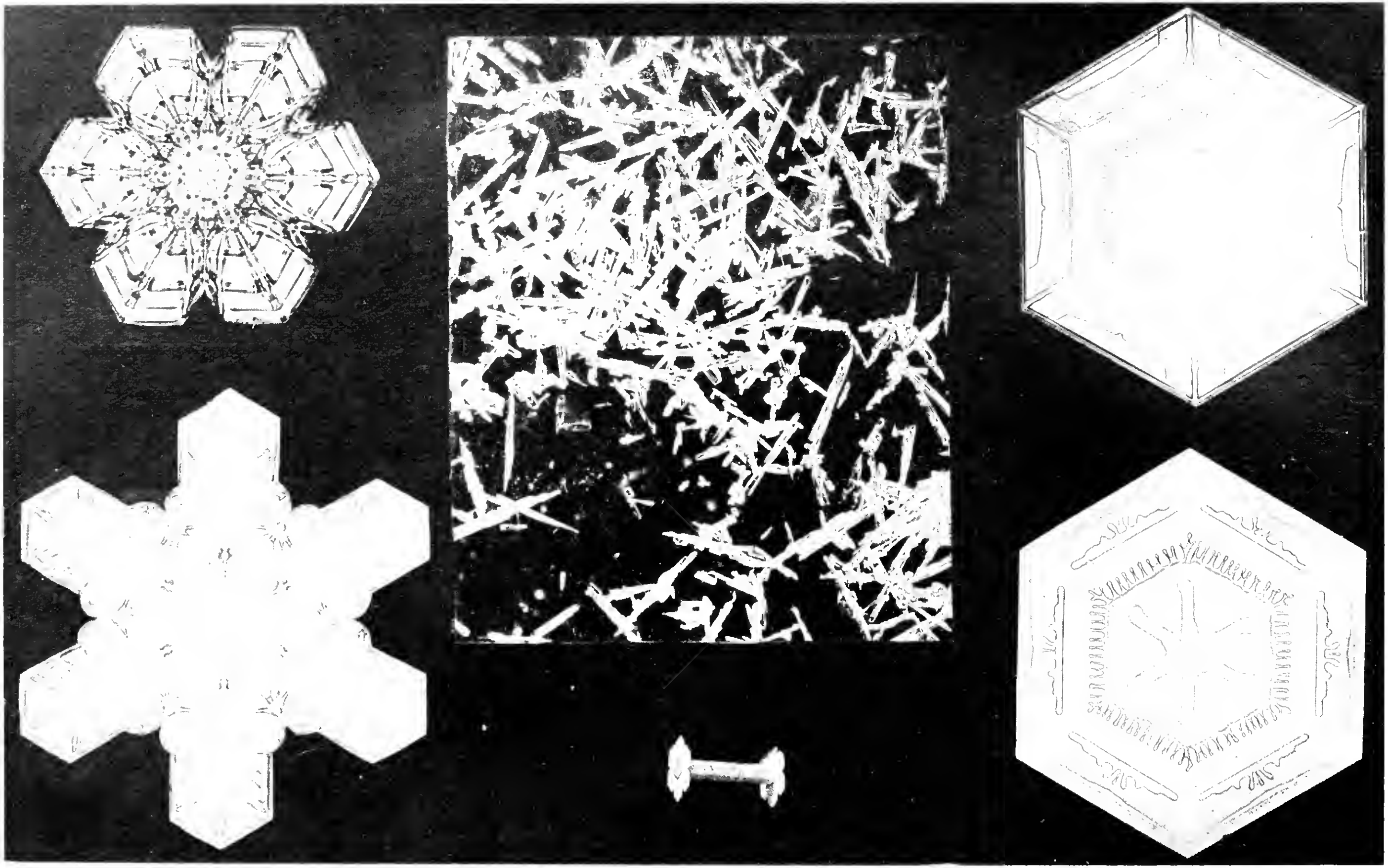
* It is only just that I should state that my share in the production of this article has been to compile its pages from Mr. Bentley's notes and photographs. The facts, theories, and illustrations are entirely due to his untiring and enthusiastic study of snow crystals.—G. H. PERKINS, *University of Vermont.*



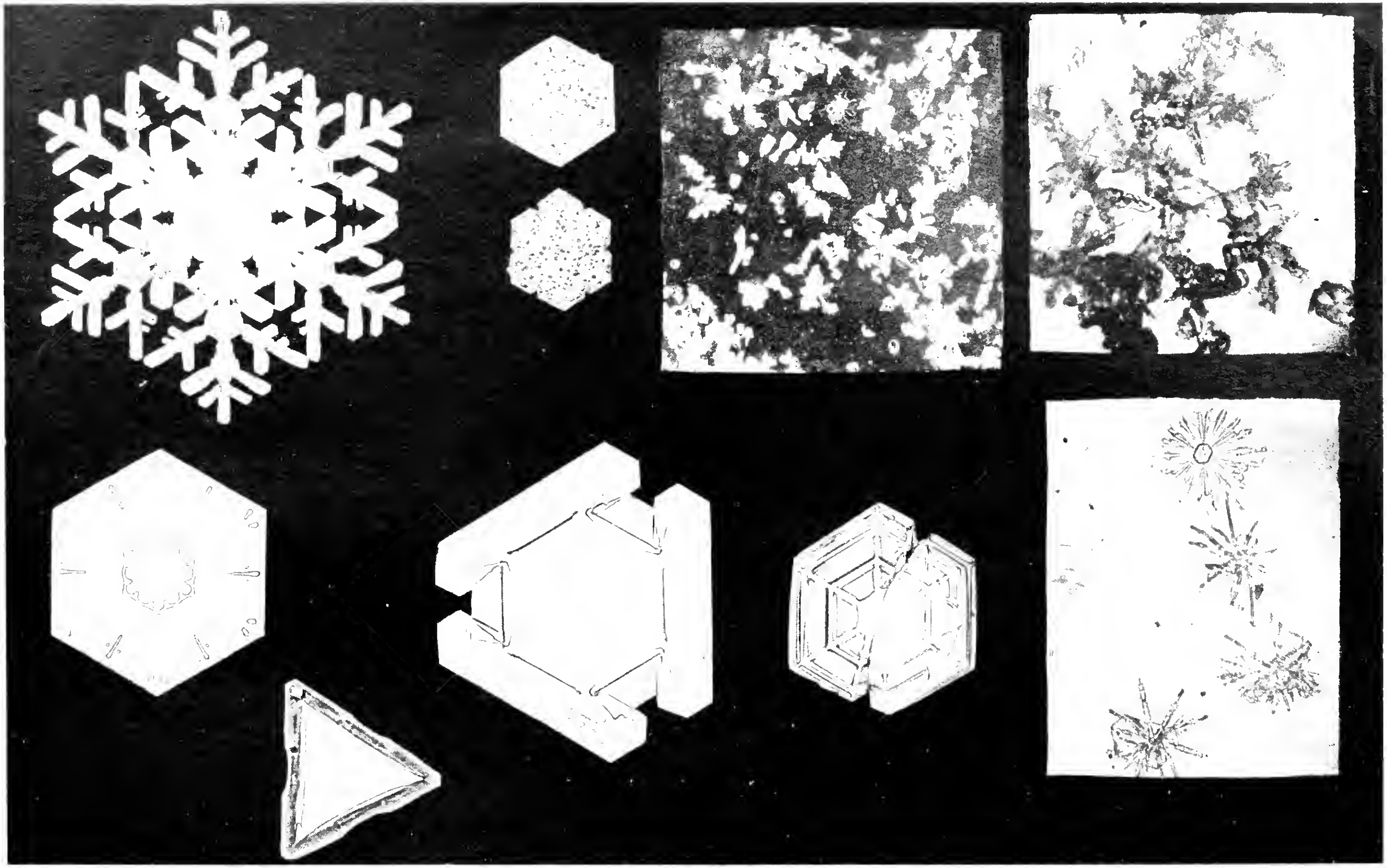
No. 16 No. 10. — No. 21. No. 19. — No. 1. No. 2.

The illustrations which accompany this article are all of them photomicrographs taken directly from crystals which were collected in northern Vermont during the past fifteen years. They are selected from over five hundred different forms. A close and minute study of many of them will reveal beauty and complexity of structure not seen by a casual observer. The methods employed in obtaining the illustrations have been very simple. It has been found that any apparatus which can be used for taking photomicrographs will serve to photograph snow crystals, but the microscope should be fitted with half-inch or two-thirds-inch objectives, of wide aperture and short axis; the focusing arrangement must work quickly and accurately; the diaphragm aperture be small, not more than one-sixteenth inch; the illumination ordinary, uncondensed daylight; the exposure, rapid plates being used, from forty seconds to three hundred, as the light is strong or weak, camera bellows closed or elongated, etc. A black card placed between two pins which project from the stage on each side of the objective serves to exclude unwelcome light when the slides of the plate-holder are changed. Great care is necessary to prevent the crystals from melting, as this is one of the chief difficulties which must be overcome. On this account the observer must not breathe upon his slides, nor handle them except with gloved hands. The whole work must be done in a cold room, with but one unscreened window. Crystals may be collected as they fall, upon a black card, and transferred by a bit of broom splint to a glass slide upon which they may be pressed flat with a feather.

Careful examination of the illustrations will soon convince one that, great as is the charm of outline, the internal ornamentation of snow crystals is far more wonderful and varied. Many of the specimens, we might almost say all of them, exhibit in their interior most fascinating arrangements of loops, lines, dots, and other figures in endless variety. So far as is known to the writer, these illustrations are the first which have been published that show in any adequate manner these interior figures, and surely they add greatly to our interest and delight as we study snow crystals. So varied are these figures that, although it is not difficult to find two or more crystals which are nearly if not quite the same in outline, it is almost impossible to find two which correspond exactly in their interior figures.

It is asserted by some observers that many of the lines or rods seen in the interior of snow crystals are really tubes filled with air.

Perfect crystals are by no means always common in snow storms, most of the forms produced being more or less unsymmetrical or otherwise imperfect. It rarely happens that during a single winter there are more than a dozen good opportunities for securing com-



No. 15 No. 9. No. 4. No. 20. No. 22.
No. 3. No. 17. No. 11. No. 8.

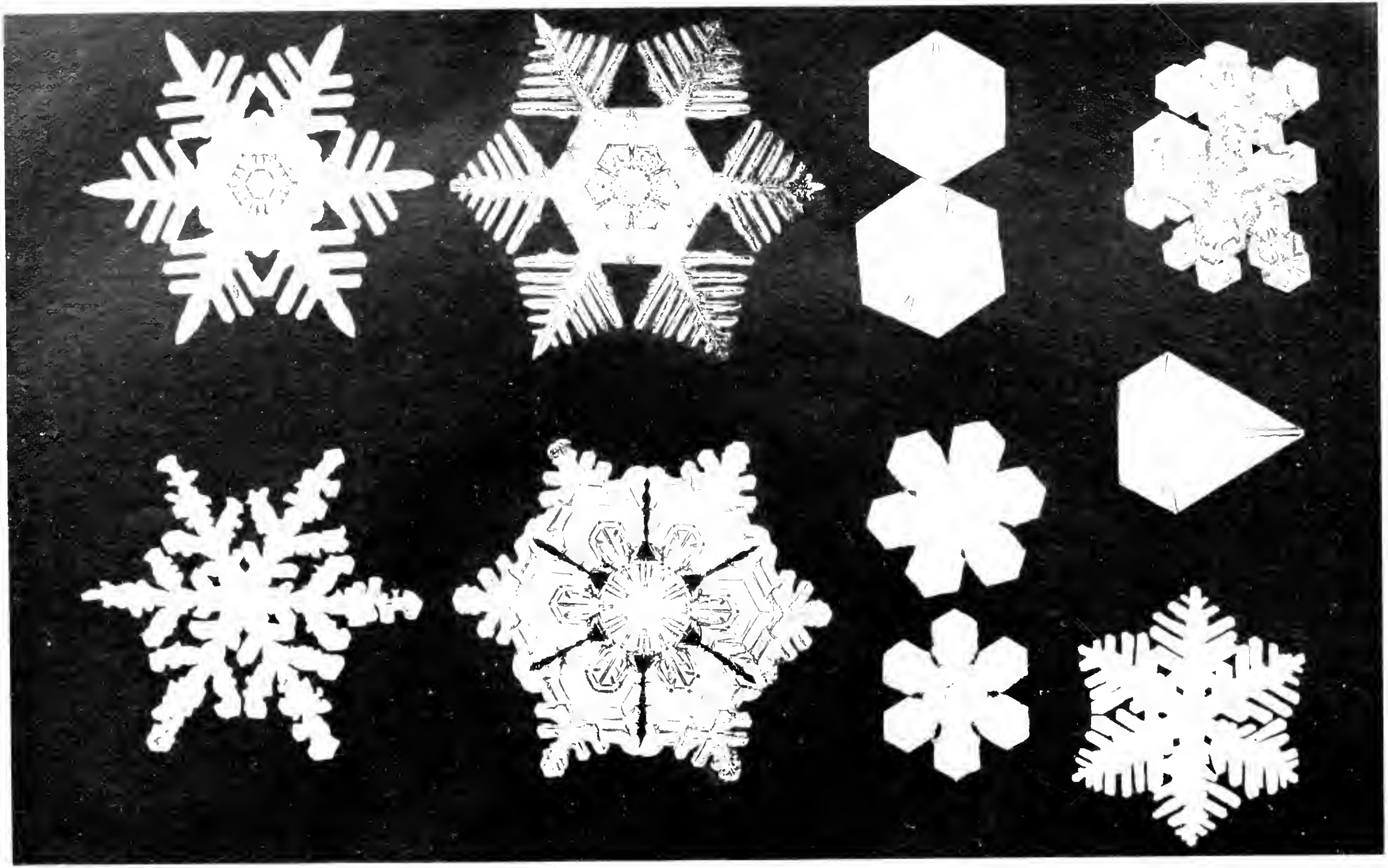
plete crystals, and there may not be half so many. The greater number of perfect crystals is found in widespread storms, or blizzards, while the local storms produce most often granular or imperfect forms. So marked is this distinction that very often the character and extent of a storm may be in general determined by an examination of the crystalline forms obtained. Extensive storms produce smaller crystals, more uniform in size, less clustered in flakes, and in greater variety than local storms. Figs. 1 to 20, inclusive, are crystals from general storms, while Figs. 23 and 24 are those of local storms. When the temperature is very low while a local storm is raging, its crystals resemble those of the blizzard more closely.

Some forms are common to both classes of storms. Probably because identical conditions do not occur frequently, the crystalline forms of each storm during a winter may differ from each other, one type appearing abundantly in one storm, a different type in the next, and so on. Conversely, the types most common in a given storm may reappear after an interval of months or years—as, for example, those obtained during the great blizzard of March, 1888, were repeated in the storms of February 16, 1892, and March 3, 1896, and most of these were of forms such as Figs. 13, 14, and 15, while unusual types, such as Figs. 7, 9, and 17, occurred in the storms of February 24, 1893, and February 13, 1894.

Not only do different storms afford different types of crystals, but different parts of the same storm, if it be general, give different forms. In this region, the northern and western portions of the storm area produce more perfect crystals than the southern and eastern, and from this we infer a difference in the atmospheric conditions in these portions, the former being more quiet and otherwise favorable to crystallization.

What has been called granular snow is shown in Figs. 4, 6, and 23. In this very common form we find only loose, irregular, subcrystalline forms, which are larger and heavier than others. This is formed in the middle or lower cloud layers, and when these are disturbed by wind, or otherwise rendered unsuitable for crystallization. Sometimes, perhaps always, these granular masses have nuclei of true crystals. Granular snow may explain the origin of the great raindrops which often fall during a thundershower. It is probable that such drops have a snow origin. Most, if not all, hailstones also originate in granular snow, as their thin, opaque centers and concentric rings of opaque, snowlike ice show.

The superiority of photography over drawing in securing details of structure may be readily seen if one compares any of the accompanying figures with the ordinary drawings of snowflakes, or even with the finest illustrations hitherto published. It is unfortunate



No. 12. No. 23. | No. 13. No. 14. | No. 5. No. 6. | No. 15. No. 7. No. 24.

that the depth and solidity seen in some crystals when the photographs are mounted as stereoscopic views can not be in some adequate manner reproduced in engravings, for this adds not a little to an understanding of the manner in which the crystal has been formed. Yet something of this can be seen in the figures as here given. A careful study of this internal structure not only reveals new and far greater elegance of form than the simple outlines exhibit, but by means of these wonderfully delicate and exquisite figures much may be learned of the history of each crystal, and the changes through which it has passed in its journey through cloud-land. Was ever life history written in more dainty hieroglyphics! It is well known that crystals which form in a low temperature are smaller and more compact than those formed in a warmer atmosphere. As the higher cloud strata are colder than those nearer the earth, the snow crystals which originate there are smaller and less branched than those from lower clouds. Such are shown in Figs. 2, 20, and 22, while crystals from the warmer clouds are more often like Figs. 24 and 25. The small, compact crystals of the upper clouds do not always remain of their original form or size, for, as they fall through layer after layer of clouds, each layer subjecting them to its own special conditions, they may be greatly modified, and by the time they reach the earth they may closely resemble the crystals from lower clouds, though they can usually be distinguished from them by an examination of the internal structure, as well as by, in some cases, their general form. All crystals falling from high cloud strata, the cirrus or cirro-stratus, are not changed; especially is this true in a great storm, or when the temperature of the lower clouds is low, and in any case some are much more completely transformed than others. One crystal may pass through cloud layers not very unlike that from which it came, and of course will not be greatly changed. Another may encounter here a quiet cloud layer and there a tumultuous layer, here a lower, there a higher temperature, here a dense and there a thin cloud mass, and by all of these conditions may be affected.

Examples of crystals which have been little changed are shown in Figs. 3, 7, and 8, while Figs. 12, 13, 14, and 16 show more completely modified crystals. Total transformation, such as the change of one type into another, does not often occur. The nucleus retains its original form, to which various additions are made during the downward passage. Composite crystals may, however, be formed during the passage through diverse cloud layers, though they are not common, as shown in Figs. 11 and 19. Usually, however, the tabular, compact, small crystals of the high clouds continue their development at lower levels upon the original plan, though becoming larger and more complex by the addition of branches at the angles. The triangular forms, such as Figs. 7 and 9, are less common than the others figured, and occur usually in the greater storms. Fig. 17 shows a very unique composite crystal, which, beginning in the higher clouds as a simple hexagon, seen in the center, received the peculiar additions which are well shown in the figure. Fig. 11 is exceedingly unusual. It appears to be a composite crystal formed from two, each of which has been in some way broken apart, and the portions shown were so brought in contact as to unite and form a single crystal of very nearly the original form of each of its parts.

The above are some of the more important of the many interesting results which have come from our study of snow crystals. They are given not merely as of value in themselves, but also in the hope that others may be stimulated to undertake similar investigations, and that thus our knowledge of these charming objects may be greatly increased. After what has already been said, it should not be necessary to add that any one who engages in the study of snow crystals will speedily find his task both absorbing and delightful. There is no surer road to fairyland than that which leads to the observation of snow forms. To such a student the winter storm is no longer a gloomy phenomenon to be dreaded. Even a blizzard becomes a source of keenest enjoyment and satisfaction, as it brings to him, from the dark, surging ocean of clouds, forms that thrill his eager soul with pleasure.

Prof. William Trelease relates, in his address on Botanical Opportunity, that when engaged with Prof. Gray in collecting and republishing the botanical writings of Dr. Engelmann, they were both surprised to see how voluminous these works were. A few years later, when Prof. Trelease had to arrange in form for preservation Dr. Engelmann's manuscript notes, he was far more surprised at the extent of them than he had been on collecting his printed works, for when mounted and bound they formed sixty large volumes. "In addition to their intrinsic value, these are of more than usual interest as showing the methodical manner in which Dr. Engelmann worked. On his table seems to have been always a bundle of plants awaiting study. As each specimen was examined its salient features were noted and sketched on the back of an ever-ready prescription blank. When interrupted, he laid his unfinished sketch away with the specimen, to resume his observation and complete his study on the first opportunity, without any doubt as to what had been seen in the first instance. And so from individual to variety, from variety to species, from species to genus, and from genus to family, his observations were preserved in memoranda that facilitated the resumption of interrupted work at any time and after any lapse of time." Thus the off moments in the work of a busy physician were made to contribute to botanical knowledge, and a seemingly small opportunity for investigation was converted into a great one.

A RELIC OF ASTROLOGY.*

BY PROF. H. CARRINGTON BOLTON, PH. D.

THE mysterious picture of a nude man surrounded by the signs of the zodiac, which forms a prominent feature of nearly all patent-medicine almanacs, is familiar to every one, yet few realize the great antiquity of the symbolism implied and the interesting history of this persistent relic of astrology.

The supposed connection between the zodiac and the anatomy of the human body is related in the following lines:

"The Head and Face the Princely *Ram* doth rule,
The Neck and Throat falls to the sullen *Bull*,
The lovely *Twins* guide Shoulder, Arm, and Hand,
The slow-paced *Crab* doth Breast and Spleen command,
The *Lion* bold governs the Heart of Man,
The modest *Maid* doth on the Bowels scan,
The Reins and Loins are in the *Ballance* try'd,
The *Scorpion* the Secret Parts doth guide,
The *Shooting Horse* lays claim to both the Thighs,
The Knees upon the headstrong *Goat* relies,
The *Waterman* he both the Legs doth claim,
The *Fishes* rule the Feet, and meet the Ram again."

Moore's Vox Stellarum, 1721.

As commonly drawn, this "repulsive picture" has changed very little in the last fifty years; a study of the bizarre conception takes us back to the earliest records of civilization: Chaldean astronomers laid its foundations, Hebrew sages and Greek philosophers built on them, Christian mystics and mediæval astrologers enlarged them so that a popular superstition arose which still has a hold on the common people. The first step in the evolution of this conception was taken more than four thousand years ago, when the star-gazers of Babylon observed the circular zone through which the sun appears to pass in the course of a year, and divided it into twelve constellations, creating what is known as the zodiac. To these twelve divisions signs were given, some of which are said to be Babylonian ideographs of the months. The astronomers of Egypt adopted this system, and their lively imaginations peopled the constellations with genii; thus arose a symbolism in which each group of stars is likened to a given animal or human character; these zodiacal signs are found sculptured on Egyptian temples and inscribed on papyri.

The second step was taken when philosophers, who "in the infancy of science are as imaginative as poets," assumed that the

* Abstract of a paper read at the Baltimore meeting of the American Folklore Society, December 28, 1897.

celestial bodies exert a controlling influence on terrestrial life. This belief is alluded to in the earliest poetical book extant; the Almighty himself is represented as saying to Job: "Canst thou bind the sweet influences of the Pleiades or loose the bands of Orion? Canst thou bring forth Mazzaroth in his season?" The word Mazzaroth is said by commentators to signify the signs of the zodiac.

The idea that man's life on earth and destiny for good or for evil is subject to the heavenly planets and stars and to their relative positions obtained in the early centuries of the Christian era; on a tombstone erected 364 A. D., in memory of an infant named Simplicius (that died the day it was born), there is an inscription which states that this double event took place in the "fourth hour of the night, of the 8th ides of May, the day of Saturn, the 20th day of the moon, under the sign Capricorn." The details of this epitaph are intended to account for the sad affliction of the parents.

> "Almighty Wisdom by a Mistique Tye
> Spread through the World a Secret Sympathy,
> Impregnating Superiours to dispense
> On lower Bodies, daily Influence."
>
> *Ames' Almanack*, *1730.*

Astrology flourished mightily throughout the middle ages, and by degrees a novel conception became ingrafted on the pseudo-philosophy; the physical universe came to be regarded as an organized being endowed with a soul and analogous to man. An intimate correlation between the universe and man was held to exist, the universe controlling the organism and destiny of man, and man having power over the fundamental laws of Nature. In this connection the terms macrocosm and microcosm came into use—the former to designate the world at large, and the latter the smaller world within man.

In the "Epistle of Isis, Queen of Egypt and wife of Osiris, to her son Horus," a Grecо-Egyptian writing on the "Sacred Art," of obscure origin and unknown authorship, man, as the microcosm, is regarded as the physical epitome of the universe, or macrocosm. "Hermes calls man the microcosm, because the man, or the small world, contains all that which is included in the macrocosm or great world. Thus the macrocosm has small and large animals, both terrestrial nd aquatic; man, on the other hand, has fleas and lice—these are the terrestrial animals; he has also intestinal worms—these are aquatic animals. The macrocosm has rivers, springs, and seas; man has internal organs—intestines, veins, and arteries. The macrocosm has aërial animals; man has gnats and other winged insects. The macrocosm has volatile spirits, such as winds, thunders, and lightnings; man has internal gases and *pordas* of diseases. The macrocosm has two luminaries, the sun and moon; man has also two luminaries, the right eye representing the sun, and the left eye the moon. The macrocosm has mountains and hills, man has bones and skin. The macrocosm has heavens and stars, man has a head and ears. The macrocosm has twelve signs of the zodiac; man has them also from the lobe of the ear to the feet, which are called the fishes." This writing dates approximately from the fourth or fifth century.

The expressions macrocosm and microcosm are frequently met with in astronomical, medical, and theosophical writings of the middle ages; they are found in the works of Paracelsus, Robert Fludd, John Baptist van Helmont, and of Nicolas Culpeper. Shakespeare used one of them; Menenius says to Sicinius, "If you see this in the map of my microcosm, follow it that I am known well enough too?" (Coriolanus, ii, 1). The phrase "map of my microcosm" obviously refers to the picture of the nude man surrounded by the zodiacal signs.

This "wicked stupefaction of the mind," astrology, has been kept alive during the past two hundred years largely through the wide popularity of almanacs. From their earliest appearance these useful aids to everyday life have mingled truth with error; and through the prevailing association of astrology with the diseases of man and the means of curing them, they become the vehicles for advertising quack medicines. This feature of almanacs is said to have originated with Francis Moore, whose *Vox Stellarum* was founded in 1698; but I have found an advertisement of a medical nostrum in the *Merlini Anglici Ephemeris* of 1671; the "Elixir Proprietatis" is advertised as an "effectual medicine for griping of the guts, putrid Feavers," and other distressing maladies.

The pictorial representation of the influence of the zodiac on man's anatomy occurs as early as the year 1496, in Gregor Reisch's *Margarita Philosophica*, a famous encyclopædia that went through many editions. This engraving is amusingly described by Robert Southey in The Doctor: "There Homo stands, naked but not ashamed, upon the two Pisces, one foot upon each; the fish being neither in the air, nor water, nor upon the earth, but self-suspended, as it appears, in the void. Aries has alighted with two feet on Homo's head, and has sent a shaft through the forehead into his brain. Taurus has quietly seated himself across his neck. The Gemini are riding astride, a little below his right shoulder. The whole trunk is laid open, as if part of the old accursed punishment for high treason had been performed upon him. The Lion occupies the thorax as his proper domain and the Crab is in possession of the abdomen. Sagittarius, volant in the void, has just let fly an arrow, which is on the way to his right arm. Capricornus breathes out a visible influence that penetrates both knees. Aquarius inflicts similar punctures upon both legs. Virgo fishes, as it were, at his intestines; Libra at the part affected by schoolmasters in their anger; and Scorpio takes the wickedest aim of all."

A similar woodcut appears in James Scholl's *Astrologia ad medicinam adplicatio*, published at Strasburg in 1537.

An examination of Astrology's Last Home, a Musty Pile of Almanacs, published in England and the United States between 1659 and 1897, shows that this emblem, modified in various ways, has been introduced since the end of the seventeenth century. In Great Britain's Diary for 1721 the central figure takes the form of a nude woman seated on a globe, and surrounded by the signs of the zodiac. Beneath is the following legend:

> "Should I omit to place this figure here
> My Book would scarcely sell another Year.
> *What* (quoth my Country Friend) *D'ye think I'll buy*
> *An Almanack without th' Anatomy?*
> As for its Use, nor he nor I can tell.
> However, since it pleases all so well
> I've put it in, because my Book shou'd sell."

In Gadbury's Ephemeris for 1721, and in Poor Robin's Almanack for 1729, the emblem takes quite another shape, being a plump cherub curved backward within a circle, which is surrounded with the usual signs. In the latter issue the following stanza appears:

> "The little Mortal in the Ring below
> Drawn Neck and Heels, doth to the Reader show
> That part of Men and Women, Sheep and Swine
> Are govern'd by each Celestiall Sign.
> But Women's Tongues, when Passion once gets vent,
> Break out from this and other Government!"

Benjamin Franklin's Poor Richard's Almanac and Poulson's Town and Country Almanac (Philadelphia) contain similar emblems. The present style of an erect man with the zodiacal signs appears in Saunders's Poor Richard Improv'd for 1783, and it has been a valuable trade mark for more than a century.

Modern pretenders to a belief in the influence of the zodiac on human life are as bold in their claims as the most superstitious charlatans of the seventeenth century. One, writing in 1894, represents the physical framework of man as merely "a vessel of breath, motion, and vibration, played upon by active thought atmospheres, waves of sound and light, and positive and negative electro-magnetic forces in limitless activity." Although the twelve signs point to weak or vulnerable parts of the body, they have no power over the spiritualized man, spirit being absolute over matter. The same writer informs us that "Aries is the head-sign of the Grand Man; cardinal, masculine, equinoctial, and movable, the positive pole of the Fire Triplicity. People born under Aries are usually very executive, earnest, and determined, also noble, generous, magnetic, and have occult powers and metaphysical tastes. Good scholars and great talkers." The modern astrologer professes to predict the personal appearance, characteristic temperament, dominant faults, prevalent diseases, love affairs, and character of children born under each of the twelve signs.

This "craft by means whereof knaves practice on fools" is now enjoying a revival in both Europe and America. Several periodicals are devoted to its propaganda; as recently as August, 1897, a monthly magazine was started in New York city, and, as an inducement to subscribe, every one is promised, not a chromo, but a "Free Horoscope of Events for 1897 and 1898." In December, 1897, a society was formed by women in New York city to study the influences of the zodiac on human life and destiny; the society is called The Zodiac, and plans to hold monthly meetings at which each sign is to be studied in turn.

The "Faust Institute of Solar Biology, Occult Science, Astro-Phrenology, and Biblical History," situated in Philadelphia, employs a perambulating agent to lecture in the streets of Eastern cities to the admiring crowds that are attracted by a vividly colored diagram and by printed handbills. Those seeking more light are referred to "Professor Faust."

M. Pierre Leroy Beaulieu concludes an article in the *Revue des Deux Mondes*, on social conditions in Australia and New Zealand, with some observations on the effect of the enlargement of the sphere of occupations for women in the postponement of the age of marriage. In 1883 the proportion of married women who were minors in New South Wales was 28·17 per cent; in 1892 it had fallen to 23·55 per cent. A similar condition is found in Victoria, where the proportion of married women under twenty-one years of age was 21 per cent, and of those between twenty-one and twenty-five years old 43·2 per cent, from 1881 till 1890, while the corresponding figures in 1893 were only 17·4 and 39·8 per cent. In New Zealand, where the married women minors constituted 29·4 per cent of the total in 1882, they formed no more than 19·3 per cent in 1893. "When a woman earns her living herself," M. Leroy Beaulieu observes, "and custom allows her considerable independence, she is in less haste to marry; and often, too, marriage forces her to give up her calling." The fact that children are less numerous when marriages are so late is the principal objection brought against this system by the author. Yet, he remarks, we ought not to sacrifice the woman's independence or forbid her all occupation unrelated to housekeeping in order that more children may be born.

A STUDY OF CHILDREN'S IDEALS.

By ESTELLE M. DARRAH.

A GREAT Herbartian wave sweeping across the schools during the last few years has carried away much of the lifeless mechanical drill which characterized the old education. In its place has been left the vitalizing influence of the study of humanity. Believing that the contemplation of the world's greatest thoughts and noblest deeds must result in arousing kindred enthusiasms, literature and history have been introduced to our youngest children. We have given this teaching a sufficient time to prove its efficacy. Is it giving our children lofty ideals? Is it exalting goodness, wisdom, strength, truth, patriotism? It is enkindling generous desires to perform noble deeds?

As a working basis for the solution of these problems, papers were collected from fourteen hundred and forty school children in answer to the following questions:

"What person of whom you have ever heard or read would you most like to resemble? Why?"

Being written as a regular composition exercise, these answers with one exception show every evidence of sincerity. Out of the total number only seven children fail to return a ready response, and their hesitation seems due to a premature development of fatalism. "Nobody," writes a boy of fifteen, "because it will do me no good to want to resemble any one." A girl of twelve reaches the same conclusion from a feminine reliance upon authority. "I would not like to envy of the people. Because they say it is not right. They say that God made you to be so."

To believers in the culture-epoch theory our results are most satisfactory, implying no accidental selection of ideals. Half the papers came from San Mateo County, California, and half from St. Paul, Minnesota; but, widely apart as are the sources, the results are so nearly identical that they have been collated together. The only pronounced difference, it may be stated, consists in the fact that while seventy-three St. Paul children find their ideal in the Divine Being, he is referred to by only four Californians.*

Sources of Children's Ideals.—The ideals of the children naturally fall into three groups:

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* See in the Pedagogical Seminary, vol. ii, No. 3, an article by Prof. Earl Barnes, entitled Theological Life of a California Child. Professor Barnes says, "Many California children seem to be ignorant of the most common and most generally accepted theological concepts of Christian people."

1. Acquaintances.
2. Historical characters, past or contemporary.
3. Characters from literature.

The comparative importance of each source at different ages is shown in Chart I.

As might be expected, the younger children pay little attention to the outside world. At seven years of age forty-seven per cent of the children find their ideals in father or mother, in neighbor or friend, thirty-nine per cent in literature, and fourteen per cent in history.

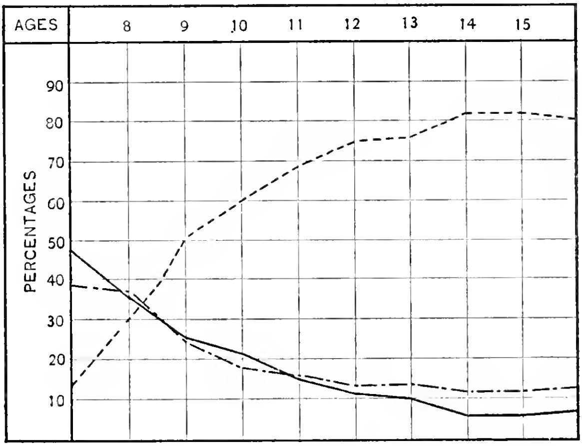

CHART No. I.—SOURCES OF IDEALS.

History - - - - - Literature — - — - — - Acquaintances ━━━━━.

But this relation changes with great rapidity, the two former elements steadily growing less important, until, at the age of sixteen, eighty per cent of the children's ideals are historical characters, twelve per cent characters from literature, and only eight per cent are acquaintances.

All this indicates strongly the expansion of the child's personality. The world of a young child, centering at first, so psychologists tell us, about his mouth, does not grow much larger than the circle of his own immediate desires and needs before the age of seven. Those characters, either real or imaginary, to whom he feels his personal relation therefore furnish his ideals. But he soon begins to feel his integration with the outside world. He reaches out beyond his own little circle, endeavoring to form some bond with the larger world. He is growing into the social consciousness, which makes him akin to all those who have felt and hoped and acted as he feels and hopes and desires to act. The characters of literature become secondary to the authors who created them. The great men of all times—Cæsar, Napoleon, Washington, Lincoln, Grant—embodying to a supreme degree the traits previously admired in his acquaintances, supplant those nearer ideals whose imperfections are more easily perceived. Enthusiasms are aroused for those men who represent contemporary society. At fifteen years of age twenty-nine per cent of the boys and twenty per cent of the girls choose as ideals the statesmen, rulers, authors, artists, explorers, and philanthropists who are making the history of to-day. Two papers, written just before the last presidential election, emphasize this participation in social movements, often extremely partisan. A boy of thirteen

Chart No. II.—Ideal Attributes.

	Seven years of age.	Twelve years of age.	Fifteen years of age.
	Per cent.	Per cent.	Per cent.
Goodness	25	23	22
Goodness to self or class	27	4	0
Truth and honesty	4	9	10
Business and possessions	10	3	2
Appearance	3	3	4
The marvelous	12	1	0
Feminine accomplishments	0	2	4
Intellectual ability or accomplishment	3	10	12
Bravery, freedom, adventure, war	5	19	13
Discovery and invention	2	1	0
Patriotism	0	6	10
Leadership	4	13	18
Miscellaneous	5	6	5

writes: "William McKinley. Why? Because his whole career shows such a nobleness of character, such true patriotism, and such honest thought that history can not help but say that a grander, nobler man never breathed the breath of life."

Another boy of fifteen writes:

"William Jennings Bryan. The reason that I would like to resemble him is because I have seen and heard him, and that is what some of these 'gold people' can not say about McKinley.

"Because Bryan had too much dignity, and he went to the people and explained the 'Silver Question' to them.

"Bryan is but 36 years old. The youngest man that has ever been nominated for president of the United States.

"He is but one year past the limited age to be a candidate for president.

"Bryan is well proportioned and well built, a good looking gentleman, and one of the smartest men in the United States, or in fact in the whole world, and is, without any exceptions, the greatest orator on the face of the globe.

"He has made as many as twenty speeches in a single day.

"Just think, all this, and is but thirty six years old.

"America had ought to be proud to have such a smart man."

From the ideals presented through the teaching of the home, the street, the newspaper, and the school, children are constantly selecting certain qualities to be emulated in their own lives. As Chart II indicates, the child's ideal must first of all be good, and to the majority of the younger children this goodness must manifest itself in some form directly benefiting themselves.

"My mamma, because she is so good and buys me clothes and shoes and hats," "My father because he is kind and gives me many things," "My aunt, because she is so kind and good. Because she lets me wheel the baby"—these papers show the original meaning of goodness. Conversely, whatever means goodness to the child must be a characteristic of his ideal.

Girls of ten write: "I want to be like George Washington because he was always good. He always kept his books clean and he loved his mother and father. George Washington obeyed his parience. He loved his parience too."

"I would like to be like Queen Elizabeth. The reason why I would like to be like her is because she was kind to everybody."

And a boy of eight writes: "I want to be like a king. Because he don't tell lies or do bad things."

As the reference of goodness to self disappears in the older children, we find it supplanted by either rectitude of life, or, still more commonly, by altruistic deeds for the benefit of humanity at large. A ten-year-old boy wants to be like his father, "For the reason that he does not drink and is honest." Boys of thirteen desire to be like George Washington, "Because he was so brave and honest, and he never told a lie." "He never did anything that he thought wasn't right and he did lots of good in the world." "He was always good to his men." Girls show more commonly than boys an appreciation of altruism.

Typical papers are the following:

Girl of eleven: "I would like to be as George Washington was, for he was good. He never told an untruth and helped other people whenever he could. I do'nt care very much if I am por or not, if I can only be as good as he was."

Girl of twelve: "Clara Barton, because she has done so much good in the world. She has taken care of the poor and has gone far away to help people. And so I wish I was as good as her, she has done so much for other people and is so kind to them."

Girl of thirteen: "I have heard a little about a girl and her teacher Miss Sullivan. She is a very good lady becuse she teaches a girl who is blind, deaf and mute, and can do most any school work so far as she has come in school. I would like to be like Miss Sullivan becuse she helps other people and I would like to help someone. I know I can not do so much but I try my best."

Very responsive are the younger children to the wonder-workers of myth and legend and Scripture: "Apollo, because he rides a golden chariot all the time"; "Hercules, because he held the earth on his shoulders"; "Quicksilver, because he can fly through the air and not get very tired," are attractive ideals. In very much the same spirit they desire to be like God, "His wonders to perform."

Of the total number of children, five per cent, most of whom are below twelve years of age, mention God and Christ as ideals. The moral attributes found in these Divine Beings are very similar to those found in George Washington or other human heroes. The majority of the children give a composite of characteristics which impress them in the Deity, into which enter the marvelous, the directly personal, and the moral. The Deity appealing to them must be anthropomorphic, human and yet superhuman, ministering directly to their personal needs. "He is onest," "He never tells a lie," "He is so kind and good," "He can do every thing," "He can turn something into enything," "He sends rain and snow for us to sled and skate," "When we go into the woods he will help us through." A boy of eleven writes: "If it was not only for Him, what would become of us. Maybe we would be stones which lay beneth the guter."

It is pleasant to find that to few of the older children do possessions make a character ideal. While ten per cent of the seven-year-olds are attracted by the commercial side of life, at fifteen only two per cent consider that paramount, at least in an ideal life.

Typical papers are:

Boy of seven: "I like two be a king of a graet kasle. Why. A king has a graet kasle."

Boy of ten: "I would like to be like Doctor About. Because it is a nice Occupation, and is a smart business."

Boy of ten: "I want to be a preacher. He is a very good man and they have a very good position."

Girl of twelve: * "My teacher. Because she is a teacher and receives a large salary a month, and teaching is a good occupation."

Boy of fourteen: "Mr. Levy. Because he has not very hard work, and he has a Good time and plenty of money and he can get any amount of money because he owns plenty of land and mortgages on peoples land, he has everything he wants."

* Teaching is not an attractive occupation to these boys; while nearly five per cent of the girls speak of this profession, it is mentioned by one boy only, ten years of age, who writes, "A teacher because they get money."

Boy of fourteen: "Fitzzimmon. Because there is money in it."

At seven years of age, three per cent of the children appreciate intellectual ability, which they commonly find among their acquaintances. As they grow older their favorite authors or artists are prized, though quite as often for their goodness as for their accomplishments, as expressed in some of the following papers:

Girl of seven: "Annie Dervine because she kin spell some words."

Girl of eight: "Olga, Becas she is a good reder."

Boy of nine: "H. W. Longfellow. Because he knows how to write poems, and knows many poems and he is called a poet and I would like to be called a poet."

Girl of nine: "Kate Douglas Wiggins, because she is so famouse and every body likes to read her books and she think of so many lovely things, because she was the first one that ever thought of having a kindergarden."

Boy of ten: "I would like to be William Shakespere because he is the famous poet in the United States."

Girl of eleven: "I would like to be like Kate D. Wiggins, because she was so kind to the poor little children in San Franceis. I have read about her that she was so kind to everone."

Boy of eleven: "I would like to resemble Lousia Alcott, she was one of the first to go to the war to help the wounded and dieing, then she wrote to some of her friends and told them to come."

Boy of fourteen: "The person whom I would like to resemble is John Greenleaf Whittier. The reason why is because he was a smart man and could write poetry."

Girl of sixteen: "I would like to resemble Shakespere, because he was such a famous poet."

The most significant increase is in those qualities which are accompaniments of an active life. To be brave, to be free, to have adventures, to go to war—these become ideal characteristics to nearly one fifth of the children of twelve. A mistaken youth of ten writes: "I would like to be like my father. Because he can do what he wants"; and a carefully reared boy of eleven finds his ideal in the neglected son of a Scandinavian washerwoman: "I would like to be like John hansen because he can play all day and doesen hafter saw wood." The pioneers of history and the heroes of frontier life and romance usually furnish this type of inspiration, as in the papers quoted below:

Boy of nine: "I would like to be like Bufullow Bill because he lived in the wild West where he went shooting buffulows and Indians, I would like to be like him because he was such straight shot in shooting."

Boy of nine: "I would like to be like Captain Jack Crawford. I like him because he is so brave and because he fought the Indians. I heard him speak at the Market Hall. He said, 'Once there was a man in front of me and one in the back and I killed them both at one time.'"

Boy of ten: "Captain John Smith because he made adventures all over america where he was captured many times by the indians."

Boy of twelve: "Wicarta the New York detective Becuse he had so many adventures."

Boy of twelve: "Robison Crusoe. Becuse he had no expenses to pay and I would like to be near the Indians and a person would be more appt to discover something."

Perhaps to us the most important result of historical instruction in the lower grades is the making of patriots. At fifteen it is true that only ten per cent of the papers consciously emphasize the love of country. But Washington and Lincoln are the chosen ideals of forty per cent of the children above ten years of age, and the curves shown in Chart III are made up almost entirely of American heroes. Probably no greater variety of nationalities could be represented in an equal number of papers than are found in those forming the basis of the present study; nevertheless, the public schools have done their work. Children of English, German, Italian, Irish, Spanish, Portuguese parentage have become Americans, and their loftiest ideals are embodied in our national heroes. A striking illustration of this is the case of an English boy of thirteen, who last year refused to salute the American flag in the school exercises of Decoration Day, but who, the following November, named, as his hero of heroes, Abraham Lincoln, "because he was trueful, honest, kind and brave." Indeed, those children who select foreign ideals often apologize, as in the case of the ten-year-old boy who explains his choice of Napoleon, "He was in a great many more wars than Washington or Lincoln." This patriotic spirit is exemplified below:

Boy of ten: "George Washington because he saved our country."

Boy of ten: "Col. Allen. I like him becuse he saved our country one clear morning."

Girl of eleven: "Washington. I wish to be good myself as Washington has been, and mostly because I wish to do good for my country (the United States) as Washington has done."

Boy of thirteen: "Abraham Lincoln. It was he who proclaimed slavery ended."

Boy of thirteen (of foreign birth): "The one whom I should like to resemble most is George Washington, because he was brave honest and truthful, and moreover he freed his country without taking pay for his valuable services. He was also the one that formed the constitution of the honored country he had saved. These are the reasons why I should like to resemble him most."

But the older children are not satisfied with an ideal who is great and good and wise and brave; he must be the greatest or best or wisest or bravest of his kind. He must excel all others in his chosen line. George Washington, "because he was the greatest man that ever lived in America"; "John S. Johnson, the champion bicycle rider in the world"; Paderewski, "because he is the greatest musician in the world"; James Corbett, "because he is the champion fighter of the world"—these are examples for this desire of leadership, almost as strong in girls as in boys. Indeed, one of the most significant features of this study is the increase in male ideals among the girls. A corresponding influence of female ideals is not shown

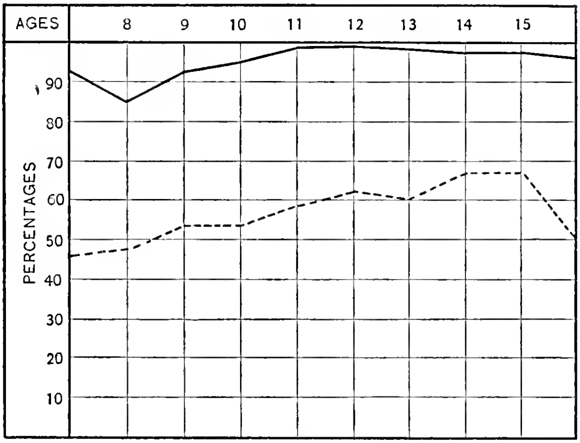

CHART No. III.—MALE IDEALS.

Boys ——— Girls - - - - -

among the boys. Some of the younger boys wish to resemble their mother, the little girls with whom they play, or the heroines of romance; but with one exception all the boys above ten years of age who select female ideals mention authors, as in the case of a boy of fifteen, who writes, "I would like to be Annie Laurie,* to be travelling all around the world and you could learn a great deal in that way and make out reports for the Examiner and always be working."

As shown by Chart III, as many as sixty-seven per cent of the girls of fourteen and fifteen select male ideals. To be sure, there are

* The *nom de plume* of a well-known Western journalist.

many who, like the girls quoted below, choose the purely feminine type.

Girl of ten: "I would most like to resemble Elsie Densmore of whom I have read in the 'Elsie Book.' because she is pictured to be as near perfect as it is possible for any one in this world to be. She is pictured as a true Christian woman, and while she is accomplished and belongs to the 'upper ten' of society, she does not neglect her home duties, and does not look down on those about her. She spent much time in charity."

Girl of fifteen: "Agnes Wickfield. Because she was kind, good natured, gentle, unselfish, loving and had very good manners."

Girl of fifteen: "I would like to resemble the Lady Rowena. Because she was a very handsome woman of the Saxon tongue and every body admired her."

But, as is shown by Charts III and IV, among the girls of sixteen, fifty-one per cent choose male ideals, and fifty per cent emphasize as ideal those characteristics which twenty years ago would

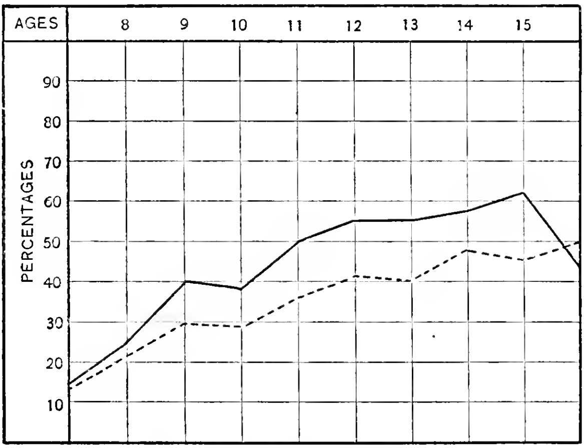

Chart No. IV.—Masculine Virtues.

Boys ——— Girls - - - - -

have been considered pre-eminently masculine. Under the heading of Chart IV, "Masculine Virtues," are masked intellectual ability, patriotism, and the desire for freedom, adventure, war, leadership, fame, discovery, and invention. On the whole, nearly as many girls as boys find in the purely virile type their ideal.

This tendency can be attributed partially, no doubt, to the "*Zeitgeist*," but it must be remembered that the historical instruction in our public schools presents only male characters, and that it deals almost entirely with conquest and war. It is more difficult for the girl than for the boy to make connections with the outside world.

This shows in the fact that at seven years of age sixty-two per cent of the girls and only thirty-one per cent of the boys find ideals among their acquaintances. But the potency of education shows in the seventy-two per cent of the girls who at fifteen find their ideals in historical characters, either past or contemporary. The following papers illustrate the curves in Chart IV:

Girl of twelve: "Washington. Because he went bravely to war."

Girl of twelve: "Julius Cæsar. Because of his bravery and greatness."

Girl of thirteen: "Remenyi. Because my name would become famous all over the world."

Girl of fourteen: "Columbus. Because he discovered America, and his name is wide spread."

Girl of fourteen: "Robinson Crusoe. I like him because he went through many adventures."

Girl of fifteen: "I would most like to resemble William McKinley, because he has such a strong will, and whatever he says that he will do he always does."

Girl of fifteen: "The person whom I should like to resemble if I were a man is Sir Francis Drake. He was a man of action. The reason I should like to resemble him is because he made a great many dangerous journeys around the world."

The tendency shown in Chart IV is best expressed by the following papers.* A girl of ten writes:

"I would like to resemble Barbara Fichy (Frietchie). Why? Because she was such a brave lady, and you know that there are not very many brave ladies."

Another girl of thirteen says frankly:

"I believe that I would rather resemble a man than a woman, because the deeds of woman, although sometimes great, selfsacrificing and brave, sink into insignificance when compared with the valorous deeds of man."

In conclusion, we are able to distinguish three marked types of

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* The following recent studies also show the same tendency:

A Preliminary Study of Children's Hopes. J. P. Taylor. In Annual Report of the State Superintendent of Public Instruction for the State of New York, 1895–'96.

Children's Ambitions. Hattie Mason Willard. Studies in Education. Edited by Earl Barnes, vol. i, No. 7.

Mr. Taylor's study finds thirty-eight per cent of the girls wishing to be teachers, twenty-four per cent milliners and dressmakers, eleven per cent clerks and stenographers, three per cent housekeepers, and three quarters of one per cent wives and mothers. Mrs. Willard finds thirty-five and a half per cent of her girls wish to be teachers, eight per cent music teachers, thirty-one per cent milliners and dressmakers, six per cent clerks, typewriters, and bookkeepers, and three per cent housekeepers.

children's ideals. Those of the youngest children must be good and kind, with desirable possessions and marvelous powers. As the children grow older, the last two attributes are supplanted by courage, freedom, wisdom, and truth, while the ideal of children of sixteen must add to these qualities altruism, patriotism, and the ability to lead. In the case of the girls, however, a divorce is evident between the ideals adopted and the line of life best suited to the interest of the race. The girl of to-day demands freedom, strength, independence, activity, and recognition. Can we not embody them in the person of "brave ladies," as our ten-year-old girl expresses it? Surely, among the "Pioneers of History," enough women have played a part brave, strong, patriotic, and wise, so that material exists for commemoration. Far more than a "Woman's Bible," which appeals only to the mature, do we not need a "Woman's History," which shall become a factor in increasing this three quarters of one per cent who desire to become wives and mothers—which shall present ideals embodying the most attractive virtues, and still permitting of a home?

This study proves that our instruction in history and literature is emphasizing goodness, truth, wisdom, bravery, patriotism, and the ability to lead, the characteristics we most desire in our children. Ethical instruction, then, in our best public schools, is anything but lifeless and impotent, as is taken for granted in much of the popular discussion. Morality is inculcated by the most effective method possible—most effective because best adapted to the child's demand for virtue embodied in a human form. Jesuit self-extinction, Chinese filial piety, emphasize the power of suggestion no more strongly than do these children's papers. When teachers and parents shall have the wisdom to consciously select and present to children those ideals into which they ought to grow, endowed with those qualities naturally seized upon by the developing soul, the cause of moral education will be immeasurably furthered.*

State Normal School, Mankato, Minn.

A bronze statue in honor of Marcello Malpighi, the famous doctor and microscopic anatomist of the seventeenth century, was unveiled in September, 1897, at Crevalcore, near Bologna, Italy. The Royal Society of London sent an address of congratulation. A memorial volume on Malpighi and his works, edited by Dr. Vallardi, is to be published, and will contain a note by Prof. M. Foster.

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* The writer wishes to acknowledge her indebtedness for the papers used in making this study to Miss Etta M. Tilton, superintendent of San Mateo County schools; to Miss Mary Hanchett, principal of the Scheffer School; and to Miss Laura Hand, principal of the Van Buren School, of St. Paul, Minnesota.

MAN'S DEPENDENCE ON THE EARTH.*

By M. L. GALLOUEDEC.

REGARDED in their relation to man, the different regions of the earth may be arranged under two general types. Some seem to repel man, who does not establish cities or large states in them. Their inhabitants lead a kind of vegetative existence, often as nomads, always thinly scattered, and poor if not wretched, with no aspirations beyond material existence. Other lands, on the contrary, seem to attract human life. Men flow to them from all quarters, as the blood from the extremities to the heart. They collect in opulent cities, and build up powerful states in which brilliant civilizations develop. But only a superficial glance over history is sufficient to enable us to recognize that these centers of resort and centers of dispersion change their places in the course of ages; and on every side we behold them undergoing alternations of grandeur and decay; countries once resplendent with glory are now deserted and wretched, while men are thronging toward regions which they formerly persistently avoided. The reason of these contrasts is to be found in the complex relation between the land and man. If man goes to one place in preference to another, it is because he finds there a fuller satisfaction of his desires and wants. To obtain the largest sum of enjoyment at the price of the smallest expenditure of effort is essentially a law of man's life. We may, therefore, conclude that if man turns away from a region to which he was once attracted it is because the resources of the country have become, in his eyes, relatively less valuable.

The study of the relations between man and the earth comprehends three parts: the determination of the factors on which the value of the relation depends; the variations of the relation and the inquiry whether it tends toward a limit, and, if so, toward what limit. The men who people the surface of the earth do not appear to have any great resemblance to one another, but the different races present very dissimilar physical characteristics and mental aptitudes. Yet these contrasts are purely superficial. At bottom all men are indifferently subjected to the same general conditions of existence and development. These conditions are of various kinds: some are essential in the nature of necessities that impose themselves on all animal life—such as the impossibility of subsisting without a certain quantity of air, warmth, and moisture, and vegetable or animal food; other conditions, still important but less essential, are those which, without directly influenc-

* A paper read in the Congress of Scientific Societies, France.

ing the very existence of man, favor or oppose his development. Nations are under similar conditions. As only a man whose corporal subsistence is assured can devote himself to research and the cultivation of thought, so only a rich nation can produce a remarkable literary or artistic movement. Civilization is the fruit of the leisure which material prosperity gives, and can not exist long of itself any more than a fire can continue to burn without being replenished. As a whole, the existence and development of man are subject to three series of conditions: for living, the realization of a certain minimum of indispensable natural requisites; for the creation of a particular civilization, a certain material abundance, which can be obtained only by utilizing the resources of the planet; and for the transformation of this local civilization into a general civilization, facilities for outside contact and mutual exchange.

The second term of this series is the earth, which is far from homogeneous in its different parts. Its surface is constituted of three elements of very different properties: a solid element, the land which incrusts the planetary spheroid; a fluid element, water, which occupies the cavities and depressions of the solid crust; and a gaseous element, the air, which envelops the land and the water. These elements, besides differing from one another, vary in their own qualities. Water is fresh or salt, stagnant or running; here spread out in wide, open oceans, there in interior basins or even confined in close ones; the air is warm or cold, moist or dry; and the solid crust is constituted of soils of different origin, composition, and aspect; level, moderately undulating, or bristling with mountains; formed of movable particles or of compact, hard masses.

The diversified shapes assumed by the constituent elements of our planet determine an infinite variety of aspects and resources. While the laws of human development remain the same everywhere, necessarily very unequal values attach to different regions in their relations to man. In fact, some parts of the earth are not at all adapted to human existence; others favor the development of a particular civilization; while other still more favored countries possess also the facilities for external communication indispensable for the growth of a brilliant civilization.

It is clearly evident that the earth does not furnish in all its parts even the minimum of comforts necessary to human existence. Man can not live on the ocean except artificially and temporarily, and is consequently confined to the land. This is not adapted to the maintenance of man everywhere alike. In many places it only sparingly furnishes the food necessary to his life. In one place, as on the tops of high mountains, the air is too rarefied; at another, it is too cold or too arid, while in other places it is perniciously hot and moist. Thus man's existence is dependent upon particular conditions of climate, the nature of the ground, and especially the relief—for the inequalities of relief, controlling the disposition of the water, exclude him from all those depressed parts which are submerged, and also from the highest spots that rise above the water.

The importance of the development attained by man in any region depends upon the same conditions. The wealth of a country must be derived from agriculture, manufactures, or commerce. Besides the factor of man's skill, it is the resultant of the natural conditions that favor the development of plants, animals, minerals, mechanical forces, and facility of communication; and all these are governed ultimately, as it would be easy to demonstrate by going into details, by these same conditions of climate, character of the ground or geological structure, and relief. When we come to consider the facilities of communication we find a new element entering into the consideration—that of situation. Even supposing that their resources are equal, we can not attribute the same value to two countries, one of which borders on civilized countries, while the other is in some out-of-the-way corner. Switzerland is worth more than Lapland, North America than South America, and Europe than Africa. A country well situated on the sea enjoys vastly greater advantages than a strictly inland country.

Of those who have treated the question of the factors constituting the value of a region of the earth, some have given pre-eminence to geological constitution, others to the relief, and others to the climate. None of these factors, it seems to me, can be regarded as exclusive, and none as always more important than the others. The favorable condition is a resultant to which all contribute. A thousand contrasts remain inexplicable if we presume that one of these factors prevails at the expense of the others. How shall we account for the dry soil of Beauce under the same amount of rainfall that once converted the adjoining Sologne into an impracticable and fever-laden marsh, unless we regard the nature of the soil—compact and impenetrable in Sologne, permeable to excess in Beauce? How can we understand that the terrible deserts of Turkestan and the famous yellow lands of northern China, which bear such wonderful crops unmanured, are constituted of the same loess, unless we recollect that it rains regularly upon the loess regions of China, while those of Turkestan are baked under an ever-cloudless sky? And how, if we ignore the influence of climate, shall we explain that the high mountain and table lands, centers of repulsion in the temperate zones, become attractive under the equator? To attempt to explain such facts by a single essential condition would be to understand only part. In fact, all varieties of reliefs, ground structures, and situations are found in desert countries: mountain and plateau by the side of the plain; regions of primary rocks by the side of limestone formations, clays, sands, and lands of wholly different composition and age; hot and dry climates, and moist and cool; the sharp promontory looking out upon the open, and the gulf with low and swampy coast; and yet, also, among the countries that attract man, we can cite side by side the plain fruitful in harvest and the mountain rich in minerals; the temperate climates of the European seacoast and the hot and moist climate of the Soudan. The value of a country, therefore, does not depend upon any form of relief or any special situation or particular nature of the ground, or special climate, but upon all these things together and the way they are combined. Soil and climate affect fitness for agriculture; the geological formation bears on mining industry; relief, climate, and geological structure regulate the natural motor powers; and all these together, with situation, determine fitness for commercial enterprises. We may, therefore, define a country as the product of these four factors, either of which may, now here, now there, have the greater part in determining its production. If three of the factors are common to two countries, it only needs for the fourth to be different to determine a variance. Let one of these factors be eliminated, and the product becomes nothing. Such is the case in Greenland and desert countries generally, where the climate, a relativly minor factor as to human existence in itself, produces a condition, however favorable the other factors may be, that makes human life almost impossible.

Thus in these four initial factors and their infinite combinations, under which the most numerous aspects and various conditions are engendered, are to be sought the reasons for the contrasts which are presented in the various regions of the earth and the human communities that are developed in them.

Both the earth and man are changing all the time, but there is no correspondence in the rate or the nature of the changes they undergo. The earth changes very slowly—so slowly that the progress is hardly appreciable in the lifetime of a single man, or so far, almost, of the human race; yet the continuance of its changes through a time of incalculable duration has made them very important, and has exposed it to many great revolutions.

Man undergoes vastly more rapid transformations. He is one of the latest comers on the earth, and has had an existence relatively as of only a moment. Yet he has undergone most wonderful transformations in his development from the cave dwellers of the stone age to the highly civilized man of the present, with his extensive knowledge and complicated relations. It is no exaggeration to say that the distance from the primitive man to the contemporary Englishman or

Frenchman is not less than that from the rude marble block to the statue which the genius of an artist designs from it. So, while the earth has evolved slowly, man has developed with a feverish activity. With time he has contracted new needs and tastes, which have caused him to appreciate and seek out what he had despised; and, collected in groups, with gathered knowledge, men have acquired powerful forces which have enabled them finally to surmount obstacles that had at first stopped them. It could not be otherwise than that the value of the relation between the earth and man should have been frequently and materially modified.

Every one of the four factors of which we have determined the essential importance has undergone great variations in the course of man's evolution. Consider the relief. Hills and small mountains appear to have been the first places inhabited by man. It was in the foothills of the Pyrenees and the Alps, in the moderately elevated limestone plateaus of the central *massif*, and the modest heights of Charolais and Picardy, that were found the traces of the most ancient human occupation in France. It is reasonable that it should be so. The nascent brook, the living spring, the slightly undulating slope, are mollified natural forms with which the individual man can enter into immediate relation without exerting too great effort.

The plain, or rather the wet plain, offers only much later vestiges than the hills. Some may say it is because it has been dug over so often; but it is probable that life became possible in such situations only after some development of civilization. Regions subject to overflow and excess of stagnant water present obstacles to cultivation and comfortable living which it was beyond the power of primitive man to overcome, and would repel habitation for a long time. But once made habitable, the plain, with its mellow, fertile soil and its rivers offering easy ways of communication, would become attractive and draw population down from the hills, the chief value of which would henceforth lie in their adaptability to purposes of defense against attack.

Only the high mountain still remains unsubdued; but daily progress is made toward mastering it. Terrible in aspect, and seemingly beyond man's reach a hundred years ago, it is now the resort of tourists, and is climbed, traversed, and tunneled or threatened by railroads. It is not yet subdued, but it no longer stops us.

Thus each form of relief is more or less adapted to some of the many human wants. Each has its special value, changing from one epoch of civilization to another. The hill, an obstacle to the agriculturist and the merchant, has become auxiliary to the manufacturer through the motor force which is derived from its streams.

The plain, precious in peaceful times, affords a poor shelter when war is raging.

So, also, the value of the different qualities of ground varies in different epochs. In the times when agricultural resources constituted the only or principal element of wealth, all the advantages appertained to lands in which the best qualities for tillage were combined. In the present age, the natural geological constitution of the soil is not of such paramount importance. As the earth has become better known, as scientific conditions of fertility have been ascertained through chemical analysis, man has learned to improve Nature by adding to soils the indispensable elements they did not already possess. Mechanical progress, creating increased facilities for transportation, and giving more perfect agricultural tools, has acted in the same direction. There is no soil so refractory that it may not be brought to reason by suitable application of fertilizing or corrective elements. By means of agricultural geology, which has been raised to a science, man can completely transform the natural value of any soil.

Different sorts of land have likewise values for mining not less unequal than their adaptations to agriculture. The minerals and coal with which industry is fed, and which have become the principal factors of wealth and power, have not been distributed at hazard over the globe. The beds exist in direct relation with the geological constitution. When we compare the fitness of different lands for mining and for agriculture, we most often find an incompatibility of qualities. The primary mineral and coal lands, when decomposed, yield chiefly hard gravels, cold and sterile. Secondary and Tertiary soils, on the other hand, almost destitute of minerals, most often have the looseness and the variety of composition that render them most friendly to remunerative cultivation. In view of these contrasts we are able to comprehend the importance of the revolution which modern scientific advance has provoked in causing preponderance of economical advantages to pass from agricultural fitness to adaptation to mineral and industrial exploitation. The equilibrium of the regions of the earth has been disturbed. Countries long neglected on account of their barrenness have been peopled all of a sudden because they contained coal; while other countries, which by virtue of their excellent agricultural soil had become chief centers of life, find themselves relegated to the second rank because that same rich agricultural soil affords nothing in the way of manufacturing facilities.

All climates, likewise, are not equally agreeable to man. Some are unhealthy, like those of marshy regions and equatorial countries, and hinder man's establishment within them, or condemn him to a precarious existence. Drainage, more and more extensively carried out, and the advance of hygienic science have modified and are still modifying these natural conditions; and the advance of civilization tends to diminish the difference in the specific value of climates to man.

As to the situation, man formerly, with his limited means, accommodated himself to Nature in the ways it offered. On the sea, he did not go far from the shores along which he coasted. On the land, he followed the stream, the valley, the mountain gorge, or the cove; and if the mountain stretched out in too compact a mass or presented a too high wall, rather than attack it in front he went round it. It is no longer so. Scientific advance has freed him from his close dependence upon these circumstances. The discovery of the compass brought on the advent of long sea voyages, and made possible the crossing of wide oceans. Moreover, we dig through continents to give passage to ships; attach islands to the mainland by means of gigantic viaducts; and pierce mountains by tunnels to give passage to railways. With each isthmus penetrated, each tunnel opened, and each new canal and railroad the courses of great commercial currents are turned. The road frequented yesterday is deserted to-day, and solitudes, lately unexplored, are filled with the periodical tumult of railway trains. Countries which were boasting of their situation deplore it now, as shops on a former principal thoroughfare in cities undergoing transformation are compelled to witness the diversion of movement and life away from them to new streets.

Thus the rational study of the soil as related to the successive scientific, historical, and social conditions of man gives the key to the local shiftings of civilization through the ages. It rested for a long time on the Mediterranean Sea, the peculiar situation and figure of which facilitated communication between bordering and adjacent countries, and this region was then the whole world, the sailor fancying when he got upon the ocean that he had passed the ends of the earth. The compass was discovered, sailors went farther, even to America, and the Atlantic Ocean became the center of the world; preponderance passed from the southern to the western countries of Europe. The development of steam navigation put all parts of the earth in constant communication. The Isthmus of Suez was pierced, and the Mediterranean recovered part of its lost prestige, while the Southern Atlantic ceased to be the principal route to the East Indies. Other changes, affecting the nations of western Europe, are still going on as results of these events; while in the extreme East, China, Japan, the Indies, and Australia, which were hardly known two hundred years ago, are forced into the current of western civilization. No one can predict what the end of this movement may be.

Without going into detail concerning the fluctuations seen in general history, we may consider those that have taken place in the interior development of particular countries. In France, once busy centers have declined, and their glory has been transferred to other places where conditions have in some way become more advantageous.

In the United States, a country as of yesterday, the fluctuations are sometimes very remarkable. A new region is opened to cultivation; a new lode is discovered; and railroads are built and cities rise as if by magic; then the railroad is extended, the mine is exhausted, or more fertile lands are discovered, and the new city disappears while another one is built somewhere else; but if the favorable conditions continue or others are found or made, it becomes permanent.

In England, the ancient towns which owed their prominence to military, ecclesiastical, or feudal conditions are declining or stationary, while places only recently of relative insignificance have become immense manufacturing centers or commercial cities.

There is no region which we can say will never be of importance; no country that can be supposed superior to a reverse of fortune. The most arid desert will become populous if a gold mine or a diamond bed is discovered in it; the most prosperous country would be liable to decline if a more important source of wealth were found near it. Suppose a method were discovered of applying the heat of the sun directly to the production of motion. Coal would become useless and coal lands waste. If a system of irrigation by artesian wells were practically developed and conveniently applied in the Great Desert, it would become populous. The future of any country is at the mercy of the discovery or of a new application by man of some property of matter. What seems to be a speculative research may possibly result in overthrowing the material or moral equilibrium of the world.

But while the evolution of the earth is going on slowly, almost imperceptibly to man, it is advancing all the time; and while man's evolution is, as we have seen, vastly more rapid to appearance, it has limitations. Man can never burst the bonds that subject him to Nature, and will never be able to abstract himself from the material necessities of his existence. Great as seem to be the resources now at his disposal, his development is absolutely controlled by the conditions of animal life. The earth is already far advanced on its course from the primitive nebulous condition toward that which has been reached by the moon. It, too, like the moon, will eventually lose its interior heat, its air and water will be absorbed into the rocks or will enter into new combinations. As man's existence was not possible under primitive conditions, so the time will come when the earth will no longer furnish him even a minimum of the necessaries of life. Even now life is not as exuberant as it was, although it is more varied.

The first care of a rational being whose resources are limited should be to husband them. Instead of doing this, we are spending lavishly, and seemingly wasting them all we can, and are destroying, without thought of the far future, the stores which the earth has laid up in the vast ages of the past. Even what we call improvement or development of a region is often its ultimate devastation, an improvident exploitation, removing from the earth what can not be restored to it, exhausting present supplies at the cost of the future. The grand discoveries on which we pride ourselves are often a contribution to this process, furnishing new means of expediting the waste and thus helping to bring on the final ruin.

Without indulging in too gloomy visions, it is a real truth that our exploitation of the earth's resources is pursued too recklessly. Consequently, we find that formerly fertile regions have become sterile; the productive deposits of our soils are undergoing exhaustion; the earth that should ripen our crops is allowed to flow into the rivers, making them turbid, and to be carried to the sea; fountains dry up, streams lose their way, and climates deteriorate.

The remedy by which these processes shall be prevented from ultimately making the planet unfit for habitation is to be found, instead of the present haphazard course, in applying rational and scientific methods in the exploitation of the earth's resources. The principle which, because it controls his development, man should never forget, is that he is a terrestrial being, that he is nothing without the earth, from which he can not disengage himself; and that the only true civilization is that which is developed in harmony and conformity with the laws that rule the planet.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE German committee on antarctic exploration have presented to the Geographentag a scheme for an expedition to remain two years within the Antarctic Circle, while a second vessel carries on hydrographic work on the edge of the ice. The longitude of Kerguelen Island is mentioned as the most suitable region for attempting to force a way southward. The coöperation of the observatories in Cape Town, Melbourne, and Mauritius would give special value to the meteorological and magnetic observations made in the selected part of the antarctic area. Two vessels of about four hundred tons would carry each four officers, four members of a scientific staff, and a crew of twenty-two. The whole cost is estimated at less than $250,000, and the German people are to be appealed to for the money.

EARLIEST RECOLLECTIONS.

By VICTOR and CATHERINE HENRI.

IN 1895 we published in a number of reviews and addressed to individuals a series of questions relative to the tenacity and distinctness of visual and auditive impressions, and to the earliest recollections of childhood. We have received one hundred and twenty-three answers to them, a larger number than we had anticipated, of which seventy-five came from Russia (obtained largely through the courtesy of Prof. A. Wedensky, of the University of St. Petersburg), thirty-five from France, seven from England, and six from America. Of them, further, thirty-five were from women and eighty-eight from men; seventy-seven from persons between sixteen and twenty-five years old; thirty from those between twenty-five and thirty-five years old, and sixteen from persons of between thirty-six and sixty-five years. Nearly all the respondents were teachers or pupils, and some were lawyers, some doctors, and two ministers.

In examining the answers we found it difficult to classify them fully and draw absolute general results from them. We proceeded thus: Each of us read the responses separately, and took note of the general ideas that seemed to be elicited from them; then one of us wrote in a general table in detail the principal points in each answer, and this done, the other underlined the points in the answers that seemed most important. The questions relative to visual and auditive images did not elicit any new results. Most of the persons answered that they had clear visual and weaker auditive images; a small number (thirteen) had better auditive than visual images; and there were persons who, using visual memory, were better able to represent forms, others colors; some, with auditive memory, pieces of music, and others words. We asked these questions in order to learn whether there was not some relation between the nature of the predominant images held in the eye or ear and the first recollections.

To the questions concerning earliest recollections, one hundred of our respondents had some recollection from infancy which seemed to be first; twenty had two or three recollections of infancy separated by days, weeks, or months, but could not give their chronological order; and three had no special recollection which they could indicate as earliest or as from a certain age. They could recall a series of facts, generally without chronological order. The age to which they referred these facts—five, six, or seven years—was quite advanced, and considerably greater than that given by other persons—two or three years—for their earliest recollections.

The date of the first recollection varies between very broad limits. There are persons who can recall a fact or scene which took place when they were one year old, or even less; others can not recollect anything from before they were six, seven, or even eight years old; but in general the first recollection corresponds with an age of from two to four years. One professed to have recollections from the age of six months, two from eight months, four from one year, nine from a year and a half, twenty-three from two years, twenty from two and a half years, nineteen from three years, fourteen from three and a half years, twelve from four years, six from five years, five from six years, two from seven years, and four from eight years.

In an inquiry made by C. Miles * on like subjects, we find two questions relative to the earliest recollections of infancy. The author concludes that the average date is about three years, but the figures are not given in detail. The questions are suggested first whether there may not be some essential difference in the nature of recollections that correspond with different ages, and then whether there is not some special cause that may explain why one person recollects a fact of his first year and another one only of his fifth year. We have not enough answers or any sufficiently detailed for the complete treatment of these questions. We proceed now to give our own conclusions.

The prime difference between recollections going back to the first year and those which relate to five or six years of age is that the former are all of events which greatly affected the child, and were frequently recalled to him in his infancy and youth; the latter are likewise facts that struck the imagination of the child, but generally less than the former; and there are cases in which the latter recollections were called up late in life; in two persons they were not evoked till our questions brought them up. One person, for instance, recalled the following scene: "A large room, with a fire on the hearth, and the ceiling and walls in the dark; an aged lady sitting before the fire, which shines brightly upon her. I am sitting in her lap. On the floor is a toy, a sheep with gilded horns. I have on red stockings, and have hold of the woman's nose. It is a large, flabby nose; the woman's face is wrinkled, her hair is white, and she wears spectacles." This was when the subject was eight or nine months old. One evening, when this person was six years old and his parents were sitting round the fire, he came up and of his own accord enacted the scene described above, and told the story, when they all laughed. Since then he has recalled the incident many times.

* C. Miles. A Study of Individual Psychology. American Journal of Psychology, vi, p. 555.

Another person recollects when he walked for the first time. He knows he was less than a year and a half old. He represents himself as walking from one lady to another, holding on to a chair, and very much pleased with his exploit.

A third person writes us: "When I was weaned, I for several days asked for *ma nini*, or sucking-bottle, and they told me that a dog had carried it off. So when I saw a dog I would say, 'The *tou-tou* has carried off *ma nini*.' This was when I was fourteen months old." The fact was often mentioned to him.

Among other recollections of early age we find one of a painful disorder of the eyes, one of a surgical operation, and one of setting out in a boat on the Aisne (at a spot to which the person returned frequently during his childhood).

Among the examples of recollections relating to five or six years of age is this: "I see again the class of little ones in the primary school which I had just entered; the master, a gentleman whose eye-glasses impressed me very much, was standing at his desk, ruler in hand, and accosted the person who was with me. During this time I stood up and looked at the wall covered with colored pictures and maps, at the blackboard, and the pupils' benches. I was then about six years old. Your list of questions was the occasion of my calling up this recollection." Another, while writing his answer, recalls a vision of his nurse, who loved him, sitting in the kitchen sewing. The subjects of other "delayed" recollections were a lunatic who was greatly frightened by the war of 1870, a fire, the death of the respondent's father, which caused a change in his life, and entering school.

A very clear difference is noticeable between the persons whose earliest recollection relates to the age of about one year, and those in whom it corresponds to five or six years. The former have many memories of an age of which the latter have none—that is, the date of the first recollection is in relation with the date of others. A person who recalls an event that happened when he was one year old, remembers also a number of events of two or three years of age, and is able to recall the current of his life after the age of five or six years. On the other hand, a person whose first recollection dates from the age of five years, begins to have several from six or seven years of age, and remembers the current of his life from eight, nine, or ten years. It would be interesting to collect facts concerning the infancy of these several persons and see if there is not some marked difference in them.

The opinion most generally current concerning the subject of the earliest recollections of infancy is that of Taine: "The primitive impression was accompanied by an extraordinary degree of attention, either because it was horrible or delightful, or because it was entirely novel, surprising, and out of relation with the habitual current of our life; this is what we express when we say we were very forcibly struck by it, were absorbed in it, could not think of anything else, our other sensations were effaced by it, we were pursued by the image continuing all through the next day, we were possessed by it, could not get rid of it, and all distractions were powerless as against it."

It is because of this disproportion that the impressions of infancy are so persistent; the mind being entirely new, ordinary objects and events are surprising to it.* According to Taine, the chief cause of the reproduction of an image is attention. "Whether attention be voluntary or involuntary, it always operates in the same way; the image of an object or an event is the more capable of revival or of complete resurrection in proportion as the object or event has been considered with greater attention." Taine's theory is applicable to the large majority of cases. Most of the earliest recollections relate to events which have attracted the child's attention by their intensity, their novelty, their action on the affections, or by numerous repetitions—facts, especially, which have evoked strong feelings—fear, terror, shame, lively joy, pain, grief, curiosity, self-love, antipathy, sympathy, etc. The first recollection, however, in some persons relates to a merely common fact, not particularly distinct from others, and which did not provoke any strong feeling, which is remembered with details; while important events which produced an impression on the child at the same period, as the parents relate, are not remembered at all. Such cases are few, and we can not explain them. It may be, as one of the subjects suggested, that the fact remembered only seems banal because it is not completely recollected, the striking elements having been forgotten.

Most of the earliest recollections relate to brief scenes. The impressive fact is generally clearly remembered to the minutest details, but it was only of an instant's or a few minutes' duration. An event of an hour or more is rarely remembered, or, if it is, there are gaps in the recollection.

As to the kind of mental images that constitute the recollection, the scene in the majority of cases is represented visually. The things, the colors, and the character of the light appear very clearly, but the personages are poorly set forth. The general form is seen, but few or no details of the figure, and sometimes it is not determined whether it is a man or a woman. Occasionally, however, the persons are clearly distinguishable, especially when they play an

* Intelligence, i, p. 35.

important part in the event that is recollected, as in the following example: "My father was holding me at the window of the ground floor in which we resided, and, balancing me now to the right and now to the left, he made me play hide and seek with one of his friends, whose hairy, laughing face I still remember. This memory goes back to an age when I could hardly walk, and could not speak—when I was about two years old." A professor's recollection is of a garden planted with flowers and vegetables, inclosed by a hedge with a green wooden gate. "The image of the garden is floating and vague, like the recollection, except that the gate is retained in my memory with a really surprising precision of details. I see it now, with its leather hinges, nailed to a rough post, and slimy with the moisture; and I see hanging to that gate a rude boy, the terror of the children of his age, who clung there with tense legs and clinched hands, all doubled up, with a grinning face and his eyes glowing with mischief through the intervals of the bushy red hair that fell over them—a cynically grotesque figure. A cracking was heard, and all the urchins ran away like a flock of frightened sparrows, this one in the lead shouting shrilly and ironically. All the details of this scene have remained very precise in memory, and yet I can not say that I recollect the mocking cries of this youngster. I do not hear them now. I was then sixteen or eighteen months old; not more than two years at most." We transcribe this example in full because it illustrates the usually indefinite character of auditive recollections. Some persons recall them more distinctly, and some can remember words that were spoken, but not by the sound. A few persons who have analyzed their remembrances subsequent to the earliest—of seven, ten, or fifteen years of age—observe that auditive memory comes later than visual.

We have the same affirmation in a large number of responses of the manner in which the subject himself is represented. He sees himself as a child, but does not feel himself a child. He has a picture in which there is a child, and knows that he is the child. "I see myself in the view as somebody outside of me." "I am at the seashore and my mother is holding me in her arms. The picture appears to me as if I was away from the scene." Many of the answers describe the feature thus.

Other sorts of perceptions rarely make part of the earliest recollection. Only three persons speak of the pain of an operation. Taine cites a fact of this kind. "M. Brierre de Boismont, having had a scalp disease when a child, declares that he still feels the pulling of the hair in the treatment of his skull." One example occurs among the answers we received: "I had the croup when I was twelve months old, and it was necessary to burn all the ulcers in my throat. I have a very clear visual image of the scene; I see distinctly four persons holding me down. What I see most clearly is a glowing brazier in which two red-hot irons were being heated to a white heat; and to this moment I still seem to feel that burning iron coming to my lips."

There is still one other group of images—the emotional ones. Our inquiry confirms the results obtained by M. Ribot on the remembrance of the feelings.* Some persons who know that they had a particular emotion do not feel it, but can only describe it. Others, on the other hand, still feel the emotion they had when a child. "My first recollection," says one, "was the astonishment I felt one morning at seeing the roofs without snow upon them. I thought they must be white all the year round, and I conceive now very clearly my surprise when I found that they were not. I was then three or four years old." "My first recollection," says another, "is of the birth of a sister. We received the news by letter, and I remember the details clearly. My father read the letter aloud, and I was very much struck with the name given my little sister—Hortense—it sounded queer. Every time I recall this memory, I witness the scene precisely in all its details, but that name, Hortense, especially, resounds in my ear, and I conceive a kind of echo of the singular impression it made on me. I was exactly two years eight months and a half old."

Our inquiry did not include the accuracy of these impressions, but several of our correspondents voluntarily communicated their verifications of them. One had frequent recollections of a modern balcony extending from the first floor of a country house, protected by a wooden balustrade, coming more commonly in dreams than when awake, and which he was not able to connect with anything real. When about fifteen or sixteen years of age, he passed through a village which his parents had left when he was two years old, and which he had never seen afterward. Everything was strange to him till he came to the balcony of his dreams. He asked what house that was, and found that it was the one his parents had lived in. Another person, who had left his natal village when three years old, returning to it when twenty, recognized the place and the former house of his parents.

In another case, where the recollection proved not quite exact, the subject remembered the death of his father as having occurred in a certain room, but learned afterward that that was not the room in which his father actually died, but one they had moved into afterward.

* M. Ribot. Psychologie des Sentiments. Chapter headed Remembrance of the Emotions.

It was not possible in any of the cases in which the point was mentioned to fix the time of the incident recollected, except it was related to other events, the date of which was learned afterward. Thus, a scene is remembered that took place in a certain house; it subsequently appears that the parents left that house when the subject was three years old, and the conclusion is drawn that the event occurred before that age. It also seems impossible to fix the date relatively, or, in other words, of several events recollected, to determine the order in which they happened. Thus, M. Binet furnishes a list of twelve events remembered which took place when he was perhaps less than six years of age, most of which acted on the emotions, and which he believes are remembered because of the feeling they excited. He remarks that the memories form complete detailed visual pictures, in which he sees the persons and their positions, and even trifling things like the stones in the wall in one of them. But he is not able to fix their order, or to say this one happened before that one, except in the case of three, which he has localized in time without knowing how.

The answers are unanimous concerning the conditions under which these recollections of infancy come to mind. They are recalled when we are thinking of our childhood, or of the places where we lived in childhood, or when we meet the names of persons who were concerned with us at that period, or when we see a thing or a scene similar to one which formed a part of the event recollected. In some persons the event is recalled by an emotional condition like the one we felt when it happened—in all these cases by some form of association by resemblance or contiguity.

In most persons a considerable interval exists between the first and second recollections; it is generally more than a year; in some cases it reaches five years; and in a few instances it is only a month or two, in which cases the subject does not know which is first or second. After the first, many isolated facts and scenes are usually remembered, but not in any known chronological order, and without connection with one another. Usually our connected recollections and power to recall our life in chronological order begin at the more advanced age of between seven and eleven years; and with many persons the period coincides with some change in the life, such as a removal of residence, entry into the lyceum, or something of the kind.

The characteristics of the posterior recollections are the same as those of the earlier ones—emotional, visual, presenting themselves as complete pictures with many secondary details, and corresponding to events of short duration; while auditive images are rare, but less so than in the earliest recollection.

Concerning recollections in dreams, we find that few persons see themselves as children in dreams, and when they do the subject of the dream is of a time posterior to the earliest recollection.

The results of our investigation, one of the first to have been made, so far as we know, are far from complete, and give no definite information concerning the why of the phenomena; but they indicate some of the points concerning which the inquiry can be pursued with profit, and will enable us to frame our next set of questions more systematically and with more intelligence. We shall be glad to receive observations on the subject from all persons who may choose to communicate them to M. V. Henri, Laboratory of Physiological Psychology, Sorbonne, Paris.—*Translated for the Popular Science Monthly from L'Année Psychologique.*

SKETCH OF RUSSELL H. CHITTENDEN.

IN his address at the celebration of the semicentennial of the Sheffield Scientific School of Yale University, President Daniel C. Gilman spoke of physiological chemistry as one of the latest additions to the subjects taught there and as a department in which the school had risen to the foremost place. "Nowhere else in this country," said the speaker, "not in many European laboratories, has such work been attempted and accomplished as is now in progress on Hillhouse Avenue, unobserved, no doubt, by those who daily pass the laboratory door, but watched with welcoming anticipation wherever physiology and medicine are prosecuted in the modern spirit of research." The creator and master mind of this establishment is Russell Henry Chittenden, professor of physiological chemistry.

Professor Chittenden is a descendant of William Chittenden, who came to America from the parish of Cranbrook, Kent, England, in 1639, and settled in what is now known as Guilford, Connecticut. Both his paternal and maternal grandfathers fought in the Revolutionary War. He is a son of Horace H. Chittenden, and was born in New Haven, Connecticut, February 18, 1856.

He received his primary education in the public schools of New Haven, and later entered the private school of Mr. French, where he was fitted for college. Even at this time his aptitude for teaching was so developed that he was able to defray his expenses in the school by giving instruction to the younger pupils in the rudiments of Latin and Greek and in mathematics. His original intention had been to pursue classical studies, but a growing fondness for natural science with a leaning toward medicine as a profession led to his entering the scientific department of Yale. He was graduated from the Sheffield Scientific School in 1875 with the degree of Ph. B., when nineteen years of age. His graduating thesis was considered sufficiently noteworthy to be published in the American Journal of Science, and it was also translated into German and published in full in Liebig's *Annalen der Chemie*, Leipsic. As an undergraduate in the Scientific School he evinced great devotion and aptitude in the study of chemistry, and became especially interested in chemistry as applied to physiology. His success is shown by the fact that in the last year of his undergraduate study he was appointed a laboratory assistant in chemistry, to carry forward such instruction in its physiological bearings and applications as was then possible. In this connection it is to be remembered that the Sheffield Scientific School was one of the first institutions in the country to recognize the importance of a preliminary scientific education for young men intending to study medicine, and in the annual catalogue for 1869–'70 reference is made to an appropriate scheme of study specially designed for those expecting to pursue the courses in the medical schools. This was the beginning of the so-called "biological course" in the school with the development of which Professor Chittenden has been closely identified. The existing laboratories of chemistry, physics, zoölogy, and botany at Yale had made it easy to establish a course in general biology at this time, well adapted for providing instruction in branches especially fitted for men intending to enter the medical profession, but in which facilities in physiology and physiological chemistry were still almost wholly wanting.

The general character of the work done in this department is fittingly recognized by President Gilman, who says, in his semicentennial address: "One of the most advantageous of these courses has been preliminary to medicine. To follow the healing arts, which have made during the last half century such wonderful advances, discipline is requisite in physics, chemistry, and physiology with prolonged laboratory practice and increasing familiarity with the normal functions of organic life. Such courses were projected here five and twenty years ago, and gradually the medical colleges are discovering their value. The Johns Hopkins Medical School, for example, allows no student to enter as a candidate for its four years' course unless he has had such training, substantially as that here offered many years ago, and never so advantageously as now. Names might be cited of eminent physicians, leaders in physiology, pathology, physiological chemistry, and hygiene, who received their bent from the preliminary medical course of the Sheffield School."

Physiological chemistry was, indeed, at that time given very scant attention in this country, and its importance in biology and practical medicine was only beginning to be felt even in Germany.

Up to 1874 only an occasional student availed himself of the opportunities afforded by the new course in biology in the Sheffield Scientific School, and physiology and physiological chemistry were taught only in name. In the class of 1875, however, there were six or seven students taking the new course, and it was decided to start an independent laboratory of physiological chemistry. Nominally under the charge of one of the professors of chemistry, the laboratory instruction was really placed in the hands of the inexperienced and youthful assistant, who, although not yet a graduate, had manifested remarkable ability in both acquiring and imparting knowledge in this direction. The laboratory was a single small room provided with the simplest of equipments, but the young man was full of enthusiasm, and by hard and persistent work managed to keep ahead of his class and pilot them safely through a moderate course of study.

Immediately after his graduation Mr. Chittenden was appointed instructor in physiological chemistry, which position he held until 1878, acquiring each year added experience and facility. Further, each year witnessed the completion and publication of some piece of scientific research in his favorite branch. Having now made up his mind to devote himself to physiological chemistry, and feeling the necessity of a broader knowledge of the subject than could be acquired in this country, he decided to go abroad, and accordingly 1878 and 1879 were spent in Germany, chiefly at Heidelberg with Professor Kühne, where the time was occupied mainly with the study of experimental physiology, physiological chemistry, and histology. Not only were routine courses pursued, but Mr. Chittenden's natural bent for scientific investigation led to constant work in the laboratory, with the result that in 1879 three papers on physiological subjects were published by him in the *Untersuchungen aus dem physiologischen Institute der Universität Heidelberg*, and one in the English Journal of Physiology. Returning to America in the fall of 1879, Mr. Chittenden took his former position at New Haven, more fully equipped for his life work. The establishment at this time of the American Chemical Journal led to an invitation to write a series of reports upon recent progress in physiological chemistry, which were continued for several years.

In 1880 he received from Yale the degree of Ph. D., and in 1882 he was appointed professor of physiological chemistry at Yale, and member of the governing board of the Sheffield Scientific School. In this same year he received an urgent invitation from Professor Kühne to come to Heidelberg and join with him in a series of investigations upon the physiology of digestion. Accordingly, on the 1st of June he started again for Germany, where he spent the summer months in the Heidelberg laboratory with Kühne, returning to New Haven in the fall in time to take up his routine work at the opening of the college year. This was the beginning of a series of investigations undertaken jointly with Kühne and carried on for many years by correspondence, which resulted in a long list of contributions bearing on the chemico-physiological problems of gastric and pancreatic digestion, published mainly in the *Zeitschrift für Biologie*, in Munich. The facts thus acquired threw great light upon many of the darker problems of gastric and pancreatic proteolysis, and constitute at present the basis of our physiological knowledge concerning the changes which proteid foods undergo in digestion. During these years Professor Chittenden's activity was very great. Besides enlarging and modifying his course of instruction to the students of biology, and attracting graduate students to his laboratory, independent research work was continually carried on, with the result that in the years 1883 to 1888 three volumes of Studies from the Laboratory of Physiological Chemistry, of from one hundred and sixty to two hundred pages each, were published, containing the results of his investigations carried on by the help of the graduate students and assistants he had collected about him. The value of these researches may be inferred from the constant reference made to them in all standard text-books on physiological chemistry.

In 1890 Professor Chittenden became one of the associate editors of the English Journal of Physiology, edited by Michael Foster, and for several years thereafter the researches from the laboratory appeared regularly in this journal. In 1885 to 1887 he wrote a number of articles on physiological topics for the Reference Handbook of the Medical Sciences. In 1890 he was elected a member of the National Academy of Sciences. In the revision of Webster's International Dictionary he was charged with the editing of the definitions in general biology, physiology, and physiological chemistry. In 1894 he delivered the Cartwright Lectures before the Alumni Association of the College of Physicians and Surgeons of New York, the subject being Digestive Proteolysis. These lectures were published in book form in 1895. When the Journal of Experimental Medicine was started, in 1896, he became one of the associate editors for physiology.

He has been on the council of the American Physiological Society ever since its foundation in 1887, and has been president of the society since 1895. He was president of the American Society of Naturalists for 1893. He has read various papers before the New York Academy of Medicine. He was active in the establishment of the American Journal of Physiology—the first number of which appeared in January of the present year—and is one of its editors. He was one of the original members of the Committee of Fifty for the investigation of the drink problem, and has contributed, with the aid of his coworkers in the physiological laboratory, two important papers containing the results of various researches on the influence of alcoholic drinks upon the chemical processes of digestion, and their effect upon secretion, absorption, etc. He served as one of the vice-presidents of the Congress of American Physicians and Surgeons, held at Washington, May, 1897, at which he presented a paper on "internal secretions" considered from a chemico-physiological point of view.

Professor Chittenden has always been especially interested in bringing about a wider recognition of the importance of the chemico-physiological side of biology. He regards the physiological side as equally important with the morphological side of biology, but finds only scanty recognition of the fact in too many of the courses in biology, and only rarely tangible evidence of appreciation of the chemical side of physiology; and yet, as he has pointed out in an address before the first Pan-American Medical Congress, held at Washington in 1893, "there is hardly a question either in physiology or in the science or practice of medicine that does not draw to a greater or less extent upon physiological chemistry for its solution. . . . In every medical school in the land there should be a well-appointed laboratory for the practice and study of physiological chemistry in every direction bearing on medical science. So, too, in every well-rounded biological course there should be ample facilities for instruction and experimentation, not only in pure physiology but likewise in physiological chemistry, so that a broader and clearer conception of physiology may be obtained than is possible by the presentation of a single side of the subject." Professor Chittenden has labored faithfully to embody the principles expressed in these views and give them practical effect in the work of the biological course at Yale University. Morphology, comparative anatomy, general biology, botany, zoölogy, etc., are by no means ignored, but physiology and physiological chemistry have been made an integral part of the instruction in biology given to the undergraduate students in the Sheffield Scientific School.

The importance of physiological chemistry as an adjunct to the medical course is forcibly presented in the address to which we have referred, where the sovereignty of morphology, which had given the course a somewhat unsymmetrical development, is said to have reached its climax, and the clinicians are declared to be "even now looking to physiological chemistry to aid them in unraveling many of the hidden processes of life, thus helping to gain clews to clearer methods of diagnosis and more rational lines of treatment." Recognizing the great gains that have accrued to medicine from the marvelous development of pathological investigation and from anatomy and histology, he added: "If, however, a small fraction of the time and energy given to these branches of medicine had been devoted to the simultaneous study and investigation of the chemical processes of the body in health and disease, I am sure equally important results would have been obtained, and, as a final outcome, a far more satisfactory explanation of many phenomena for which anatomy, histology, and pathology have thus far given only incomplete or unsatisfactory explanations. It is from a judicious combination of the results obtainable by different lines of inquiry that the broadest and most definite, as well as the most accurate, deductions are to be drawn. In estimating the value of the various aspects of the study, it is shown that our knowledge of the composition of the tissues, organs, and fluids of the organism is derived entirely from chemical study and investigation. This is plainly self-evident; but when we consider how far-reaching are the facts thus obtained in promoting our understanding of the laws of growth of the human body, of the relationships of the various physiologically active and inactive tissues, of their development, of the character and extent of their activity, and of all the variations incident to pathological conditions, we see at once the great importance of this knowledge in aiding us to a rightful interpretation of physiological laws. The great progress made of late years in our knowledge of the various digestive juices of the body, of their mode of action, of the character of the products resulting from the digestion of the various classes of food stuffs, of the conditions favorable and unfavorable to ferment action—these and many other things connected with the study of digestion in its broadest sense have all been accomplished as the results of long-continued and laborious experiments—results that have not only helped to give us broader and clearer ideas of the physiology of digestion, but have made possible much of the advance in the diagnosis and treatment of disorders of the alimentary tract." Then there are the chemical composition of muscle and nerve tissue and the processes going on in them, with their influence on heat production and on proteid and other forms of metabolism; the broad question of nutrition in general, with its bearing on health and disease—"in great part chemical problems, partial solution of which has already afforded results of inestimable value"; and "the part chemistry has played in bringing about our present understanding of the manner in which micro-organisms act in the animal body, with its bearing upon the whole question of infectious diseases, the discovery of the production of distinct chemical poisons by specific pathogenic bacteria, with the impetus this fact has given to the search for methods of producing immunity. Then, too, we must not forget to recall the great aid chemistry has lent to therapeutics, not only giving us methods for the preparation of purer and more definite products, but opening up methods of studying the physiological action of drugs which have greatly advanced the growth of scientific pharmacology."

A course in physiological chemistry worthy of the name should extend, Professor Chittenden thought, at least through half the college year, and preferably through a whole year, with an average of fifteen hours of laboratory work a week, interspersed with lectures, recitations, and demonstrations. It could be advantageously undertaken only by men who already have knowledge of general, analytical, and organic chemistry, physics, anatomy, and histology, together with more or less familiarity with general physiology. An outline of the order of such a course as existed in the author's mind is given in the address, with the observation that, to make it of the highest value, no opportunity should be lost to show the physiological bearing of all the results obtained; to try and instill into the mind of the student the idea that the facts of physiological chemistry have a wide application.

The biological course (purely optional), started originally in the Scientific School, is now open also to those junior and senior students in the academical department who are desirous of taking this line of work. Naturally, the majority of the students electing this course of study, extending through two years of the college course, are intending to enter upon the study of medicine after graduation, and it is interesting to note that the graduates of this course almost invariably take a high standing in their professional study, thereby indicating the beneficial effects of their biological training.

To-day the Sheffield laboratory of physiological chemistry is a very different structure from the laboratory of twenty-three years ago. Situated in what was formerly the Sheffield mansion, on Hillhouse Avenue, nine good-sized rooms are required to care for the many students working there, while one assistant professor and three instructors aid in carrying on the instruction given.

In addition to his duties at Yale, Professor Chittenden has recently been made lecturer on physiological chemistry at Columbia University.

The list of Professor Chittenden's publications to date contains ninety-three titles of papers, etc., nearly all contributions to scientific journals and the proceedings of scientific societies, and nearly all bearing on physiological chemistry or subjects related to it.

Correspondence.

A FASTING FROG.

Editor Popular Science Monthly:

DEAR SIR: Late last autumn, just as the winter was beginning, I drew from our well one evening a live frog. It was getting dusk, and, as I was about to pour the water into the teakettle, my little girl said, "Mamma, there is something in that water"; so we took a cup and fished Mr. Frog out of the bucket. We put him in a "Mason" quart jar with some water, and there he has lived all winter without anything to eat, and unless he in some manner drew sustenance from the water, which we changed frequently, I do not know what he lived upon.

Our frog proved a better weather prophet than De Voe, for he invariably warned us when there was going to be a change in the weather. We had had him only a few days when, one night, after we had retired, we heard a slow, low, grating sound from the sitting room; for some minutes we could not imagine what it could be; again it came—a sort of low g-r-r-r; then it occurred to us it must be the frog. We wondered what it meant, for it was the first time he had made a sound, unless when the children handled him and squeezed him a little too tightly. The next day was cold and stormy, and from that time on we noticed that whenever the weather changed our frog always croaked the night before; I do not think he ever did in the daytime. Sometimes he gave only one croak, but we have counted nine, yet he never croaked very loud nor but one series of croaks.

When the weather was warmer he would sit up in the water, and if the sun shone he would swim and splash in a lively manner; but when the days were quite cold and cloudy he would lie in the bottom of the jar entirely under the water, and if it was very shallow would flatten himself out until as flat as one's hand.

We put in more water and placed a large pebble in the jar to see if he would sit upon that when he wished to be at the surface, but he did not; he simply floated on the surface if he could not sit up with his head out.

Our frog is a pretty creature too. His eyes are gold with a spot of jet for the pupil; he has two gilt stripes down the back just at each edge; his body is gray lichen color with spots of dark wood color, which vary in size and shape, each spot edged with a hair line of gilt; his sides and the edges of the thighs are of a green tint which shade to white underneath.

A curious incident occurred the night of February 4th. A cup of salt water had been left on the table, and one of the family coming in hastily and wishing a drink, without knowing what it was, poured the salt water into the frog's jar. The next morning Mr. Frog was stretched out on his back on the top of the water, cold and stiff and puckered up till not larger than my thumb. I took him out of the jar, but he did not move, so I tossed him on the table and let him lie there until I had made the kitchen fire. Then I thought to experiment: I would put him in fresh water; I did so, and in the course of half an hour I was surprised to see him flop over right side up, although still pretty well shriveled up; I again changed the water, and in a little while he had apparently resumed his normal condition, and ever since has prophesied for us as before.

SARAH A. EDENBURN.

DES MOINES, IOWA, *March 1, 1898.*

DEAN BUCKLAND AND THE HEART OF LOUIS XIV.

Editor Popular Science Monthly:

DEAR SIR: A beautiful painting of Louis XIV when a child of five years suggested the relation of the following anecdote, which the narrator assured the writer was authentic:

When the French revolutionists were breaking into the tombs of their kings and throwing the bodies into the Seine, it was found that the heart of Louis XIV had been taken out by the embalmer and preserved in a leathern sack. The heart had shrunken to about the size of a mulberry. An English officer, at the time in Paris, rescued the heart and carried it off to England, where it was preserved by a family represented to-day by one of England's most distinguished statesmen, the name being here withheld for personal reasons. The family caused to be made a golden receptacle, with a glass top, to hold this treasure, and it was frequently shown to guests, who were not supposed to open the lid.

Every one familiar with the history of geology knows the name of Dean Buckland as one of the English fathers of the science, who was also one of the most absent-minded, and late in life became the most eccentric of men, owing to brain disease. Upon being shown the casket he immediately opened it and, before the heart could be rescued, he, according to his habit of tasting minerals (as is the case with all mineralogists), not only tasted it but swallowed it! Thus disappeared the last remains of the great king.

J. D. SPENCER.

WASHINGTON, D. C., *March 21, 1898.*

Editor's Table.

AN EDUCATIONAL HERETIC.

WE observe that Professor Peck has not feared to include, in his lately published collection of essays, the title of which, The Personal Equation, no one has yet been quite able to understand, the paper on American Education which appeared in The Cosmopolitan last year, and for which the editor of that periodical felt compelled, in a manner, to apologize. Some of Professor Peck's utterances, it must be acknowledged, sound rather awful, considering the age and the *milieu* in which they are given to the world. When he says, for example, that "every really great thing that has been accomplished in the history of man has been accomplished by an aristocracy," he runs the risk of shocking, if not the moral, the political sense of the community no less rudely and painfully than the anarchist does when he passionately pronounces the doom of private property and recommends the treatment of all social diseases by dynamite. We are not sure, however, that Professor Peck means as much harm to our cherished institutions as the average reader might be led to suppose. By an aristocracy he does not mean a privileged caste, but simply a body of men trained to think and having personal gifts of control. Even the most extreme democracy must acknowledge that there are such persons. By whom are our "primaries" dominated if not by individuals trained to think along certain lines which, by an abuse of language, we call political, and who are masterful in council and decisive in action? And how many men, all told, have a really controlling voice in our national politics? We doubt very much if their numerical proportion to the whole community is greater than that borne by the narrowest aristocracies of the past to the communities in which they have severally existed. Yet without these men nothing, substantially, can be done. Their will is law. It is true they rule partly by fawning on the multitude, but they can afford a little of this condescension to secure the reality of power. "Paris is well worth a mass," said Henry of Navarre, when he became a Catholic on succeeding to the throne of France; and the boss does not grudge a little servility when needed to strengthen his hold upon the people. In Professor Peck's sense, then, we have an aristocracy now—that is to say, a ruling class—only it is not one out of which much good can come. It is organized on too bad a principle.

It is apropos of education that the professor gave expression to this shocking sentiment. He does not believe in compulsory education, and evidently thinks that the state goes too far now in facilitating education for all. It is not, if we understand him aright, that he grudges education to any, but simply that he thinks the present system, from a strictly practical point of view, is not working well. "A sounder policy," he says, "would be to make the way to education easy, but not free, to all." As we have before expressed our general adherence to this view, we must be content to share whatever odium attaches to the professor for his remarks. A recent writer in a French review * has been discussing what he

* See Revue des Revues for January 15, 1898, article by M. Henry Berenger.

calls "the intellectual proletariat" in France. The facts and figures he furnishes in regard to the moral and economic condition of a large proportion of the educated class are not at all encouraging. "Our poverty-stricken mandarins," he says, "are starving in their tracks." He remarks that the evil of an intellectual proletariat has not yet manifested itself in America; but some of us who have a closer view of the facts would not be quite prepared to indorse the statement.

The moral and intellectual progress of a people, it can not be too often repeated, depends largely upon its ideals; and there is reason to fear that universal education, or rather the attempt at universal education made by modern states, tends to lower rather than elevate popular ideals. The one great false thing the system teaches—not advisedly and intentionally, no doubt, but all the same most effectually—is that education is mainly to be desired as a qualification for money-making. That idea alone is enough to poison the popular consciousness. Education means nothing if it does not mean the improvement of the intellectual and moral nature of the person educated; but to what extent can it be shown that the state agencies in operation are really working toward such a result? We do not, therefore, regard Professor Peck, in spite of his audacious and seemingly paradoxical expressions, as an enemy of the people. We believe, on the contrary, that he means right and has at heart, as fully as the intensest democrat of us all, the greatest happiness of the greatest number.

REALIZATION OF A PROPHECY OF MR. SPENCER.

"Are we to become the China of the West?" shouted a United States Senator, indignant because the American people would not fly to arms at his bidding and put an end to the savage struggle between the Spaniards and the Cuban insurgents. The implication was that, unless they did so, they would fall a prey, just as is threatened in the case of China, to the attack of some militant power. Only by cultivating the war spirit, which the Chinese hold in such detestation, could they maintain, to use the glowing language of Mr. Theodore Roosevelt, "our proper position among the nations of the earth, and . . . do the work to which our destiny points."

Since the opinion appears to be general that the sudden assault of the European powers upon China and her apparent impotency to resist them are due to her devotion to pacific pursuits, and that the aggressive policy of her assailants is something that the American people ought to imitate in order to save them from the same fate, it seems needful to call attention to a prophecy that Mr. Spencer makes in the last volume of his Principles of Sociology. It has a very instructive bearing upon the astonishing political phenomena now witnessed in the far East. It makes perfectly clear the absurdity of the interpretation that the Senator in question put upon them. It shows that China is not a victim of her devotion to pacific pursuits, but to militant pursuits, and that her assailants are following in precisely the footsteps that have brought her to her present position of impotency. The conclusion to be reached is that only in imitating them is there the slightest danger of the United States becoming "the China of the West."

In forecasting the future of the peoples that seek social regeneration through the adoption of certain institutions, which are simply the institutions of aggression, Mr. Spencer says that they may hold their place in the world for a long time. But the moment they come in contact with peoples not become degenerate through the sustention of the unfit at the expense of the fit, they will repeat the history of the conflict between the Spaniards on the one hand and the Mexicans and Peruvians on the other, and, like a house of cards, collapse almost without a struggle. Had Mr. Spencer postponed the writing of the chapter in which this prophecy appears, he could have cited as a fulfillment the cowardly and contemptible submission of the Chinese to the militant barbarians from Europe. Enervated by institutions that grew out of militant pursuits, they find themselves unable to resist their more vigorous and progressive assailants.

It is but a commonplace to say that China has the most powerful, conservative, and corrupt bureaucratic system in the world. As may be easily shown, this system, like all other bureaucratic systems, is the natural and invariable product of militant activities. Although it has outlived them many centuries, it has not ceased in any considerable degree, if at all, to exert the restraining and paralyzing influences that come from a crystallization of society. To it is due very largely the extraordinary difficulty now experienced in introducing into China new ideas and new industrial methods. An abandonment of old ideas and old methods would mean a disturbance of its privileges, and a disturbance of its privileges would mean a diminution or abolition of the sources of plunder that it has enjoyed time out of mind. Hence it has opposed the introduction of Western culture, Western modes of production and Western means of communication and transportation. Hence China is what she is to-day—a great, unwieldy mass of ignorance and superstition, destitute of the power of initiative and incapable of lifting a hand against the unscrupulous greed that has all at once encompassed her on every side.

Not less grossly inaccurate than the prevalent theory of China's helplessness is the theory advanced to account for the sudden desire of her assailants to appropriate her territory. It is supposed that the inhabitants of France and Germany, crowded to suffocation at home, are anxious to find an outlet for their energies, and, like the emigrants that have poured out of the harbors of Great Britain during the last three centuries, wish to establish another *patrie* or fatherland beyond the seas. But there is not the slightest foundation for this enchanting supposition. One of the most melancholy complaints heard in France for many years is that the births do not equal the deaths. Another complaint is that the French people show no desire to leave their country and take up with the life of a pioneer in the new territory acquired in northern and central Africa and in southern China. They prefer to remain at home and live upon the slender incomes they get from a government office in the city or some strip of land in the country. The same is more or less true of the Germans. Although they emigrate in larger numbers than the French, they do not leave their country to establish another fatherland in the colonial empire that German statesmen have attempted to establish in the wilds of Africa. Anxious to escape the intolerable despotism of their own Government, they go to new countries already peopled, chiefly the Argentine Republic and the United States, to swear allegiance to another flag than the one they have lived under all their lives.

What, then, is the explanation of

this sudden desire of the French and Germans to get possession of the Chinese Empire? If they do not want it as an outlet for a surplus population or for a population ambitious to improve its condition, what do they want it for? The answer to these questions is to be found in the powerfully aggressive impulse imparted to them by their military and bureaucratic systems. As is well known, these systems inspire a contempt for industrial pursuits, which require private initiative and enterprise, and lead young men anxious to distinguish themselves to seek to do so in the army or the civil service, where they are cared for as recipients of pensions in case of failure. But in both Germany and France the number of places of this kind is necessarily limited, and as a consequence the demand has far exceeded the supply. A further consequence is that the tests applied to candidates for appointment have become very severe. A still further consequence is that after candidates have spent the best part of their lives in preparing themselves for a certain kind of work, and fail, as they often do, to get it, they consider themselves too old to prepare for anything else. Naturally they are inclined to join what Prince Bismarck has fitly stigmatized as the educated proletariat, and begin an agitation for the vague and absurd reforms known under the name of socialism and anarchism. If places could be found for such men and the country relieved of their disquieting presence by the establishment of a colonial empire in a land like China, where there is a vast industrious and docile population to be ruled and exploited, would not an enterprise of this kind appeal, consciously or unconsciously, to the leaders of a nation? Would not a vain and ambitious man, like the German emperor, see in it an opportunity not only to gain an outlet for the military activities of his people, but to make for himself a name that would compare with that of any of his Hohenzollern ancestors? What is true of him in a striking degree is true in a less degree of every other victim of the militant and bureaucratic spirit of France and Germany. China is wanted, therefore, not as a home for landless populations, but as a place for the soldiers and officials of these countries to pillage.

But, unless France and Germany change their policy, China will have her revenge. The time is certain to come with them, as it is certain to come with the American people, if their example be followed, when the same fate will, as Mr. Spencer predicts, overtake them that has overtaken their victim. Great standing armies of soldiers and officials, coupled with constant aggressions upon weaker nations, can not fail to produce again the same paralysis that made the Mexicans and Peruvians such easy prey for the Spaniards. The immutable law of biology, that benefit must always be commensurate with merit, and the equally immutable law of sociology, that militant institutions lead to foreign and domestic aggression and finally to national decay, can not be suspended. Even in the case of Spain, there has been an exemplification of this profound and important truth. Why should not the French, Germans, and Americans exemplify it, if they pursue the same career of shameless aggression?

Scientific Literature.

SPECIAL BOOKS.

THERE is no form of literature that has been more affected by the modern scientific spirit than history. Readers who are familiar with the writings of our earlier historians, even to the time of Bancroft, have found that the stories of the Discovery of America, of the Beginnings of New England, and of the Revolutionary War, as told by Professor Fiske, were full of freshness and novelty, taking hold of one in a way not felt before. The countless details of these respective periods under Fiske's philosophic treatment are found to have acquired an absorbing human interest. In tracing effects to causes and showing the successive stages in the progress of events, new meanings are perceived and new emotions awakened, and the period we are studying becomes a part of "the solemn work of ages, which is slowly winning for humanity a richer and more perfect life."

While each of Fiske's histories deals with a period that can be studied by itself as an epoch in human experience, the several works constitute a carefully planned series, and Old Virginia and her Neighbors* falls at once into its place between the Discovery of America and the Beginnings of New England. The story of Old Virginia begins with Sir Walter Raleigh and the Rev. Richard Hackluyt, near the close of the sixteenth century, and ends in 1753 with the expedition of the "youthful George Washington to warn the approaching Frenchmen from any further encroachment upon English soil." On March 25, 1584, was sealed the document that empowered Raleigh to "hold by homage remote heathen lands not actually possessed by any Christian prince, nor inhabited by Christian people, which he might discover within the next six years." The wealthy Raleigh, without delay, sent out two ships, which reached what is now known as North Carolina on July 4, 1584, and after a run of a hundred miles northward their commanders landed at Roanoke Island. The next year Raleigh sent out a hundred men to make the beginnings of a settlement at this island, which Queen Elizabeth suggested should be called Virginia, in honor of herself. But Raleigh's Virginia extended from Florida (held by Spain) to Canada (in the hands of the French). The first charter, issued by James I in 1606, limited Virginia within the thirty-fourth and forty-fifth parallels of latitude, and from the seashore a hundred miles inland. Three years later a second charter made the hundred miles inland reach "from sea to sea." In 1609 New England and New Netherlands were cut off from Virginia; in 1632 Maryland became a separate palatinate; in 1663 Carolina, and in 1732 Georgia, were also detached from the original tract.

The preliminary chapter is entitled the Sea Kings, and it closes with the destruction of Spain's naval power by the catastrophe of 1588, when England snatched from Spain the sovereignty of the seas, and determined to begin the work of settlement in America, hoping to find mines of wealth like those Mexico and Peru had supplied that power; Chapter II, A Discourse on Western Planting; III, The Land of the Powhatans; IV, The

* Old Virginia and her Neighbors. By John Fiske. In two volumes. Cambridge: Houghton, Mifflin & Co., The Riverside Press.

Starving Time; V, Beginnings of a Commonwealth; VI, A Seminary of Sedition; VII, The Kingdom of Virginia; VIII, The Maryland Palatinate; IX, Leah and Rachel, comprise the first volume, which is illustrated by three maps—Tidewater Virginia, from a sketch by the author; Michael Lok's map, 1582, from Hackluyt's Voyages to America; and the Palatinate of Maryland, from a sketch by the author. In this volume we are brought down to the middle of the seventeenth century.

Chapter X, on The Coming of the Cavaliers, opens the second volume, and the reader's interest deepens as the history proceeds. Not the least of the charms of Professor Fiske's style are the racy comments and the fine observations interspersed throughout the story. Here is one. In speaking of the contrast between the maps of New England and Virginia, he says: "One can not find in all New England a county named from an English sovereign or prince, except Dukes for the island of Martha's Vineyard. . . . But for this one instance we should never know that such a thing as kingship had ever existed. As for the names of towns, there is in Massachusetts one Lunenburg, copied in Vermont, and on the map of New England we may find half a dozen Hanovers and Brunswicks, originals and copies. Between this showing and that of Virginia, where the sequence of royal names is full enough to preserve a rude record of the country's expansion, the contrast is surely striking. The difference between the Puritan temper and that of the Cavaliers seems to be written ineffaceably upon the map."

Now follows a spirited sketch of the Cavalier element in the composition of Old Virginia, and, while deprecating the personal and sectional prejudices of half a century ago, the author adds: "It is impossible to make any generalization concerning the origin of the white people of the South or of the North, further than to say that their ancestors came from Europe, and a large majority of them from the British Islands." And again: "It is a mistake to suppose that the contrast between Cavaliers and Roundheads was in any wise parallel with the contrast between high-born people and low-born"; and toward the close of the work we come upon the following statement that will doubtless be a surprise to many readers: "A comparative survey of Old Virginia's neighbors shows how extremely loose and inaccurate is the common habit of alluding to the old Cavalier society of England as if it were characteristic of the Southern States in general. Equally loose and ignorant is the habit of alluding to Puritanism as if it were peculiar to New England. In point of fact the Cavalier society was reproduced nowhere save on Chesapeake Bay. On the other hand, the English or Independent phase of Puritanism was by no means confined to New England colonies. Three fourths of the people of Maryland were Puritans. English Puritanism, with the closely kindred French Calvinism, swayed South Carolina; and in our concluding chapter we shall see how the Scotch or Presbyterian phase of Puritanism extended throughout the whole Appalachian region from Pennsylvania to Georgia, and has exercised in the Southwest an influence always great and often predominant."

Following the opening chapter upon the Cavaliers is Chapter XI, on Bacon's Rebellion, and like all the rest it is full of interest and instruction; XII is entitled William and Mary; XIII, Maryland's Vicissitudes; XIV, Society in the Old Dominion; XV, The Carolina Frontier; XVI, The Golden Age of Pirates; XVII, From Tidewater to the Mountains. There are three maps—Western Growth of Old Virginia, frontispiece, from a sketch by the author; North Carolina Precincts in 1729, after a map in Hawk's History of North Carolina; A Map of ye most Improved Part of Carolina, from Winsor's America, vol. v, p. 351.

Professor Fiske's genius for the writing of history is apparent on every page of his work. His broad training in philosophy and his accurate knowledge of modern science, along with his remarkable historic consciousness, make him equally happy in tracing effects to causes, in vivacious narrative, or when dealing with stirring incidents and graphic details. Nor does he omit upon occasion to draw lessons from the past for our present guidance, and now and then to point a very opportune moral. His next contribution to American history will be The Dutch and Quaker Colonies, which are promised without much delay, and will be warmly welcomed by a host of readers.

The purpose of the founder of the Smithsonian Institution, as stated in his will, "the increase and diffusion of knowledge among men," has been more fully achieved by the group of men who constituted its officers during its first fifty years than even James Smithson himself could have expected. His motto has been faithfully adhered to, and as a result its workers and laboratories are probably more widely known among scientists than those of any other American institution. Its close connection with the Government has not been the least of its difficulties, and the consistency with which anything savoring of politics has been avoided reflects great credit on the officials. It is to these latter that whatever success the Smithsonian has achieved belongs. The simple subsidizing of an institution is but a step in its foundation. That the Smithsonian has been singularly favored in its officials, its present position implies. Joseph Henry, Spencer F. Baird, and Samuel Pierpont Langley, its three secretaries, are all names of high repute in pure science; as also those of men combining in a most unusual way executive ability with the true scientific spirit. Its minor workers have been equally efficient in their special departments and have also contributed largely to the success of the institution. In fact, the Smithsonian is one of the few scientific national enterprises of which we can be entirely proud. The present volume * is published in honor of its fiftieth anniversary, and to commemorate its first fifty years' work. A brief preface by William McKinley and a paragraph by the present secretary serve to introduce the reader. The first chapter gives a history of the founder, James Smithson. An account of the founding of the institution and the board of regents and the work of the three secretaries occupies the next three chapters and is by James Brown Goode, who was to have seen the volume through the press, and whose untimely death not only much delayed the latter's issue, but made a vacancy in the institution which it will be difficult to fill. The benefactors of the Smithsonian and their bequests are next taken up by Professor Langley. Since the original endowment, which was about $700,000, there has been received over a quarter of a million more; $250,000 of this latter amount was given by Thomas George Hodgson, whose curious and eventful life is briefly sketched by Professor Langley. A number of smaller bequests are also spoken of. The United States National Museum, the Smithsonian Library, and the general buildings and equipment of the

* The Smithsonian Institution, 1846–1896. The History of its First Half Century. Edited by George Brown Goode. City of Washington. 1897.

latter are described in a chapter by G. Brown Goode. The Bureau of American Ethnology, one of the most efficient of the Government's scientific departments, is treated of by W J McGee. Several other papers calling attention to various outside scientific enterprises instituted by the Smithsonian, the international exchange system, the National Zoölogical Park, etc., are concluded by an appreciative sketch of G. Brown Goode by David Starr Jordan; and finally we have a series of papers under the heading, Appreciations of the Work of the Smithsonian Institution, which occupy the last three hundred pages. A number of excellently executed portraits add much to the attractiveness of the volume, which is in purpose, contents, and mechanical execution a worthy monument to the institution which it describes.

GENERAL NOTICES.

By *the Sun's Place in Nature** Sir *Norman Lockyer* means the stage of stellar evolution through which the sun is passing. This subject and the constitution of the sun, the source of its light and heat, and the nature and history of meteorites, stars, and nebulæ, as they may throw light upon what is going on in the sun, have been the objects of Professor Lockyer's studies for a long period. The results of twenty-five years' investigation of the subject and the conclusions the author had matured have been published in the books The Chemistry of the Sun and The Meteoric Hypothesis. Their most important points were, as regards the general question, that there is the closest possible connection between nebulæ and stars, they representing two stages in an evolutionary series: that the first or nebulous stage in the development of cosmical bodies is not a mass of hot gas, but a swarm of cold meteorites; that some of the heavenly bodies must be increasing their temperature, while others are decreasing; and that therefore a new classification is demanded, based on the varying states of condensation of the meteoric swarms. Great advances have been made in physical astronomy since these books were published. Larger telescopes have been in operation; the system of mountain observations has been established and carried on; spectroscopic observations and astronomical photography have been energetically prosecuted; *novæ* or new stars have come and gone; and the mysterious element, helium, of the solar spectrum, has been found on the earth. A new discussion seems to be required in view of these recent developments, and is given in the present work. Vogel's classification of stars based upon the supposition that all the stars are cooling is set by the side of the author's view in the face of the new evidence, and the conclusion is reached that the result of the test is in favor of the latter; that some stellar bodies are increasing their temperature, while others are reducing it; that the sun is cooling in a similar stage with that of Arcturus and Capella; that the theory that the primal nebula of the sun was not exclusively gaseous, but only contained gases among its constituents; and also that in general, "along all lines, the fundamental requirements of the meteoric hypothesis have been strengthened by the later work."

Professor *Curtis's Text-Book of General Botany** is intended as an introduction to the study of the science, and not as a substitute for any of the books designed for persons who would know something of botany and have but little time at their disposal. The text is based upon the laboratory work required of beginners at Columbia University. The book being intended for a single year's work, rigid compression and broad generalization have been compelled. The author emphasizes the importance of guarding the student "against the peril of making him dependent upon directions and so defeating one aim of the work, the making of self-reliant, intelligent observers. The student should see everything, but first and clearly

* The Sun's Place in Nature. By Sir Norman Lockyer. New York: The Macmillan Company. Pp. 360. Price, $2.75.

* A Text-Book of General Botany. By Carlton C. Curtis. New York: Longmans, Green & Co. Pp. 359. Price, $3.

the essentials of each exercise and as many modifications of it as possible. For this reason a variety of species has been used rather than a few types, since, if our experience is not at fault, this assists rather than confuses our comprehension of the subject, and above all prevents those false generalizations and conceptions that must follow a narrow study of forms. The student should collect and prepare his own material. The anatomy of the plant body, plant physiology, systematic botany, and plant morphology are treated in succession.

In his *Afloat on the Ohio*,* the Secretary of the Wisconsin State Historical Society has given us a book that may be read with pleasure and profit by every lover of American history and advancement and by persons who enjoy beautiful scenery or are fond of sketches of personal idiosyncrasies as well. The author's primary object in making the pilgrimage was historical; that appears on every page of the narrative as well as in his own avowal that his purpose was to gather "local color" for work in Western history, the Ohio River having been an important factor in the development of the West and in the making of the nation and of its greatness to a much more predominant extent than we are accustomed, in our superficial view, to realize. The party of four, voyaging in a skiff, floated down the stream by day and camped on the shore at night; and they contrived to have some shopping to do at every town so as to get more opportunities to explore. Their very starting place—Redstone, or Brownsville, at the mouth of Redstone Creek—is famous in history, beginning even with its prehistoric foundations, and is memorable for having been the first English agricultural settlement west of the Alleghanies, and for its prominence as a post in the frontier wars; and it was only the portal, as it were, to the succession of historical sites that are distributed along the whole length of the great river. The descriptions of the ever-varying scenery of the river, which are given in a few happy touches here and there, are another element of attractiveness in the narrative. At the beginning of the voyage are the manufacturing establishments, forming an almost continuous line for miles along either shore of the river; farther down it is more rural, with wide bottoms on one side, sharp bluffs and high hills on the other, alternating with one another, broad meadows, cultivated farms, and forests; towns that were prosperous in the days of steamboating, and now falling into decay, and other towns that have brought railroads to themselves and are busy and prosperous; changing below Louisville into broad reaches of meadow, with the hills receding far away; and then the bayous and swamps: truly the Ohio is a stream of many aspects. It is a surprise to learn how the more obscure parts have been left behind by the railroads, which have built up and developed the inland towns at their expense, and how primitive the rural populations still remain. In order to give a clearer idea of the history which is interwoven with the narrative, a historical outline of the settlement of the Ohio is given in the appendix; and this is followed by a bibliography. "It is time," the author says, "that our Western and Southern folk were awakened to an appreciation of the fact that they have a history at their doors quite as significant in the annals of civilization as that which induces pilgrimages to Ticonderoga and Bunker Hill."

The soil of the subconscious forms a fertile ground for the experimental labors of Dr. Sidis,* and he harvests there a large crop of new ideas in regard to the laws and conditions that govern suggestibility. This state of mind is one open to suggestion, but the latter term is not given its ordinary significance of an external idea which influences the mental attitude. Neither is it confined to the technical definitions of the psychologists of Salpêtrière and Nancy who employ it mainly in their studies of the neurotic. Our author by definition and illustration furnishes a clear conception of his special use of the word. "By suggestion is meant the intrusion into the mind of an idea, met with more or less opposition by the person, accepted uncritically at last, and realized unreflectively, almost automatically."

* Afloat on the Ohio. An Historical Pilgrimage of a Thousand Miles in a Skiff from Redstone to Cairo. Chicago: Way & Williams.

* The Psychology of Suggestion. By Boris Sidis, M. A., Ph. D. New York: D. Appleton and Company. Pp. 386. Price, $1.15.

To investigate suggestibility in normal individuals, Dr. Sidis conducted over eight thousand experiments. These consisted of letters, figures, or colors displayed for a few seconds and arranged variously so as to demonstrate whether frequency, repetition, coexistence, or last impression influence the greater number in their choice. An exhibition of colored shapes revealed the extent to which strangeness of tint, shape, or position were factors in the decision. Movements and acts were also verbally suggested, and from them all the law of normal suggestibility was deduced; it increases as the suggestion becomes *indirect*. Examining hysterical, hypnotic, and somnambulistic subjects revealed the law of abnormal suggestibility, which is the reverse of the former. Its strength is in *direct* suggestion. The conditions under which a suggestion is effective are found to be nearly the same in normal and abnormal instances, fixation of attention, monotony, limitation of movement, inhibition of ideas. These divorce the higher controlling consciousness from the lower reflex consciousness, so that suggestibility is simply "a cleft of mind," a disaggregation of consciousness. By a number of experiments, Dr. Sidis arrives at the conclusion that even in normal subjects the subconscious self possesses a superacute sense-perception. The phenomena of crystal-gazing, shell-hearing, and automatic writing he accepts also as "*facts* that clearly reveal the presence of this hyperæsthetic consciousness." Although in several instances the subconscious self is called an *ego* and endowed with personality, "it must not be regarded as an individual; only as a form of mental life."

According to Dr. Sidis's researches, man may be occasionally social, or even rational, but he is, above all, a suggestible animal. In this characteristic of his nature lies the explanation of the mental epidemics that ravage nations. The crowd swayed by the flattering orator, the mob that lynches defenseless men or sacks Versailles—are exhibitions of the soulless, senseless, secondary self ordinarily dormant. It is shown as well in the uniformity of manner and fashion that is the creed of society, but this manifestation does not excite alarm. The same unreasoning consciousness obtains the mastery in speculative fevers and panics, in revival meetings, witchcraft delusions, and popular crazes of all sorts.

Having unveiled for us this uncanny spirit—"the subconscious self, devoid of all morality"—a clew for its exorcism may be found in a description of the primary self, "which alone possesses true personality, will, and self-control, . . . creates ideals and struggles for them." The outlook, however, for the growth of this better consciousness would be a very gloomy one were it true, as our author states, that "under the crushing pressure of economical, political, and religious regulations there is no possibility for the individual to move, live, and think freely, or determine his own relations in life." This prognosis would deaden all effort; and its faultiness is shown by the fact that, however difficult it may be, a minority do find it possible to live and think freely and to cultivate that personality which is a lasting safeguard against all unreasoning action.

*A Manual of Fish Culture** has been prepared by the United States Fish Commission under the feeling that a handbook describing its manner of propagating the different fishes was needed, and would be of value to all persons interested in the subject. The material for this book has been furnished by experienced fish culturists connected with the commission, who have treated of the subjects with which they were especially familiar. In order to increase the usefulness of the work to the general reader, a technical description of each important fish is given, together with brief information respecting its geographical distribution, habits, movements, size, growth, food, natural spawning, and other characteristics. While the operations described are essentially those of the National Commission, they are usually the same as those employed by the State commissions and individual fish culturists, while in some instances excellent work is done by other methods. Among the fishes coming under review are the salmon, trout, whitefish, shad, basses, and other fresh-water fishes; the cod, mackerel, flatfish, and other salt-water fishes, and lobsters, frogs, oysters, and clams; trans-

* A Manual of Fish Culture. Based on the Methods of the United States Commission of Fish and Fisheries, with Chapters on the Cultivation of Oysters and Frogs. Washington: Government Printing Office. Pp. 340, with 35 plates.

portation of fish and fish eggs, spawning seasons, the character of fresh eggs, and periods of incubation are also treated.

Lieutenant *Butts's Manual of Physical Drill* * is a useful book generally, and not in the army alone. Its object is to systematize physical training in the army and to furnish a practical guide that will enable any officer to give regular and beneficial instruction to his command. Illustration is largely used, as being the simplest mode of description. The exercises are supposed to be controlled by music, of which two schedules are furnished, and are arranged in sets of five each—adapted to other music in many of the drills —and are made to follow one another so closely as to compel the attention of the men and demand concentration of mind upon the work in hand. The work is introduced with brief remarks on the method of instruction, dress, hygiene, bathing, general rules, etc., and includes rifle drill, bar and dumb-bell drill, calisthenics, Indian clubs, running, wall scaling, work with the various articles of gymnastic apparatus, athletic games and contests, and related exercises. The directions are very brief, but plain and explicit. The value of the work depends largely upon the illustrations, a considerable proportion of which are from the life, by instantaneous photography.

Mr. *Teall* recognizes in the beginning of his lessons on *Punctuation* † the difficulties in the art, and the failure of authors to agree upon a reasonable and consistent system. It is, in fact, a matter into which the personal equation enters to a much larger extent than is generally suspected. Each writer has his own moods, his own shades of meaning, and his own emphases to express, of which he alone is conscious, but which he wishes to convey to others; and for this, punctuation is his resource. Hence a punctuation proper for one author might not be suitable to another, even though he may have seemingly the same thoughts, the same words, and the same construction of sentences. There can, therefore, be no hard-and-fast rules for the details of punctuation. The effort in Mr. Teall's treatise has been to reduce the number of actual rules to the fewest possible. Principles have been considered as much as possible, and the rules given are, with the exception of a few that it seemed impossible to reduce to that basis, really concise statements of principle. Much detail that other authors have subjected to special rules thus becomes here mere exemplification under general rules.

We have received No. 4 of the second part of Vol. II of the *Bulletin of the Geological Institution of the University of Upsala, Sweden*, edited by *Hj Sjöznen*. It contains articles in German on the Cambrian and Silurian phosphorus bearing rocks of Sweden, by John Gunner Anderssen; Graptolites, by Carl Wiman; Peat Bog Investigations, by Rutger Servander and Knut Kjellmark—all accompanied by fine illustrative plates; and in English, Notes on the Structure and Development of the Turfmorr Stormur in Gestrikland, by Gustaf Helsing, and Proceedings of the Geological Section of the Association of Natural Science at the University of Upsala.

The *Transactions* of the Nineteenth Annual Meeting of the American Microscopical Society, held at Pittsburg in August, 1896, form a volume of upward of 400 pages, and comprise various papers on Histology, Photomicography, Astronomical Photography, the Rotifers of Sandusky Bay, Water Supply, the Bacteriology of Diphtheria, and kindred subjects, chiefly in biology; together with methods of teaching microscopical science. Numerous full-page plate illustrations are given.

The second part of the voluminous report of the United States Commissioner of Education for 1895–'96 contains elaborate summaries of the usual character concerning various educational matters at home and abroad. The first article is on education in Sweden and Iceland. It is followed by brief accounts of upward of fifty institutions characterized as "typical," that offer manual or industrial training. Dr. Gabriel Compayré's criticism of higher and secondary education in the United States is reproduced from his report as delegate to the Chicago

* Manual of Physical Drill, United States Army. By First Lieutenant Edmund L. Butts. New York: D. Appleton & Co. Pp. 175. Price, $1.25.

† Punctuation, with Chapters on Hyphenization, Capitalization, and Spelling. New York: D. Appleton & Co. Pp. 193. Price, $1.

Exposition. A short article is given on mental fatigue in school. The Bertillon system as a means of suppressing the business of living by crime is explained in a chapter entitled Current Discussions. Several of the papers relate to æsthetic cultivation in connection with manual training and to decorative art; another chapter is given to art decorations in schoolrooms; and another treats as "current questions" of teachers' mutual benevolent associations and pension laws, coeducation, compulsory school attendance, transportation of children to school, and temperance instruction; and there are statistical chapters on agricultural and industrial education in the United States and other countries, education in Alaska, city school systems, commercial and business schools, professional schools, education of the colored race, schools for the defective classes, reform schools, and other schools.

The sixteenth annual *Report of the Bureau of American Ethnology*, besides Mr. Powell's administrative report giving details of the work of the bureau month by month, and by departments, contains papers on Primitive Trepanning in Peru, by M. A. Muñiz and W J McGee; Cliff Ruins of Canyon de Chelly, Arizona, by Cosmos Mendeleff; Day Symbols of the Maya Year, by Cyrus Thomas; and Tasayan Snake Ceremonies, by J. Walter Fewkes. We have also Dr. Thomas's Day Symbols of the Maya Year in a separate publication.

We have the first number, October, 1897, of the *American Quarterly Economist*, published at 15 East Eleventh Street, New York, a magazine devoted to the interests of economical science. It advances a formula for the conception of the point of equilibrium of the wages of labor which it proposes to demonstrate. This initial number has articles on A New Theory of Value and Price; Labor, its Price; and how affected by the Use of Machinery; Machinery; and Success of Nations. Pp. 31. $1 a year.

Uncle Robert's Visit is the third book in the series Uncle Robert's Geography of Appletons' Home-Reading Books. This series is edited by Colonel *Francis W. Parker*, one of the most eminent and successful teachers in the country. He believes in putting life into the schools, and has done it wherever he has been, and designs the geography series to help teachers put life into their teaching in the primary classes. Uncle Robert comes to the farm and talks to the children, assisting them at the same time to observe and experiment, about the map of the farm, the thermometer, the animals, flowers, sunlight and shadow, barometer, woods, birds, thundershower, railroad, the rainy day, etc., and the things which these suggest and illustrate, always having the geographical bearing well in view. So far as is possible each child is left to discover facts for himself and make original inferences—an example which the teacher may follow to a reasonable extent, taking care that the child's desire for knowledge is in the end satisfied. The name of Nellie Lathrop Helm is associated with that of Dr. Parker in the authorship of the book. New York: D. Appleton & Co.

We have from the Macmillan Company the first four volumes of a series of six *Science Readers* for the schoolroom or the house, by *Vincent T. Murché*, revised and adapted by Mrs. L. L. Wilson (price, 25 and 40 cents each). They are intended to be used as reading books or text-books or as the bases of object lessons in the secondary and grammar grades, and the teacher is expected to illustrate them by object exhibitions and experiments before giving them to the children. The lessons are consecutive in groups of which the members depend severally upon the preceding one, and concern the properties of bodies; the nature, growth, and structure of plants; the common types of animals; minerals and metals; the phenomena of the weather; and, generally, the conditions around us.

The Open Court Company, Chicago, publish a second edition of the *Popular Scientific Lectures* of Dr. *Ernst Mach*, revised and enlarged. The additions consist of the author's Vienna inaugural lecture on The Part played by Accident in Invention and Discovery, a lecture on the Sensations of Orientation, and two historical articles on Acoustics and Sight. The lectures are of the highest order, as to both matter and manner, thoroughly scientific and adapted to popular understanding. One of the purposes which the author seeks to carry out in them is to show the substantial sameness of scientific and everyday thought, by perceiving which the public loses its shyness toward scientific questions and acquires an interest in scientific work that is a great help to the inquirer, and he is brought to understand that his work is only a small part of the universal process of life. Price, $1.

PUBLICATIONS RECEIVED.

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Fragments of Science.

Folklore of the Yew Tree.—Various reasons are cited by Dr. John Lowe, in his book on yew trees, as having been given to account for the planting of yews in churchyards. The yew is said to be sacred, the Druids having sacrificed in groves of them, and the character of the tree having been preserved when Christianity superseded Druidism. Evelyn thought that the trees were planted there so as to have them handy to furnish branches for processions, and other authors believed they furnished a substitute for the sacred palm. The yew is, in fact, still called palm by rustics in East Kent. One writer affirms that the evergreen was considered typical of the immortality of the soul. The supposition that the tree was planted to afford shelter to the buildings is contradicted by the fact that the yews are seldom large enough or near enough to the church to protect it. Dr. Lowe believes that these churchyard trees were planted in order to insure a continual supply of bow staves for the English bowmen. A general plantation of yew trees for the use of archers was directed in the reign of Richard III, and in the reign of Elizabeth they were ordered planted in churchyards to insure their cultivation and protect cattle from their leaves. Foreign as well as English yew was used for bows, and the rate of prices fixed by an act of Elizabeth indicates that the foreign was preferred. The best bows, it is said, were made of Spanish yew. The yew tree has poisonous properties which affect both men and animals when they eat too copiously of it, and a drug of considerable value is extracted from it. English schoolboys are said to be fond of taking the small red fruit of the yew into their mouths, chewing it, and then spitting it out, while they are careful not to swallow any. The berries when thus used go by the name of "spitagobs."

Predeterminate Selection.—Telesis is the name given by Lester F. Ward to that principle or that faculty of mind which pursues some definite end. It is further explained as the law of mind, in contradistinction to the process or principle according to which evolution in general takes place, and which the author calls the law of Nature; not that telesis is not also a natural law; but it is utterly unlike the other law, came forward at a late stage in the history of cosmic evolution, and seems to have inaugurated a new order of things. In dealing with the animal world the law of Nature is replaced by that of reason in destroying the tendencies of the wild state and substituting complete submission to man's will, or domestication. By a process of artificial selection, which supplants that of natural selection, those qualities which are most useful to man are rendered more and more prominent until most domesticated animals undergo profound physical modifications in the direction of utility. These modifications are not always also in the line of natural evolution, but, so far as the particular qualities selected are concerned, they usually are so, and in many cases careful breeding improves the whole animal, so that man becomes a powerful ally of evolution itself. This is not disproved by the fact that such improved races usually revert more or less to their original condition when human influence is withdrawn; but the fact establishes another law of biology; viz., that natural selection does not secure the survival of the fittest in the struggle for existence. It merely fixes the exact position which each species is capable of holding in the general competition. This is far below what it might attain if competition were removed. Exactly what man does is to remove this competition, and the immense progress that every species makes is shown in the improvement of the stock under man's intelligent care. Substantially the same results have attended the operation of the telic power on the vegetable kingdom. The display of individual telesis on inanimate objects and natural forces has been the mainspring of human progress; and the definition of civilization is reached that it is the utilization of the materials and forces of Nature.

Decorative Art of the Northwestern Indians.—The decorative art of the Indians of the North Pacific coast—the subjects of which are almost exclusively animals—is characterized by Mr. Franz Boas as differing from other arts in that it is less conventionalized and geometrical, and the parts of the body may still be recognized as such, although liberties have been taken with their size and arrangement. The objects decorated are always of practical use, and the carvings are subordinated to them and limited by their shape. Carving is done mostly in wood, but also in stone and horn, and is usually in the round, in bas-relief, or, although more rarely, in high relief. In consequence of the adaptation of the form to the decorative field, the native artist can not attempt an artistic representation of the object, but is compelled to indicate only its main characteristics. In consequence of the distortion of the animal body due to its adaptation to various surfaces, the animal meant would be hardly recognizable if the artist did not emphasize what he considers its characteristic features, and these in many cases become its symbol. Yet, while the symbolism develops a tendency to suppress parts of the animal, we find in the efforts of the artist to adapt the form of the creature to the decorative field a desire to preserve, as far as is feasible, its whole figure; and with the exception of a few profiles, we do not find a single instance that can be interpreted as an endeavor to give a perspective and therefore realistic view of the animal. The representations are combinations of symbols of the various parts of the body, arranged in such a way that if possible the whole animal is brought into view. A tendency is manifest to exaggerate the symbols at the expense of other parts of the subject.

The Chinese Oil Tree.—We find the following interesting information in the Consular Reports, vol. liv, No. 203: The wood-oil tree (*Aleurites cordata*) belongs to a family very common in China, known as the *Tung*. It is mentioned in some of the oldest books of the Chinese, where it is praised for its beautiful flowers and for the peculiar value of its wood in the manufacture of lutes. The leaves, bark, and flowers of certain varieties are used in medicine. The variety from which the oil is obtained is known as the *ying tzu tung*, so called from the shape of its fruit—*ying* means a jar. Oil is said to be derived from other varieties, but it is the *ying tzu tung* which is especially cultivated for this purpose. It is found chiefly in Hunan, Hupeh, and Szechuen. It attains a height of from ten to twenty-five feet. It has large, beautiful leaves, small pink-white flowers, and a green fruit somewhat like an apple. The seeds are large and poisonous, and it is from them that the oil is expressed. The fruit is gathered in August and September. The machinery used for extracting the oil is very rude, consisting of wooden presses with wedges. The oil is usually of a light color, somewhat resembling linseed oil, and emits a nauseous odor. The principal place of export is Hankow, whence in 1895 there were shipped, chiefly to Chinese ports, 38,714,112 pounds, the value of which amounted to $1,162,524.80. The oil is used in the manufacture of paint and varnish, waterproof paper, and umbrellas, and in western China, it appears, for lighting also. The greater part, however, is consumed in calking, for which purpose it is everywhere used in China. In applying it to the bottom of boats it is put on hot, but for parts not commonly submerged it is used cold. The upper part of a Chinese boat is oiled once or twice a month. Soot from the burned oil and nut is also extensively used in making ink.

On the Summit of Mauna Loa.—Dr. H. B. Guppy recently published an interesting account of a three weeks' sojourn on the summit of Mauna Loa. Many curious observations were made. The air was at first highly electrified. A red blanket used by Dr. Guppy crackled under his hands at night, and he could trace letters on the surface in phosphorescent lines with his finger nails. The effects of these meteorological conditions soon showed themselves in the cessation of the action of the skin, in severe headaches and sore throat, in a tendency to palpitation and dyspnœa, and in sleeplessness, general lassitude, and loss of appetite. These symptoms were attributed to the extreme dryness of the air; for, when a short spell of damp weather intervened, most of the unpleasant symptoms disappeared. Another interesting phenomenon was observed every morning and evening. For about twenty minutes after sunrise and before sunset the shadow of the mountain was thrown back against the sky of the opposite horizon. The average range of daily temperature was found to be about twice as great as at the coast. In order to familiarize himself with the crater, Dr. Guppy adopted the method of making a rough plan with a pocket prismatic compass. In some places the lava crust was thin and fragile, and there was always the chance of a sudden fall into a subterranean cavern. His descent into the crater was made on the northwest side. During dry, clear weather smoke is only evident at two places in the crater: one near the center, and the other in the southwest corner from the base of a yellowish cliff, where there are apparently extensive deposits of sulphur. When, however, the sky is clouded, and especially when the air is moist, white vapor may be seen arising from the greater part of the surface of the crater. The explanation seems to be that this vapor is escaping all the time, but is only visible when the air contains a large quantity of moisture. A very large amount of vapor is discharged from the borders of a small crater lying near Pohaku Hanalei, and this is the smoke sometimes observed from the Kona coast. It is probable that the next eruption will occur on this, the south-southwest, slope of the mountain. Strange to say, a considerable amount of insect life was observed. Butterflies, moths, gnats, bees, and house flies were quite numerous, and in noticeably larger numbers when the wind was southerly. No doubt, they had all been brought up to this absolutely sterile region by air currents.

The American Association, 1898.—The officers of the American Association for the Advancement of Science and the local committees are preparing to make the meeting for 1898 of the association, to be held in Boston, August 22d to 27th, which will be its fiftieth anniversary, or jubilee meeting, worthy of the occasion and of the honorable record the association has made for itself. It is realized that the anniversary gives promise of being the most important scientific gathering ever held in the United States. Many foreign men of science have been invited to take part, and many foreign educational and scientific institutions are expected to send delegates, whereby the meeting will be given an international character. Additional interest will be afforded by the meetings of affiliated societies to take place in connection with it. The officers of the Massachusetts Institute of Technology and of the Boston Society of Natural History have offered the use of their halls and rooms—constituting three closely adjoining buildings. The corporation of Harvard University will make the association its guest for a day in Cambridge; the Essex Institute has arranged for a day in Salem; and there will be an excursion in the harbor, and after the meeting, trips to the White Mountains and Cape Cod. It is hoped that one of the results of the anniversary meeting will be an increase of the research fund of the association, which in twenty years has grown to only six thousand dollars. All members whose names have dropped from the roll are requested to renew their membership, either by paying back assessments and having their names replaced on the roll under their old date of election, or by re-election.

Nature Study for Farmers.—The Agricultural Extension work instituted by the College of Agriculture of Cornell University, in compliance with a law of the State of New York, has so far borne the shape of an attempt to discover the best method of teaching the people agriculture. The results to the present time indicate as the most efficient means of elevating the ideals and practice of the rural communities the establishment of Nature study or object-lesson study combined with field walks and incidental instruction in the principles of farm practice in the rural schools; correspondence instruction in connection with reading courses; itinerant or local experiment and investigation, made chiefly as object lessons to farmers, and not for the purpose, primarily, of discovering scientific facts; the publication of reading bulletins which shall inspire a quickened appreciation of rural life; the dispatch of special agents as lecturers or teachers, or as investigators of special local difficulties, or as itinerant instructors in the normal schools and before the training classes of the teachers' institutes; and the itinerant agricultural school. The farmers are found, as a whole, the report says, willing and anxious for education; but "it is astonishing, as one thinks of it, how scant and poor has been the teaching which has even a remote relation to the tilling of the soil; and many of our rural books seem not to have been born of any real sympathy with the farmer or any proper appreciation of his environments." In the belief that the fundamental difficulty with our agriculture is that no attempt is made to instruct the children in matters that will awaken an interest in country life, the experiment was tried of visiting the rural and village schools and talking to the children about any object that presented itself at the time. The children imbibed the information with notable readiness and showed a keen interest in it, while the teacher took an almost universal interest in this kind of work; so that the conviction resulted that the greatest good that can be rendered to the agricultural communities is to awaken an interest in Nature study on the part of teachers and children. The best way to reach these persons appears to be by short and sharp observations upon plants, insects, and other objects, and not by means of definite lectures of stated lengths.

Hand Spinning.—Domestic spinning, except in its modern revival, is treated by Mr. T. Blashill, of the British Archæological Association, as a lost art. Although it went out in England some fifty or sixty years ago, and in the United States a little later, it has become as completely forgotten by the world as if it had been for centuries unknown. Spindle whorls have been discovered from time to time in deep excavations; implements used in spinning may be seen in the most ancient Egyptian sculptures; and spindles with the whorl attached are found in Egyptian excavations; so that we have means of acquainting ourselves with the conditions of the art in all ages. In hand spinning with spindle and distaff there has been no progress through all these ages, and the most ancient specimens extant might be used by women who in remote countries practice hand spinning to-day. The great wool wheel was in use as early as the fourteenth century and lingered on in Wales down to recent times. The ordinary spinning wheel was known as early as the middle of the sixteenth century, and was at first turned by hand and afterward by the treadle. The earliest spinning wheel extant in England is believed to be in the British Museum, and is of the fourteenth century. In former times the art of spinning was a necessary accomplishment for women and girls, and perhaps its use was rendered more popular by the idea that it promoted grace in the female form. In the year 1721 an aged lady left considerable property to endow a school for spinning. The art was practiced in England in the drawing rooms and servants' halls of country houses as late as 1830. Rabbit wool is spun at Aix in Savoy at the present time. Statements were made, after the reading of Mr. Blashill's paper, that the spinning wheel is still used in Sutherland; that "home-spun" is made in the Isle of Lewis; and that the Bedouins in spinning use their fingers and no distaff.

Child Training.—The child and the man he is destined to become, said M. Berthelot in his address on Science the Educator, are not passive beings, receivers into which we can arbitrarily pour a certain sum of teaching and science, distributed more or less harmoniously—matters which they will find later in special schools and their whole life. Far from it. We should seek to develop in the child, along with memory and alertness in answering the questions of the examiner, aptitude for work and personal activity; to excite curiosity and the initiative in the young man, and to provoke in his mind suitable elaboration, a kind of digestion of the information hastily accumulated. In this way only can we make individual faculties and latent capacities really available. Plato teaches us to study the dispositions of our children and adapt our instruction to them so that it shall seem less like work and more like play. Hence in our first essay in instruction we should try to draw out the tastes and aptitudes, in order to discern what they are and put them to profitable use. We can reach this essential result only by giving the child leisure enough to develop them in the special direction it prefers. But the child must have to do the work. Now the tendency of our systems of secondary education is to do away with this leisure of work and of personal tastes. During the years of youth, perhaps the most fruitful for mental evolution, we are eager to push the child into intellectual molds. Instead of its first object being science and letters in themselves, or the seeking for scientific truth and literary beauty, which woo the child by their intrinsic attraction, reserving till afterward the more special determination of its inclination toward some particular end, our teaching is first and almost exclusively directed with reference to the examination. The highest motives of the mind are thus suppressed or diverted from infancy. Baccalaureates and the competitions of the special schools spoil the late and most precious years of youth, those in which the individual initiatives and vocations ought to appear.

Bounties and the Extermination of Noxious Animals.—We are informed by Mr. T. S. Palmer, of the Department of Agriculture, in a paper on the extermination of noxious animals by bounties, that "more than a score of animals in the United States are considered sufficiently injurious to require radical measures for their extermination. Wolves, coyotes, panthers, bears, and lynxes are very destructive, but perhaps do not cause greater loss than ground squirrels, pocket gophers, rabbits, and woodchucks. A few birds also, such as blackbirds, crows, English sparrows, hawks, and owls, are sometimes included in the category of noxious species." Remarking that the most plausible and persistent demands for protection from the depredations of wild animals have come from owners of sheep and cattle, and many of the laws offering bounties have been enacted ostensibly to encourage sheep-raising, Mr. Palmer notices the curious fact that while, no doubt, this industry has many claims for protection, "the most urgent demands for bounties in the West have come, not from the farmers or owners of small flocks, but from cattle and sheep men whose immense herds and flocks are pastured on Government lands, and who claim that the cost of protecting their herds and flocks should be borne by the county or State." In some regions the losses on account of wolves and coyotes are so serious as to threaten the success of the sheep industry. The author further shows that while bounty legislation has existed in the United States for two centuries and a half, has called for an enormous expenditure, and has been thoroughly tested in most of the States and Territories, bounties have not resulted in the extermination of a single species, and have failed even in the island of Bermuda, which has an area of less than twenty square miles. The larger animals are gradually becoming rare, but it is through the growth of settlement rather than by the operation of bounties; and Iowa, Minnesota, and South Dakota have tried to rid their lands of pocket gophers and ground squirrels by offering bounties, "but the effect of the law was far more evident on the county treasuries than on the animals."

Ancient Monuments of Ceylon.—An inkling to the character and extent of the ancient cities and architectural monuments buried in the forests of that island is given in Mr. H. W. Cave's book on The Ruined Cities of Ceylon, but yet the author has to confess that he has only touched "the merest fringe of the great subject." The works of which they are examples were comparable with other massive works of antiquity, and such as we could not imagine the modern Ceylonese capable of constructing, and that the ancestors of these people should have been competent to execute them is hard to conceive. They are, however, like other Buddhist art, rather monotonous, repeating the same motives. A single exception to this rule is the crag of Sigiri, where King Kasyapa secured himself as in an impregnable fortress after he had by his crimes made his life among the people unpleasant and dangerous. He carried a spiral stairway around the precipitous sides of the rock to the summit, surrounded it with a strong rampart, collected his wealth and treasure there, and built a palace and offices. There he lived in great luxury. The rock rises abruptly from the plain, and has an artificial lake on its west side. Traces of massive stone walls inclosing about fifty acres are visible around its base; within these terraces, defenses, and the foundations of buildings are marked. Parts of the spiral galleries of ascent are well preserved. On the top of the rock ruins have been found that belong to two periods at least. Only small parts of the ruins of the huge cities of Anadhurapa and Polanaruwa have been recovered from the jungle, and "other remains of a glorious past are scattered here and there all over the island." The "moonstones" are a peculiar feature of Singhalese architecture, and constitute the doorstep to the principal entrance of a building. They are floridly ornamented, and look very much like a door mat laid at the foot of a staircase. The carving of one specimen described by Mr. Cave, not less than sixteen hundred years old, "is as sharp and well defined as if it were just from the sculptor's chisel." Works on a similar scale to those of Ceylon abound in Burma, Java, and Cambodia, and are all attributed to the early Buddhist ancestors of the present common people. Their dynasty ended in Ceylon in the thirteenth century, when Tamil invaders took the capital and laid the whole country waste.

Ancestral Survivals in Domesticated Animals.—Dr. Louis Robinson, in a book he has recently published concerning that subject, goes back to their wild ancestry for the origin of nearly all the traits we observe in domesticated animals, giving only a minor place to human selection and human training. Thus, as the Academy says in a review of his book, he suggests that the dog could never have been taught what man has taught him had he been originally a solitary hunter; he was a member of a pack which co-operated for common purposes; which subordinated some individuals to others; which had division of labor and specialized functions. By virtue of this fact, when man took the dog into his company for a partner, the dog continued to fill his accustomed place in the new community. His loyalty to his master and his readiness to defend him when attacked are an echo of his loyalty to his four-footed comrades. His work as pointer or setter is the result of the habit of hunting in company. To dogs man is a very superior dog, a capable leader in the pack to which both belong. The shying of horses is explained by the fact that horses descend from ancestors accustomed to roam over close-cropped pastures, where any tuft of long grass might conceal a snake or other venomous animal. Hence timidity about such objects—transferred now to pieces of loose paper or cabbage leaves in the road—was really in the beginning a preservative trait. The donkey, whose progenitors were mountain beasts living among desert rocks, does not shy. Pigs fatten easily, because their ancestors had to eat mast in autumn against the winter fast; and when frost lasted long, the fattest wild boar would alone survive to carry on the species. Cows give us milk and wait to be milked, because the ancestral cow left her calf in hiding, and went far afield for pasture. Her chewing the cud depends upon her habit in early days of eating hastily when exposed to the attacks of wild beasts, and then digesting at leisure in her lair with comparative safety.

Abatement of Smoke.—The best method of abating the smoke nuisance has undergone a full discussion at the instance of the Franklin Institute, several meetings having been devoted to the subject, and communications having been invited and received from engineers and scientific men in different parts of the country, and the subject has been treated practically from a scientific point of view. The participants in the discussion seem all to have agreed that the abolition of smoke is practicable and not difficult; and most of them prescribe for the accomplishment of it the simple remedy of securing a perfect combustion of the fuel. This can be effected, according to Professor Thurston, of Cornell, and the others, through care and skill in stoking and by the use of properly constructed furnaces, without any costly apparatus. "Secure maximum temperature of furnace, producing the whole heat of combustion, as nearly as practicable, before commencing to take off heat for application to steam-making." This, according to Prof. L. M. Haupt, can be largely effected by intelligent firing, whereby a large amount of oxygen is admitted over the incandescent material instead of being forced through it. Experiences were related with patent devices, which with a bad fireman produced no better results than the plain fire box with a brick arch and a good fireman; and with the steam jet, which promoted quicker and more thorough mixture of the gases and air, and was good; but no device found better favor than the judicious, even distribution of the right proportion of added fuel over a hot fire. Finally, resolutions were adopted declaring the continuous and frequent emission of dense black smoke unnecessary, and advising that it be not permitted within the city limits. Accounts of special antismoke devices were avoided in this discussion, which related to general principles only; but inventors were given opportunity to describe and illustrate their apparatus at two subsequent meetings of the institute held in the fall of 1897.

MINOR PARAGRAPHS.

M. Moissan, who has had much success in preparing carbides of the metals by heating charcoal and the metals directly at the temperature of the electric furnace, now describes a new and general method of preparing these substances by placing together in the furnace a metallic oxide and carbide of calcium in fusion. The metallic oxide is reduced; the metal unites with the carbon, producing a crystalline carbide, and the oxygen combines with the calcium to form lime. By this method M. Moissan has obtained crystallized carbides of aluminum, manganese, tungsten, molybdenum, titanium, and chromium. In case the metal does not give a combination with carbon, it is obtained in free state as a melted button. There have been reduced in this way by carbide of calcium, to form free metals, the oxides of lead, bismuth, and tin. Silica is likewise easily reduced by carbon and gives carbide of silicon, or carborundum, a substance much used in industry.

President Gilman observes, in his semicentennial historical discourse at the Sheffield Scientific School, that the institution has been a department of a university "which never suffered its love of letters to blind its eyes to the value of science. In the days of closely restricted income, during the first half of the century, chemistry, mineralogy, geology, botany, mathematics, physics, meteorology, and astronomy were taught in Yale. Nor will any one think that scientific research was undervalued if he recalls the preparation of Dana's Mineralogy, the light that was thrown on meteoric showers, the studies of the aurora and of the zodiacal light, and the search for an intramercurial planet. Very different would have been the Sheffield record if it were not associated with the fame, the fortune, and the followers of a greater alma mater. . . . No conflict of studies has been heard of; no hostility between science and letters; no 'warfare' between science and religion. The Sheffield

School has always stood for the idea of a liberal education in which scientific studies should predominate, but in which a moderate amount of Latin and of modern languages is required; history and economics are also taught. It is memorable that for a long period the greatest of American philologists was the daily instructor in French and German, that the most learned study ever made of 'Dan Chaucer and his well of English undefyled' proceeded from a Sheffield chair, and that no American professorship of economics or statistics has been more prolific or stimulating than that which was held for many years by one but lately brought to the end of his career."

The custom of trepanning, or taking small pieces of bone from the living head, was much practiced in prehistoric times, as the skulls prove to us, and is still in vogue among some peoples. Among these are the people of the Berber stock in the Djebel Aurès and the Djebel Chechar of the edges of the Algerian plateau. The method of performing the operation is carefully described by Drs. H. Malbot and R. Verneau, of whom Dr. Malbot was shown by a native doctor a skull with more than a dozen circular holes, two slits, and a large irregular orifice, all of which had been pierced when the man was alive. The skull was kept hidden, and was evidently used as an example by the local doctors. The natives have recourse to trepanning for blows or wounds on the head; and it does not matter how long before the blow may have been given, if only the sick person can remember that he has had one. The operation is not severe. A woman, tired of her husband, is said to have called in the service of a trepanner in order to get a divorce from him by producing a piece of her skull and affirming that he had broken it in some of his cruel acts.

The chief fire warden of Minnesota, C. C. Andrews, says in his report for 1896 that the main work under the fire-warden law of the State is to make people more careful about causing fires and more thoughtful of the benefit to the public and to individuals of forest resources. There are several million acres in the State, in detached areas, fit only for growing timber. It is computed that trees take from the soil only one twelfth part of the mineral substances required for field crops; and it is therefore profitable for the non-agricultural lands to be retained in timber or planted with it. Properly taken care of and protected the forests might afford a sustained, permanent, and growing industry for many thousand more laborers than are now employed. A bill passed one house of the Minnesota Legislature in 1896 providing a way by which the State could receive and administer, on forestry principles, donations from individuals of cut-over and waste lands unsuited for agriculture. The measure has been discussed and approved by the Forestry Association and the State Horticultural Society; and as it seems to be all meritorious, it is to be hoped that it may become a law.

NOTES.

Ebeonite, a new material invented by M. Panchon, a French paper maker, is named from the resemblance of many of its properties to the hardest woods. It is made by treating fine chips of resinous woods with lyes of sulphates or sulphites, as if to obtain wood cellulose. The softened chips are then pounded to a pulp, which is treated during refining with such chemical or coloring substances as will impart desired special qualities. The pulp is then transformed into boards of leaves of paper, is piled up to whatever thickness may be wanted, pressed in a hydraulic press, and dried slowly. The resulting crude ebeonite can be worked into any shape; or the pulp can be molded, before drying, into articles which will be proof against atmospheric changes, heat, and moisture, and can be rendered incombustible.

A curious instance of instinctive fear is related by R. L. Pocock, in Nature, of a baby orang, with which the writer and his wife were playing. When the lady gently extended her muff, made of the skin of the Indian flying squirrel and ornamented with the unstuffed head and tail, toward the animal, it showed signs of terror. "Upon repeating the experiment, the ape promptly rolled over backward as the quickest way of removing himself from the immediate vicinity of the object; then, getting himself together, climbed up the branches of his tree and retired to the back of the cage, keeping all the while a wary and frightened eye upon the muff, as if in fear of an attack from behind. During all this, the orang made no sound.

A proposal was made some time ago in a Belgian journal for the celebration of the seven hundredth anniversary of the discovery of stone coal, which was made in 1197 by a blacksmith of Liége. He found a kind of black earth, and, wood and charcoal being very dear at the time, the thought occurred to him to try its properties as a combustible. This black earth was coal. The man's name was Hullioz; whence the French word for coal—*houille.* Authentic documents show that coal mines were fully worked in Belgium in 1228 and 1229. The use of coal was introduced into England in 1340, but did not become common till the beginning of the sixteenth century. It was first mined in France in the fourteenth century; in Austria and Bohemia in the last century; while it was mined in North Germany about the year 1200.

Some seeds of common plants—such as bloodroot, the large-flowered uvularia, and trillium—are furnished with whitish fleshy appendages, forming a slight ridge on one side. These crests are not conspicuous to be noticed by birds, but Mr. Charles Robinson, of Carlinville, Ill., has found them attractive to ants. He has often exposed seeds of bloodroot in situations frequented by ants, and has observed that the insects invariably seize them and carry them away, the crest serving as a convenient handle by which to take hold of them. He has also experimented with seeds of the other plants named with like results. These seeds seem to have no other means of dissemination, being such as simply drop from the capsules and lie where they fall, till the ants carry them away. They thus add one other to the variety of means by which seeds are scattered.

The possibility of electrifying air entirely free from dust particles is still an open question. Late investigations by Lord Kelvin and S. Arrhenius tend to prove that dust is not essential to electrification.

The Proceedings of the Meeting of the American Railway Association held in October, 1897, contains a carefully compiled report of the committee on the metric system, in which is embodied a brief, convenient, and useful history of the English and French standards, enlivened with interesting incidents. We learn from this report that "the tendency in railway operations has been toward the use of a decimal system. Rates are made on the basis of one hundred pounds. Civil engineers have abandoned the Gunter's chain of sixty-six feet for that of one hundred feet, and divide the foot decimally. The ton of two thousand pounds and the hundredweight of one hundred pounds are now generally used, instead of twenty-two hundred and forty and one hundred and twelve pounds. These changes, both American in their origin, have commended themselves because they permit calculations in decimals."

During the year covered by his last report, the director, Dr. Elkin, of Yale Observatory, studied the photographic trails of five Perseid meteors which were secured in August, 1896. So far the results are not very conclusive as to the character of the radiant, but each year is expected to add to the data, and it is hoped that most valuable deductions may be ultimately possible. A portion of the work on the parallaxes of the ten first-magnitude stars in the northern hemisphere has been passed through the press; and values have been calculated which the director believes can hardly be modified appreciably by further discussion. Dr. F. L. Chase, assistant astronomer, has taken up the heliometer work on the parallaxes of large proper motion stars.

Eight new asteroids—a smaller number than the average of previous years—were discovered in 1897, bringing the whole number up to four hundred and thirty-three. Instead of names the later discoveries are designated by combinations of letters of the alphabet—as DH, DI, DJ, DK, DL, DM, DN, and DO for those of 1897.

An exhibition of culinary art recently held in Vienna met with a prodigious success. It included everything appertaining to cooking, from a richly served table to the emperor's bivouac kitchen. Under a system of reducing the prices of tickets each day, the attendance on the second day was double that on the first, and on the third the ticket office had to be closed against the crowds. It is observed that such throngs came as are never seen at industrial expositions or displays of pictures.

We have to announce the deaths of Dr. Waldemar von Schroeder, professor of pharmacology in the University of Heidelberg and author of a number of treatises on physiological chemistry; William A. Rogers, professor of astronomy in Colby University, and formerly assistant in the observatory of Harvard College, at Waterville, Me., March 1st, aged forty-six years. He was the author of some important contributions to astronomy and physics, and especially to the technique of measurement. Léon Jambert, director of the Popular Institute of Science at the Trocadero, Paris; M. Charles Cornevin, professor of hygiene and zoötechny at the Veterinary School of Lyons, France; ex-Director Winneke, of the Strasburg Observatory; Charles Scofer, a distinguished Orientalist, at Paris, aged seventy-eight years; Sir Henry Bessemer, by whose invention the manufacture of steel was revolutionized, at London, March 15th, aged eighty-five years; Sir Richard Quain, the eminent English physician, March 13th, aged eighty-three years; Admiral Popoff, Russian inventor of a curious form of circular ironclad war ships; Professor Kirk, of the Department of Forests of New Zealand and author of valuable works on the timber and timber trees of that colony; and Dr. Ferdinand Huster, near Liverpool, a chemist of considerable local reputation.

ANDREW C. RAMSAY

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THE PHILOSOPHY OF MANUAL TRAINING.

By C. HANFORD HENDERSON,
LECTURER IN HARVARD UNIVERSITY.

I.

IT is said of a well-known American Hegelian and educator that he always starts out with Adam and Eve. The method is thorough, but it gives a long preface. I may seem guilty of the same tendency when in writing about manual training I appear to write about everything else, and very seldom directly about the subject in hand. But this is precisely what I expect to do, and I expect to do it for the sole purpose of throwing light on manual training.

No scheme of education has any serious claim upon our attention unless it is founded upon some rational system of ethics—that is to say, upon some rational view of the proper conduct of life. And the foundations of any acceptable scheme of ethics must be laid deep in the broadest generalization of all, in our philosophy of life.

Education then, is not an inductive but a purely deductive science.

It is true that every primary science, in the course of its historical development, passes through two distinct stages: the stage of induction, in which from the study of special cases we are led to the perception of a general law or principle; and the stage of deduction, in which from this body of general principles we work out a whole series of special and important conclusions. This double course of development is now so well recognized that we are withholding the name of science from those branches of inquiry which have not yet reached the deductive stage. Comte's test of science was the power of prediction. This power comes only when we have such a store of general principles to consult, and can with their help state with confidence just what will happen under any given set of conditions.

Judged by this stricter standard, many of our so-called sciences are only now earning the name. Chemistry is an excellent case in point. For many years it was purely inductive. Every new reaction was very properly described as an experiment, for no one knew precisely what would happen. It is still largely experimental. But out of this accumulation of experimental data there are slowly emerging a few general principles which give us the power of limited prediction.

It is the same with physics and the group of studies generally classed as natural sciences. Some of them, such as mineralogy, are hardly sciences as yet, since they allow small deduction. Similarly with the group of studies that may be called the human sciences—sociology and economics. So far as they are primary, they must first be studied in their manifestations, and any general laws wrought out from just such a mass of details.

These remarks are limited to the primary sciences. The distinction between these and what may be called the secondary sciences is of great practical importance. I conceive those to be primary which are, so far as we know, self-founded, and must perforce work out their own laws. The first stage of their development is necessarily inductive, for they have nothing to build upon except direct and immediate experience. And I conceive those sciences to be secondary which receive their laws at second hand, if we may so phrase it, from some more basic science, and simply apply them to a special class of conclusions. Such sciences are necessarily derivative in origin, and must proceed deductively. The present trend of scientific opinion is to recognize but one science, mechanics, as fundamental or primary, and to regard all other sciences as secondary. It does this when it attempts to explain the phenomena of these sciences by referring them to mechanical principles. With the progress of scientific generalization we may look forward to a time when there will be but one theorem in the geometry of Nature, and the separate sciences of to-day—biology, physics, chemistry, sociology, and the rest—will assemble themselves under this theorem as a series of manifest corollaries.

And I may say that such a view, suggested with increasing emphasis by the experimental sciences, is also in harmony with the deepest generalization of a more abstract philosophy, which sees in the universe the operation of but one power. It is also interesting from a metaphysical point of view to notice that of all the concrete sciences, the one chosen as fundamental—mechanics—is just that science which embodies the largest *a priori* elements with the least possible external elements.

I have said that education is a purely deductive science, and the reason now becomes plain. It is necessarily a secondary science, since it depends, not upon any self-contained principles which may be brought to light by careful inductive reasoning, but solely and entirely upon external considerations—that is to say, upon the social ideals growing out of our accepted ethics and philosophy, and upon the methods which our current psychology suggests as the proper means of realizing those ideals. It is for this reason impossible to study education, and much less any specific scheme of education, such as manual training, at first hand, as a thing in itself. Education can not evolve its own laws, can not be said to have any definitely discernible end and purpose of its own. It is purely a process—a delicate, subtle process by which psychological methods are made use of to attain social ends. In saying this, one does not belittle the function of education; one magnifies it. I should then be treating manual training in a most superficial way, alike unjust to it and to the reader, if I considered it other than I propose to consider it—as a part of a larger plan.

Emerson, and others less inspired than he, have repeatedly pointed out to us how prone we are to mistake the means for the end. And this is nowhere more marked than in education. We start out very badly as students of education when we erect it into an end in itself. It is very far from being an end. It is simply a means, the servant of a higher science, the servant of the social ideal.

I have always cherished a sympathetic interest in the progress of American architecture. It is an interest that survives the years, and I constantly find myself looking at new buildings and at old with half-closed eyes, and through my lashes—which they tell me is a sure sign of the artistic temperament. But, be this as it may, what I see, even with half-closed eyes, does not, in the main, please me. I see a dreary succession of unbeautiful buildings. And I ask myself the cause. The American schools of architecture are admirable. The work done in several of them will bear comparison with the best work done at the *École des Beaux-Arts* in Paris, and the *École des Beaux-Arts* is, I believe, the Mecca of all our young architects. And in contemporary architecture it is not boastful, I think, to say that America is abreast of the world. Nowhere in Europe will you find more beautiful modern buildings than the Public Library in Boston, the Madison Square Garden in New York, or the Pennsylvania Station, before it was spoiled, in Philadelphia. And yet the mass of our buildings are hopelessly ugly. Many of these aberrations are due to poor architects, for the profession is not yet limited to men of taste; but for much of the ugliness, and especially the suburban ugliness, we are indebted to that individual known as the architect and builder. I need not enlarge upon his sins. You will, perhaps, see him at his worst in San Francisco, where eleven bay windows are sometimes bestowed upon one small house.

The characteristic of the architect and builder is excess of action and deficiency of thought. He looks so long and so steadily at the mere process of building, at the operation itself, that he quite forgets to ask whether what he builds is beautiful or suitable. He belittles the graver function, the designing. The putting of architect before builder on his signboard is merely for trade purposes. Even excellence of workmanship is no extenuation for such social crimes. No matter how strong and solid and tight an ugly, inconvenient building may be, it remains a social offense, for it has done violence to the higher and essential requirement.

The same criticism must be applied to the schools. They are not admirable simply because they are alert. They may do with rigor and vigor many things that had better be left undone. However well and thoroughly their methods may be carried out, they are a poor thing, after all, if what they create is not beautiful and seemly. Back of the hundreds of builders who put together the Public Library, the Madison Square Garden, the Pennsylvania Station, stand the several true architects in whose hearts and brains these buildings first took shape. Ten million builders could never alone have created so beautiful a result. It was not in them to do it. And as an old lady once said in speaking of her sister-in-law, "You can't get more out of people, my dear, than there is in them."

Back of everything that is noble and beautiful you will find a compelling idea. Back of the five hundred thousand teachers in America, who are to-day fashioning sixteen million young minds into patterns beautiful or grotesque, there should stand the compelling impulse of a high social idea.

The main question in education, indeed, I may say the *one* question in education, is simply this, What type of men and women do we wish to prevail? What *is* the social ideal toward which we wish to work? And the one question of method is, What process will produce this type, will realize this ideal?

I need not point out that the question of method can not possibly be answered until the first question is definitely settled. That would be a perfectly useless journey which had no objective point in view. Yet I think it is no exaggeration to say that the very large majority of teachers and school boards have very vague ideas indeed as to where they want the children to be landed when the formal process of education comes to an end. And these ideas are not only vague, but frequently they are contradictory as well, and so the long journey turns out to be aimless.

To attempt to formulate, and particularly to formulate for others, what would be a reasonable ideal of life, is to put one's philosophy to the supreme test. When I look about me on the drama of life—when I look within, upon the drama of my own life—what is it that stands out above the rest as the very necessary and essential thing? What constitutes the most evolved conduct and animates the most evolved people? In putting such basal inquiries as these it may be thought that, like the Hegelian I mentioned, I am going back almost as far as Adam and Eve. But unless one is willing to ask such questions one's speculations will continue to play forever about the surface of all educational problems, and will never strike into the heart of the matter.

In the first place, then, how much of conduct does education cover? The answer is not far to seek. If education be a process for the realization of an ethical ideal, it must have to do with all that part of human action which is touched with morality—that is, with conduct as a whole. And what constitutes conduct? Arnold says that conduct is three fourths of life. Spencer says that it includes all action which involves a purpose. But the ethical teaching of these undoubted masters of ethics may, I think, be profitably extended. A keener scrutiny of cause and effect throws out the fractions and dispenses with the qualifications. Conduct has to do with the whole of life, and education, which has to do with conduct, must have to do with the whole of life. There is no action which is ethically indifferent. Even the bodily functions, the act of breathing, the beating of the heart, the process of digestion, which in health are so automatic that we are quite unconscious of them, are nevertheless the product of knowable conditions, and as such are under the indirect control of the informed spirit.

Whether the breathing be long and deep, bringing with it the power of wholesome, manly action, is a moral question. Whether the pulse beat be strong and steady, sending the blood coursing through the veins and making one the center of a radiant helpful life, is a moral question. Whether the digestive apparatus is doing good work, renewing and refreshing the tissues, is a moral question. Since all these functions are open to modification, they are open to improvement, and the *quality* of the life dependent on them may be made better or worse. In the last analysis, every act of life, be it bodily or intellectual, is morally significant. Modern man has tasted too deep of the tree of the knowledge of good and evil to plead ignorance and hide when the lord Conscience walks through the garden of his spirit in the cool of the evening. I must not linger too long over this idea. But it is a transforming idea. It allows no act of life to be commonplace. It makes every act of life a moral act, and if it be touched with emotion it makes every act of life a religious act. It is a thought to awaken enthusiasm, for it seems to me in a very real sense to transfigure life.

All conduct, all action, is, then, either good or bad; not good or bad abstractly and absolutely, but good or bad with respect to some tangible end. But this relativity must always be kept in mind. A coat is good in winter if it keeps us warm; it is good in summer if it keeps us cool. A shot is a good one if it goes straight to the mark. A machine is a good one if it does the required work. The criterion of the thing seems to lie in this, whether it is well or ill adapted to the end in view. It is precisely the same with conduct. Evolved conduct is marked by a nice adjustment of means to ends.

Now, a thoroughgoing analysis of every scheme of life shows that happiness, whether it be called such with all frankness and sincerity, or whether it be called blessedness, or virtue, or perfection, is in reality the final end. The immediate end must be the means to happiness, and morality, the art of right living, must consist in the realization of these means in the fullest possible measure. But bear in mind that happiness is not self-existent, a bright light shining in the darkness of the unfelt. It is a state of individual consciousness, which results from the gratification of individual desires. You remember what Omar Khayyám says:

> "I sent my Soul through the Invisible,
> Some letter of that After-life to spell;
> And by and by my Soul returned to me,
> And answered, 'I myself am Heaven and Hell.'
> Heaven but the Vision of fulfilled desire,
> And Hell the shadow of a Soul on fire."

The moral life consists in realizing the utmost attainable measure of happiness, and this, not alone for one's self, but quite as ardently for one's children and one's fellows. It is not a selfish scheme of life, not happiness for one's self and misery for others, but happiness as a universal end. It means fullness of living, the entertaining of manifold desires and interests, and their most complete and rational gratification. It is a divine abandon, rather than a narrow asceticism; extravagance, rather than parsimony. Plato, you may remember, speaks of the world as the product of the divine *ungrudgingness.* What an unparalleled description, and how pleasant to repeat to one's self in the midst of a commercial age! The human life which most nearly approaches the divine is steeped in this same generosity and openness. We want to drink greedily of this cup of life. We want to press it upon others, for it is good. This is not alone the teaching of modern science. It is, as well, the song of modern verse.

Life in its fullness and totality means much. It means youth, manhood, and old age. It means one day and all days. It means the life of the body, that it shall be clean and sweet and wholesome; it means the life of the intellect, that it shall be keen, inquisitive, receptive, creative; it means the life of the emotions, that they shall be strong and deep and human.

These needs of the complete man, these needs of the body, of the mind, of the heart, must be recognized and gratified if life in its fullness and totality is to be realized. Human nature is many-sided, and in this consist its charm and its promise. Not one of its many sides may be neglected. As Spencer puts it, "The performance of every function is in a sense a moral obligation." The social ideal which philosophy and ethics press upon us is not that of an economical community, but rather that of a community touched with the divine ungrudgingness, a community made up of men and women of large needs, large appetites, large hearts, large capacities for receiving and giving pleasure, and in addition equally large opportunities for gratifying to the full these many sides of an enriched human nature.

Do you realize that to-day nine tenths of our people, perhaps more, are leading starved lives, and the pity of it is that they don't even know that they are starved? It is the mission of social culture to arouse these benumbed spirits, to set them on fire with the vision of the complete life, to quicken the social conscience so that it shall not rest content until these, our brothers and sisters, shall have drunk to the full of the riches and glory of life. The social ideal of philosophy and ethics has little to do with the economic law of supply and demand, and much to do with the human law of need and fulfillment. To accomplish this end, to open to each soul the fullest life of which that soul is capable, is manifestly the social purpose of which education is the formal process.

In deciding upon the type man and woman we wish to have prevail, we assuredly stand at the parting of the ways. The more definite and concrete ends appeal to practical minds, because they seem the more attainable. But if, my friends, a careful analysis of life shows—and I am sure that it does show—that these ends are not the major ends, it is surely a poor victory to compass them and to leave the major ends unessayed.

We stand to-day in the midst of much educational activity. We see a great deal of dull, routine work, but we also see many new departures, teachers with their own particular methods and special ends. I should be the last to disparage this attempt at originality, for out of it in the end some good will come. But when I look upon it, and upon its first harvests, I am constantly reminded of some wise words of Arnold's—words to the effect that not alone must we live up to the light that is in us, but as well must we see to it that the light be not darkness. These are simple, homely words, but if they once lay hold upon your spirit, they have a compelling force that is imperative.

It is not uncharitable, I think, to say that much of this educational activity is one-sided. Analyze it for a moment. Here is a man who has looked so long and so steadily upon the function of government that he has lost all sense of proportion. The giant apparition of the State has obscured the other sides of life, and has come to occupy the whole field of vision. He sees in men only citizens, and in children only possible citizens. The one study is civics, and education groups itself around that. Here is another man, upon whom the bread-and-butter study has made a too deep impression. When he reflects upon life, the pale and haggard faces of the poor stare at him, and their thin and ragged garments flutter in the wind of his imagination. In the rich city of New York a woman died of hunger. It is horrible. The daily loaf stands out in large dimensions and obscures the rest of life. The one study becomes for him the bread-and-butter study, and education gives place to industrial training. Here is still another man who has busied himself with questions of rent and wages, profit and loss, currency and land, free trade and protection, until these tools of social life become for him the life itself, and the great issue—it seems a sacrilege to say it—is plainly economic. And another, who sees in trade and shopkeeping the blood of life, and would make arithmetic and bookkeeping and business practice the food of children. Or another, who is impressed with numbers, and who believes that New York and Chicago are great cities because of their millions of people. To him children are socially interesting as future mothers and fathers. His cry is the vainest of all. It is the *race*. Nor should I omit in even so partial a survey that large group of men and women who rightly hold the achievements of the human spirit to be very precious, but who see, unfortunately, in the vehicle which brings these records from the past into the present—that is to say, in language—a thing as worshipful as the achievements themselves. Are we to forget that Thucydides and Zenophon were soldiers, that Goethe was a chancellor, and Shakespeare an actor; that all the men and women who have reported the spirit worthily have been men and women who have tasted life, and have had something to report? Are we to forget that in the age of Pericles, that flowering time of the human spirit, there was but one language held worthy of study—the native tongue? To look too steadily upon the vehicle of thought and erect that into an end is to make no less grave a mistake than was made in the other partial ends that we have examined and rejected.

But it is un-Froebelian and unphilosophic to dwell too long upon the negative side of things. The materials of life are positive. I have had a purpose, however, in stopping so long among these negations. I have wanted to make it very clear that these ends are partial and fragmentary, and quite unworthy of those who seek the highest good. If one still believes that citizenship, or industrialism, or economics, or trade, or parenthood, or language, is a defensible end of education, it will be difficult to concentrate the interest upon a worthier image.

It is not idle to let one's imagination and one's love play about this image of the complete man, to picture him in all his beauty of body, of intellect, and of heart, for it is only by thus entertaining this conception and making it thoroughly our own that we shall ever have it prevail, and ever have the educational process conform to this as its ideal product.

It is perhaps convenient for purposes of study to consider man in the threefold aspect of body, intellect, and heart. But the division is not true to Nature, and if it blinds us to the essential unity of man, it is an expensive convenience that we had much better do without. The common conception of his nature is dualistic. He is body and spirit, or he is body and soul. This conception, which from an educational point of view, is certainly unfortunate, is founded upon the current dualistic philosophy, which discerns a universe made of mind and matter. Even more particularly is it founded upon that theological dualism which makes the spirit and the body the most unhappy of partners, forever at warfare, and each defeating the other's best interests. It is a philosophy whose logical extreme is asceticism, and would land us all, like poor Simon Stylites, on top of a pillar of useless renunciation. It would lead us to miserably dwarf our natures instead of gloriously expanding them. This bloodless philosophy is deeply instilled into us all, for it has been a part of our creed for many generations back. Even now, I find myself—and probably many of you do the same—when taken unawares, deciding that the disagreeable thing must be the right thing, and simply because it is disagreeable. The Jonathan Edwards in those of us who have inherited both the riches and the poverty of the New England blood is very apt to speak out and commit us to many such immoralities.

This dualistic philosophy is the very opposite of the philosophy involved in manual training, and in the new education generally. The systems of education founded upon dualism must seem to us false and irreverent. The truer conception of life is monistic. It dwells not upon the shadows and the cold and the evil of life, the subjective demons of negation, but upon the brightness and warmth and goodness of life, upon the joy and sunshine and beauty of Nature. This is the positive material out of which we are to construct our world. And this vivifying, beautiful spirit comes to us not from Edwards and Calvin, but from men like Emerson and Froebel, men who believed in righteousness rather than sin, in light rather than darkness, in heat rather than cold.

Our image of the complete man is, then, the image of a unit, of an organic whole, and the educational process, whose sole function is to expand and develop and perfect this organism, must address itself to the whole task, and must deal with man as a unit, with his emotional, physical life as well as his intellectual life. And here, observe, we do not say that it is *desirable* to do this—we say that it is *necessary*. A modern educational scheme founded on dualism might profess that it were good to have a sound body and a warm heart as well as an evolved intellect, and might even work with some degree of intelligence and success toward the solution of the double problem. But the weakness lies in this, that the least pressure, a lack of time or equipment or power, and some selection is bound to be made, under the belief that one part of the problem may be solved apart from the others. It is impossible. It is *quite* impossible. Concentrate all effort upon the body, and we have an athlete who turns out to have not even good health. Concentrate all effort on the emotions, and we have a sentimentalist, who is neither loving nor lovable. Concentrate all effort on the intellect, and we have that sorry creature, the pedant, who does not even know.

Development must be continuous, and must proceed step by step. And this, let me repeat, not merely because it is desirable to have sound bodies, and warm hearts, and evolved intellects, but because they depend upon one another, and can not be separated. I conceive this unity of man to be the very basis of the new education. It is certainly the foundation of all we do in manual training. It is, therefore, a principle which invites the closest scrutiny. If this philosophy be true, if this doctrine of ethics be sound, if man is so essentially a unit, if his happiness and welfare are the business of morality, then we can not escape the conclusion that any scheme of education, to be a true scheme, must have its foundations laid deep in such a doctrine of ethics and such a philosophy of life. But if these be false, if between mind and matter there is eternal warfare, if the conflict between Ormuzd and Ahriman is to go on forever in the human soul; if duty consists in a daily death, in the ceaseless thwarting of one's nature, in self-sacrifice in place of self-realization; if Satan be the reality that God is, then I believe that the new education is a sad mistake, a thing quite false, and that I could render best service by presenting manual training pathologically as a thing to be known in order to be avoided.

In thus seeking the philosophy of the new education, we assuredly stand at the parting of the ways. It is useless to blink the fact. Indeed, it is worse; it is cowardly. Let us frankly admit it—everything *is* involved. When you scrutinize your educational creed, you scrutinize your religious creed, your ethical creed, and your social creed as well. And until there is harmony among these, until your religion and your ethics and your sociology have been settled upon some rational basis, it is impossible for your education to be other than a poor makeshift thing, like the work of the architect and builder, showing an excess of action and a deficiency of thought.

Until one makes such a thoroughgoing examination of one's fundamental beliefs and reaches some degree of consistency, one can not teach one's self, one can not direct the teaching work of others. One can go through the emotions of teaching and can do infinite harm. Do you remember the story of the man who led the little ones astray, and the sad comment on his life—it were better that a millstone had been hanged about his neck and he had been drowned in the depths of the sea? It would be horrible in the end to feel that these words applied to us. If you have not the time to make such an examination, or, having attempted it, if you have not been able to reach any broad and human philosophy of life, it were better not to teach; it were better not to concern yourself with education; it were better, like Thoreau, to go to raising beans, for this at least you can do honestly. How can you hope to renovate others until you have renovated yourself?

As I see the matter, then, the philosophy of manual training, and of the new education generally, is plainly monistic. It sees in man not body and mind, with independent powers of action, and astonishing possibilities for conflict, but the contrary, a unit organism, with thinking and feeling among its essential characteristics quite as much as extension and impenetrability. And this organism is a sensitive one, responding to the stress and strain of desire and emotion, quite as readily as to mechanical forces, to the push and pull of bodily contact. What affects one aspect of this organism affects the other. If you touch the body you touch the spirit. If you touch the spirit you touch the body. One reacts on the other. The unfolding and perfecting of the human spirit is the object of manual training, as it is of all education.

This view of man, of unit man, offers a new avenue of approach to the spirit. Every good thought strengthens and vitalizes the body. Every wholesome exercise of the body invigorates the spirit. The action of each is carried out in terms of the other. See how wonderfully true this is. Each conscious act of the outer bodily life is first rehearsed in the inner thought life. If you stir, you do it first in thought. If you go on a journey, you go first in thought. If you build a house, you build it first in thought. If you work in your garden, you do it first in thought. An idea precedes each conscious act, is indeed the father of the act, the essential part of it. But the converse is just as true. The drama of the inner life would be quite impossible without the imagery and symbolism of the bodily life. Imagine, if you can, a formless, immaterial world, and then try to think. There would be no terms in which to think, and nothing to think about. It would be complete cessation of being. Thought is not carried out in terms of thought, but in terms of things. It is as dependent upon these as bodily action is dependent upon thought.

Regard for a moment the interaction between this inner and outer world. Every bodily experience affects one or more of the sense organs, and sends one or many impulses along the nerves to that central receiving station, the brain. And here something very wonderful takes place, something so wonderful that we have no explanation for it in the whole realm of empirical science. The nerve current setting in from the outer world to the inner world of the brain manifests itself there as a fact of consciousness, a sensation. All we know about it is that these impulses taken together produce that stream of thought which is the drama of existence. The richer and more varied these impulses or sensations, the richer and more varied the stream of thought. With meager sensation comes meager thought. We must cut the coat according to the cloth. This perceptual knowledge, this report of the senses is the only thing that comes to us, and out of it we build our entire world. Reflection and reason make use of this material, but they can add nothing to its original content. It is impossible to overestimate the importance of having the senses alert and keen that they may report the outer world accurately. It is impossible to overestimate the importance of giving the senses much to operate upon, the largest possible field that they may report the outer world fully. We want for the complete life, the fullest and most accurate perceptual knowledge, and we can only get this through the activity and training of the senses. The application in education is obvious. This is what constitutes the great difference in environment, and makes one favorable to growth and another unfavorable. A keen tool with nothing to work upon, a dull tool with a wealth of material, can neither of them turn out much of value.

We please ourselves by saying that experience is the best teacher, that the world is the best schoolhouse, that travel is the best education. But in reality we prevent experience, we shut out the world, we disallow travel. We ask children to reason and reflect about a world that they do not yet know. Surely this is unphilosophic. We give them small perceptual knowledge—mainly what they get on holidays and when they play truant—and spend nearly all our time in attempting to build larger logical structures than we have the material for—bricks without straw. It is this that makes the school teacher's life hard. It is not working with the children. The children are the most lovable and interesting part of creation. It is in attempting impossible tasks. It is a very large part of the philosophy of manual training that the senses shall be alert and keen—good tools; that the brain shall be well developed and active—a good workman; that the store of perceptual knowledge shall be full and accurate—good material to work upon. And it seems to me that we have here a recognition of cause and effect that is not only in the highest degree logical, but is also far ahead of the position taken by any other scheme of education.

Furthermore, it is very evident that not only is every bodily act preceded by a mental act, but if it produce a new sensation is followed as well by a distinct mental reaction. The circulation is complete. If we arrange a series of bodily acts, we bring about a corresponding series of mental reactions, and if we arrange the bodily acts with sufficient cleverness, we bring about a series of mental reactions of high educational value. This is what manual training attempts to do—to utilize this newly apprehended avenue of approach to the spirit. It arranges a series of bodily acts, for the most part having to do with the hand and eye, and does so simply and solely for the sake of the mental reactions that follow upon these acts. While the term manual training is roughly descriptive of the outer fact, you will notice that the real purpose and essence of the training are mental.

I need not point out the evolutionary significance of such a training. If we accept evolution, if we believe that man is the reaction of the world environment on the human spirit, we will not be slow to seize upon the thought that it is now possible to direct this reaction and so make evolution a conscious process. Do you see that manual training attempts to do precisely this thing—to create a definite bodily environment in order to bring about definite spiritual results? Nor need I point out again how absolutely such a scheme is dependent for its justification upon our philosophy, how utterly false it must be if the spirit of man is one thing and his body another.

But the end of evolution is a moral end, and education, evolution made conscious, is also moral. The series of mental reactions brought about by the succession of bodily acts undertaken by manual training has a definite moral end. If the most evolved conduct is, as we have tried to show that it is, that which leads to the fullest measure of happiness for one's self and for one's fellows, and if morality, the art of right living, or right conduct, consists in the realization of the means of happiness, the end of the educational process is no less clear. It must be an attempt to lead man out of a narrow existence, poor in experience, in sensation, in thought, in feeling—poor, that is to say, in happiness—into a broader and more complete life, rich where the other is poor, rich in experience, in sensation, in thought, in feeling; that is to say, rich in happiness. Now, manual training is just such an attempt, and it has just such a warm, human end. It is an attempt through a succession of bodily acts to bring about a series of mental reactions of a definite, happiness-producing kind.

The exercise of every faculty short of the point of fatigue brings a strengthening of that faculty. Every demand upon the skill, judgment, and accuracy means a building up of those qualities, and this increase of power brings an increase of interest. We like to do what we do well. It is this development of a many-sided interest that enriches life and makes each day a welcome experience. It is loss of interest that makes the tragedy of old age. What a spiritual abyss is represented by the men and women who are killing time! The mental reactions of well-planned bodily work make for power, and for that power which leads to the complete full measure of life. Not only is the instrument itself, the brain, made more sensitive by this play of activity, but its power has more to work upon. An enlarged world of experience and sensation makes possible an enlarged world of thought. The effect is cumulative.

Manual training, believe me, is not practically or theoretically a scheme to merely train the hands, to make boys useful about the house, to supply the world with artisans, to take the place of a dead apprentice system, or to meet in education the demands of an industrial age. It has no such special and technical end. Its true end is the major end, the attainment of the complete life, the unfolding and the perfecting of the human spirit; and this end it proposes to gain by recognizing to the full the principle of cause and effect, and by setting into operation agencies adequate to bring about such large results. These agencies are organic. They have to do with the person of the child. Such work can not be exterior. It must be done in the blood and the tissue. It means literally a change of structure, a new birth, a refining and sensitizing of the organism, a nicer adjustment of the bodily powers. It is only by such thoroughgoing practical work that the process of education can be carried out and the ethical ideal realized.

Nor must we forget that while this ethical ideal has to do solely with the individual, it has equally to do with every individual, and so becomes a social ideal. The full measure of life and happiness which we have in mind as the educational goal can only be attained when each individual life is full to the brim. But the results are never mass results. They are purely individual results. There are moments in life—moments to be remembered—when a whole group of men is stirred by a common sentiment, joy or sorrow, fear or anger, applause or condemnation, and one seems to feel the pulse beat of the whole, and to stand in the presence of something larger and more beautiful than the individual life. But this social organism, of which we seem to catch a glimpse, is at best a mirage, and when followed leads one further and further into the desert. It is true that the mass results which make this vivid appeal to the imagination are due to the multitude of men, but their *quality*, the thing that gave them value, is inseparable from the individual. The new education has always in mind this large social ideal, but it is a practical process and must proceed individually. It gains the social end by the very emphasis it places on individuality. The complete man, strong in his bodily powers, keen in his intellect, warm in his affections, sees in his own personality something very beautiful and very sacred, and comes increasingly to respect the personality of others.

I have tried to present the philosophy of manual training. Let me sum it up. It rests upon a belief in the unity of man. It creates a definite environment for the bringing about of definite moral and æsthetic results. It has for its ethical ideal the complete life of the individual. It has for its social ideal the complete life of every individual. In a word, it is monistic, evolutionary, individualistic, social. Believe me, it is a human movement, directed to human ends, and warm with the best sentiment and best aspiration of the human heart.

EVERY family, Prof. L. H. Bailey says in his Garden-making, can have a garden. If there is not a foot of land, there are porches or windows; and "one plant in a tin can may be a more helpful and inspiring garden to some mind than a whole acre of lawn and flowers may be to another. The satisfaction of a garden does not depend upon the area nor, happily, upon the cost or rarity of the plants. It depends upon the temper of the person."

A CRUISE AMONG HAIDA AND TLINGIT VILLAGES ABOUT DIXON'S ENTRANCE.*

By GEORGE A. DORSEY, Ph. D.,
FIELD COLUMBIAN MUSEUM, CHICAGO.

ON May 11th of this year, accompanied by Mr. E. P. Allen, the museum photographer, I left Chicago for a four months' tour among the Indians of the far West. The object of the journey was to secure material for the Department of Anthropology, more especially to get such objects as could be worked into groups to illustrate the culture history of the Western Indians, and also to secure material to represent the physical characteristics of certain of these races.

Between Chicago and the Pacific coast we visited three great families of Indians: the Blackfeet of Montana and Canada, the Flatheads of Montana, and the Kootenays of British Columbia and Idaho. When we reached Victoria, on June 19th, we had before us two groups of Indians on the northwest coast to visit—the Haidas and the Tsimshians.

As may be seen on an ethnographical map of the Northwest, the Haidas and Tsimshians are only two of five great stocks which are to be found on this coast. Beginning with the north are the Tlingits, who occupy the islands and coast of southern Alaska. Just to the south come the Haidas, who live on Dall and the Prince of Wales Islands of Alaska and the Queen Charlotte Islands of British Columbia. Next come the Tsimshians of the Nass and Skeena Rivers and the neighboring coast and islands. Below them are the Kwakiutls, inhabiting the coast from Gardiner Channel to Cape Mudge on the mainland and the west coast of Vancouver Island. The fifth and last group is the Salish, inhabiting the eastern half of Vancouver Island, the southwestern corner of the mainland of British Columbia, and parts of Washington, Idaho, and Montana.

It is not an easy matter to reach the Queen Charlotte Islands. The Victoria steamers touch at the town of Skidegate once a month, but remain for a few hours only, and the facilities for getting away from Skidegate are limited to Indian canoes. Furthermore, Skidegate and vicinity have been pretty thoroughly investigated by anthropologists, and we were especially desirous of visiting Masset, a remote Haida village on the northern shore of Graham Island, the largest of the Queen Charlotte group. This village is visited by steamers but once or twice a year, when the supplies are taken over

* From a lecture delivered in the Field Columbian Museum, November 6, 1897.

for the Hudson Bay Company's post. We finally decided to take one of the British Columbia steamers, and land at Port Simpson, the chief town of the north coast and the one nearest to Masset. There we hoped it would be possible to secure some sort of a sailing vessel with which we could make our proposed journey.

After eight days of steaming along that most wonderful of inland seas we landed at Port Simpson, six hundred miles from Victoria, on June 30th. The prospect, after a few hours' survey of the barren beach and of the bay devoid of boats, was not cheerful; nor

STREET IN MASSET. Queen Charlotte Islands.

did the perpetual patter of the rain, nor the thick depressing fog, nor the forlorn, deserted appearance of the town, contribute greatly to encourage a belief that our mission was to be successful. One thing, however, was in our favor: the Hudson Bay officer from Masset was in Simpson and was ready to return to his post. This fact, in the end, proved greatly to our advantage, for by his efforts we were enabled to secure one of the boats which had been used by the Canadian surveyors in running the international boundary line in 1895. So the Janet, the largest of the boats, was taken out of the shed and put into the water, and after two days' soaking it was found that the leakage could easily be kept in check, and she was pronounced seaworthy.

Our party numbered five: Mr. Stephens, the merchant; Mr.

Chapman, our skipper; Mr. Deans, our guide; Mr. Allen, and myself.

Upon looking at a map of this region it would seem that the voyage from Port Simpson to Masset ought to be made with no difficulty, but Masset is almost seventy miles due west from Port Simpson, and the prevailing wind hereabout is from the west, and it blows with such force and persistency that Masset must be reached in a roundabout way. Long experience has taught that it is best not to attempt to make a direct passage, and that time is saved by sailing from one island to another along southern Alaska until Point Chacon or even Cape Muzon is gained. From either of these two points Masset is reached usually with but little difficulty. Another reason in favor of this circuitous route is the fact that out from the northeast corner of Graham Island projects a long sand bar, many miles in extent and known as Rose Spit. Over this long, low-lying reef the water breaks with great fury and the tide currents are almost irresistible. Rose Spit is the terror of the Northwest coast, and many are the schooners and canoes which have met an untimely end on its treacherous sands.

All this we knew when we set forth from Simpson at noon on July 3d, but little did we realize what all this meant. There certainly was nothing auspicious in our departure, as we started forth in the midst of a fog and drizzling rain, and after six hours we had only made North Dundas Island, not more than fifteen miles from Simpson. But, notwithstanding the fickle wind and the drizzling rain, the evening and night were happily spent. We had left behind us steamships and towns and civilization, conventionalism and restraint; we were now fairly out of the world. We were to see no boat but our own, nor a living being save at Masset.

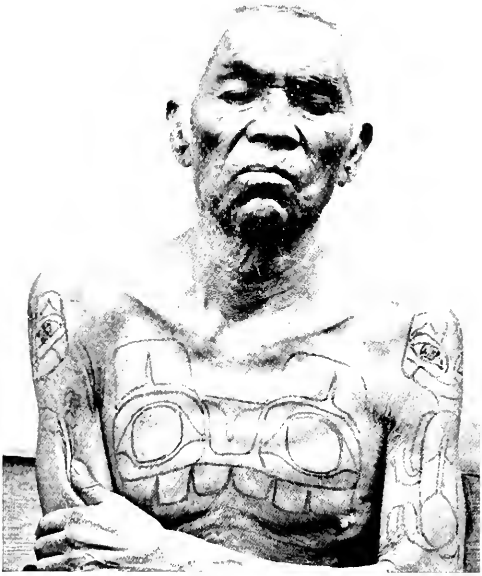
On the following morning we were to make our first acquaintance with a specimen of the tides of this region. An early start had been our plan and our hope, and to this end we had our boat loaded, were all aboard, had one sail up, and were ready to push off, but the Janet wouldn't push. When a tide has to fall twenty-two feet within two hours it can't afford to lose any time, and consequently it did not wait for us, and the Janet was hard aground and firm as a rock, and so we waited for the turn of the tide; we waited just five hours.

On account of this mishap the best we could do that day was to make Cape Fox, but that was not without some compensation, for we thus spent the night of July 4th on Alaskan soil. By two o'clock on the following day we had gained Cape Northumberland and were snugly anchored in a cove on Kelp Island. The weather now was all that we could possibly wish, the sky was as clear as crystal, and far away on the mainland to the east we could see the sun glistening on the myriad ice-bound peaks of the coast mountains, while about us in every direction were the forest-covered tops of half-submerged mountain peaks which make up this sea of islands. The afternoon was one long to be remembered. Tents, blankets, and clothing were put out to dry, while we rambled through the forest, following paths made by deer and bear down to the springs near our camp. The forests were a revelation—bathed in an almost eternal mist which

HAIDA WOMAN OF MASSET WEAVING A BASKET.

has been tempered by the mild Japan ocean currents, they are indescribably green. Giant cedars, firs, spruce, and hemlock fairly crowd each other and leave but scant room for the ferns and underbrush which cover every inch of ground. Then there is a ruggedness about the shores of the islands; here absolutely barren, there piled high with drift, often to a height of sixty feet or more, which speaks eloquently for the mighty forces of Nature which never tire.

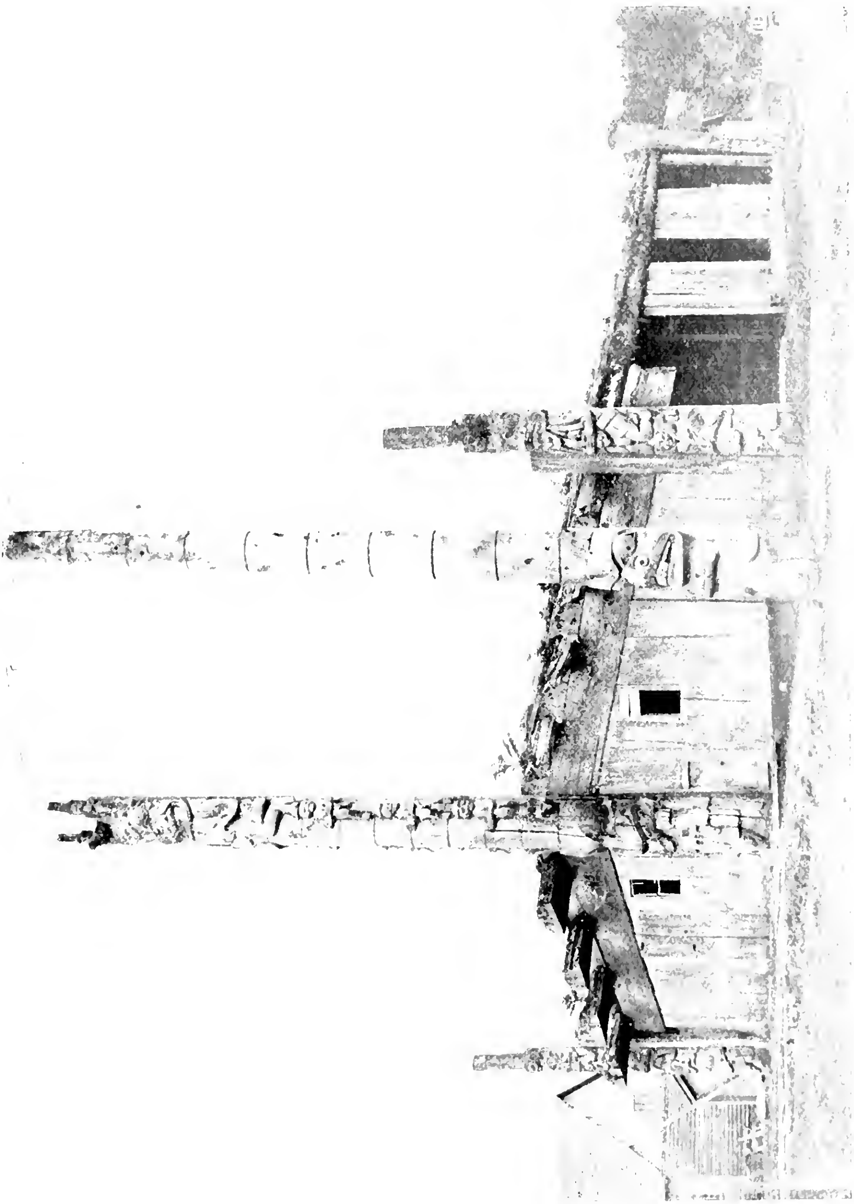
We left Cape Northumberland at three o'clock on the morning of July 6th, just as the sun was beginning to throw a ruddy glow over the ice-bound peaks on the mainland. By eleven o'clock we had rounded Devil's Rock, upon which the ill-fated Mexico was to strike only a few days later. At one o'clock we were within sight of Tow Hill, the most prominent point of the northeast shore of Graham Island. And then the wind veered to the west again. Harder and harder it blew until the sea was lashed into white foam. For twenty-six hours we beat in the face of that wind, now gaining a little to the west, now carried toward Rose Spit by a current which seemed stronger than the gale, and now so close to the shore that we could all too plainly hear the roar of the surf as it broke upon the rocks. Drenched to the skin, the waves breaking over us every few minutes, the air filled with spray, our boat half full of water at times, we passed twenty-six hours of wretchedness, misery, and abject fear. At times we were only a few feet from waves which, had they broken a little nearer, would have filled our boat and lowered us away to the bottom of the sea.



A TATTOOED HAIDA OF MASSET.

On the following afternoon we began to put miles between our boat and Tow Hill, and were nearing the mouth of Masset Inlet. With one more tack we have rounded the point and are headed due south, and a favorable tide bears us rapidly down the inlet; a minute more and we sight Masset—a strange, quaint little sleepy village, with its tall totem poles and row of cottages.

Masset is one of the two villages which to-day make up all that is left of the Haida nation on the Queen Charlotte Islands. The Haidas numbered seven thousand in 1840, and counted over thirty villages. To-day there are two inhabited villages and less than one thousand Haidas. They are a doomed race. Wars, smallpox, gross immorality, a change from old ways to new ways—their fate is the common fate of the American, whether he sails the sea in the North, gallops over the plain in the West, or sleeps in his hammock in the forests of Brazil. Masset typifies in itself that process of change and decay which we find going on among the aborigines all over the con-



Ancient House of Chief Weha. Masset.

tinent. The totem poles drop one by one; the great massive houses of the old times, with their mighty cedar beams, slowly succumb to the wind and the weather; the old grave posts totter and fall, but their ranks are not filled up. In their stead are little stuffy, propped-up cottages with iron stoves and glass windows, and by the side of this modern village is the marble burying ground with marble columns brought from Victoria. Masset is the Clyde of the coast, and in the fall and winter the little street along the water's edge is lined with great cedar logs, which are being chipped, steamed, pressed, and fashioned into canoes, some over fifty feet long. Strong and well built, the Haidas make journeys in them of hundreds of miles—they are the vikings of the New World. Another important industry of the town consists of weaving cedar bark into mats and baskets. These mats are strong and well made, and serve innumerable purposes, the chief uses being for the floor and for the outside covers of bundles and packages. But their principal utensil for carrying is the white basket made of closely woven splints of maple.

The real interest in Masset, as well as that of other Indian villages of this region, lies in the past; and to the past we turn. Beginning with the ancient customs, we look in vain for the great labret or lip ornament of old, which formerly played such an important part in the fashion in deformity. We did see one woman with a tiny plug in her lip, but from this one can form no estimate of the extent to which this custom was formerly carried. Of the tattooing little remains, for the custom has long since been given up. But the majority of the middle-aged men and women have their arms and legs tattooed; and by dint of much persuasion and a piece of silver we induced a decrepit old man to leave his house long enough to enable us to carry away the photograph of his totem, which was tattooed on his breast.

The physical characteristics of the Haidas are peculiar and are to be explained by the circumstances under which they live. With but little exposure to the sun their complexion is very much lighter than that of the coast tribes, and indeed often for fairness compares very favorably with that of the Europeans. They have a full, broad face, large eyes, a nose rather delicately molded, and prominent cheek bones. The hair is jet black, thick, and heavy. The men usually keep the hair plucked from the face, but where the beard is allowed to grow it is generally thin and scant, and is almost confined to the mustache. With both sexes the hair grows low over the forehead. Twice while in Masset we encountered faces which in their features seemed unusual and out of place. On inquiry we learned that they were both slaves who had been taken in war from the coast Indians long ago.

Owing to their almost constant seafaring life, the Haidas have long and powerfully developed arms, while their legs are proportionately short. A single glance at a Haida walking is sufficient to convince one that he is more at home in a canoe than on the land.

Of the ancient houses in Masset not one remains in good condition. But stately even in its ruins still stands the historic house of old Chief Weha. It is composed of massive beams and walls of great, wide, rough-hewn cedar planks. Its entrance is still guarded by the ever-present totem pole, which is one of the best in the village. The interior is even more interesting than the exterior, for it reveals the massiveness of the timbers and the solidarity of these houses. When one looks upon such a structure as this and compares

A Tlingit Shaman's Grave on Duke Island.

it with the ramshackle cottages of to-day, the feeling forces itself upon one that in this respect as in many others the Haidas have given up the substance for the shadow.

It is sad to relate, but it is true, that the day is not far distant when there will not be a single totem pole in British Columbia. I believe I am safe in saying that another one will never be erected. The old ones do not fall of their own accord as fast as they are cut down; for, strange as it may seem, the natives actually cut down one or more poles every winter for firewood, and in this they are encouraged by the missionaries. The totem pole is a coat of arms, it is an epitome of the owner's mythical ancestry; from its curious conventionalized animals or hieroglyphs we read into the past, of the time of their garden of Eden, and of their struggles and friendships with the monsters of the deep and the creatures of the land and air.

The totem pole stands immediately in front of the dwelling, and in its more ancient form was even an intrinsic part of the house, for an oval opening at the base of the pole served as the entrance.

In addition to the totem poles there was erected in former times an additional pole at one side, near the front of the house, which answered the purpose of a mortuary or memorial column. This pole is usually quite plain, and is surmounted by the crest of the man in whose honor it was erected. Several of these are still standing at Masset, one of the best preserved being the bear column in front of old Chief Edenshaw's house. Farther down the beach we came to another pole which was surmounted by a conical structure which bears a close resemblance to a Haida hat, and, in fact, they relate in Masset that it actually is intended to represent a hat. This pole is not duplicated elsewhere on the Queen Charlotte Islands.

Of the ancient burial columns but two remain standing, the others having been pulled down and the dead buried in the little modern cemetery. The first column is single and stands near the water's edge. On the side facing the village and near to the top a rectangular cavity had been chiseled out within which was placed the box containing the body. The other burial structure is in the form of a double column or two posts, whose tops are united by a hollow, boxlike crossbar. In such burial columns as this were usually placed two or more bodies, and in some even entire families.

More photographs, purchases of relics, and measurements of heads, and we were ready to leave this half-modern, half-barbarian, half-dead, half-alive village, for others which knew neither teacher nor preacher, but which were long since abandoned and given over to solitude, to moss, and cedar trees, to snails and hoarse-throated ravens.

Skirting along the western half of the northern shore of Graham Island, we made our first stop at Yan, about three miles from Masset. Here, as elsewhere, we encountered a luxuriant vegetation which covers every inch of the soil, and even mounts to the top of the burial columns and to the decaying rafters and beams of the great old houses. Probably the most interesting object we saw at Yan was a mortuary column, the crossbar or the coffin-box support of which was of a single board, and most handsomely carved in totemic designs. After pushing and crawling for an hour through wet underbrush, made up largely of salmon and rose bushes over three inches in diameter and from fifteen to twenty feet high, we were off again, and that night, with the friendly assistance of a favorable tide, we dropped down into Virago Sound and anchored in front of the old moss-covered village of Kung. This was one of the best of the old villages along this coast, but is now completely deserted. We found much to interest us. The totem pole with the moon symbol was the first we had seen, nor is it reproduced elsewhere on the island; but what proved of special interest were several very old graves which faced the beach on the east side of the village. These were the burial places of medicine men or Shamans, and quite different from the ordinary grave. Instead of a single pole in which the body is placed through a hole in the top or at the side, or from the double-pole platform grave which we saw at Kung, we found a little house built of short cedar logs. Inside was placed the Shaman in a long coffin-box, reclining at full length with his

EGG-SHAPED ROCK CONTAINING BURIAL HOUSE OF A HAIDA SHAMAN.

rattles and other ceremonial paraphernalia about him. With one had been placed several very fine masks, but they had almost entirely crumbled into dust. The grave of the old chief at Kung was the best I had seen. Four short, stout posts had been firmly planted in the ground, and on the inner corners of each grooves had been cut out to receive the beams that supported the little house, in which lay the chief in state. The structure was nearly buried in a thick growth of vegetation, and much work with the axe was needed before the beautifully carved posts could be rendered visible to the camera.

Leaving Kung at ten o'clock in the morning, we set out for the extreme northwestern shore of the island, and that night anchored in a little cove on North Island. We were now on deserted but historic ground, for it was here in 1787 that Dixon first traded with the Haidas, and in one day secured over three hundred sea-otter skins, which to-day are so extremely precious. This was the opening of the fur trade on the Northwest coast, and from this memorable day's trade sprang up a commerce in furs which has continued down to the present time.

Fortunately for us, one of the old houses had been re-roofed by some previous visitor, and so we found within dry cedar planks upon which to spread our blankets for the night.

On the following morning we crossed over to the old village of Kiooste, where there is much of interest; but the place is so over-

Grave of a Haida Chief. Queen Charlotte Islands.

grown with underbrush that it was only with the greatest difficulty that we could get from one house to another. Recrossing the strait to North Island and anchoring our boat to a piece of kelp, we explored the little egg-shaped rock of Gorgie Sethlingun Nah, or Gorgie's Coffin House. Gorgie was a famous Shaman of Kiooste, and when he died was laid to rest in a handsome little house on the summit of this island. By much hard work we were able to reach the top of the rock, but the house had tumbled into ruin, and two bats were all that remained to tell of the former glory of Gorgie.

Next day we explored the cave of Skungonah. Skungonah was a hermit who lived over a hundred years ago and dwelt here alone, living on raw fish and birds. But in after years the great cave became the burial ground of Kiooste.

We were now obliged to return to Masset for provisions. Leaving Masset at half past ten in the morning, we entered the harbor of Old Tongas at half past nine the same night, having made eighty miles in eleven hours.

We were now in the country of the Tlingits, and before us was Old Tongas—old because it was long since abandoned, and its inhabitants had formed another or New Tongas. Tongas is the southernmost of a chain of Tlingit villages which extends as far north as the Aleutian Islands. Like the Haidas, the Tlingits are slowly but surely disappearing, and the time must soon come when the race will be entirely extinct.

There is but little of interest to-day in Old Tongas except the totem poles and the old ruined houses. Totems with the Tlingits play the same important part in their civil and religious life that they do among the Haidas. Even the corner posts of their houses are carved into totemic designs. Comparing their totem poles and memorial columns with those which we saw in the Haida villages, it becomes apparent at once that the symbols are more boldly executed and the conventionalism less pronounced. The figures are not blended and combined as they are among the Haidas. We noticed also that the human figure is repeated over and over again, and is always portrayed with a boldness and fidelity that are worthy of the highest praise.

One of the unique features of Old Tongas, and one we saw nowhere else, was the ruin of a house which still retained its old front porch made up of heavy logs; while in front, leading up to the porch, was a pair of primitive steps hewn out of a solid log. In another place, almost entirely obscured by vegetation, we came upon a recent house grave surmounted by a cross, showing that the influence of missionaries had been felt here before the town was deserted.

At ten o'clock we started toward the east again. We had been disappointed in not finding the grave of a Shaman or medicine man. It is no easy matter to secure osteological material from the Tlingits, for until within a very few years the dead were cremated. This rule, however, did not apply to the Shamans, for it was believed that their bodies would not burn, and consequently they were placed in little house graves usually erected upon some lonely rock or picturesque promontory. We had been slowly working away at the oars, for the wind had completely died away, and were rounding a point on Duke Island, when we espied one of these little houses perched far up on a rocky point which was piled high with innumerable drift. We were soon ashore with the camera and found our-

Tlingit Village of New Tongas. Alaska.

selves well repaid for our pains. The house was about thirty years old, and its roof was covered with a thick growth of moss. It was about five feet high and nearly six feet square. Removing a portion of one of the walls, we could see the body, which had been carefully wrapped in several cedar-bark mats, and tied into a neat bundle with stout cedar-bark rope. Over the bundle were branches of bog myrtle, and under the head was a box. Removing the wrapping still further, we disclosed the desiccated body of a woman doctor. In one hand she clasped a long knife, its steel blade entirely wasted away, leaving only the handle. In the other hand was a beautifully carved wooden pipe inlaid with finely polished abalone shells; but her real title to distinction lay in the immense wooden plug or labret which still remained in her lower lip. Throughout the entire Northwest coast the labret was a mark of honor, and the larger its size the more honor it conferred, for every time a new labret of larger size was inserted it necessitated the giving of a great potlatch, or present-distributing feast. It is related that in the olden times disputes between women were often settled by one of the disputants, scornfully pointing one hand at her enemies and laying a finger on her own labret, declaiming in a manner at once emphatic and conclusive, "My labret is bigger than yours."

Our next stopping place was New Tongas, which we reached at six o'clock on the following afternoon. We were soon ashore, but our expectations were not fulfilled, for in this town of *New* Tongas there was not a single living soul; all were away at work in the salmon canneries.

The location of the town is most delightful. It stands on a little island facing a long, rocky beach. At the rear of the village is a dense forest of cedars, pines, and spruces. The architecture displayed in the houses is not of the usual white man's cottage order, but the plans of the old times have been followed, so that the houses bear a superficial resemblance to their former dwellings. In the place of massive beams and three or four foot cedar planks, however, are light frames and thin, narrow weather-boards. Most of the houses have two or more windows, which are often boarded up and are generally without glass.

In still another respect this modern village has preserved one of the old-time features of house building. We looked in vain for any chimney, but found instead a square opening in the center of the roof, partially covered over, through which the smoke makes its exit. Of the many interesting totem poles two may be noticed particularly. The first stands by the side of the present chief's house, and has been erected within a few years. The designs are well made and of an unusual character. The other totem pole is one of the largest in Alaska, and was put up during the life of Ebbits, a Tongas chief who was named in honor of one of John Jacob Astor's captains. A tablet near by reads:

"TO THE MEMORY OF EBBITS,
HEAD CHIEF OF THE TONGAS,
WHO DIED IN 1880, AGED 100 YEARS."

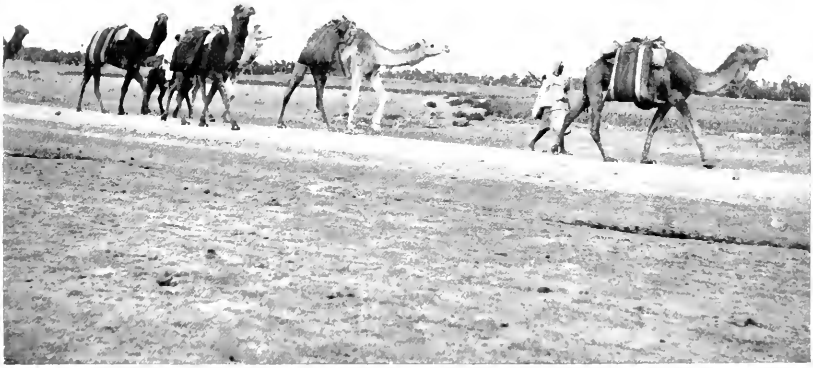
At one o'clock we started for Simpson. The run of twelve miles was made in about two hours, and within less than half a day's time we were aboard the magnificent steamer Islander, bound for Port Essington.

ASPECTS OF NATURE IN THE AFRICAN SAHARA. A SUMMER JOURNEY.

By Professor ANGELO HEILPRIN.

II.

MORE than one traveler has remarked that the most important lesson that traveling teaches is to unlearn that which has been learned before. No matter how seemingly truthful a picture may be, how carefully worded a description is, somehow or other the actual fact rebels against the conception which has been brought to the mind. The great African desert repeated the lesson that was taught to me a few years before by the icy wilderness of the far North, and still earlier by the primeval fastnesses of the tropics. Is it that the description of a new country is so difficult a task, or that the narrator intentionally beguiles himself into an excess of imagination, which makes the telling or the conveying of the simple truth so seemingly impossible? The late Professor Drummond, in his work on Tropical Africa, ventured to lift the veil from the picture that had generally been drawn of the dark continent, and assumed to disenchant the reader of preconceived notions regarding vast and impenetrable primeval forests, of gayly plumaged birds, of monkeys swinging from trapezes in shaded bowers, etc. But for this mendacious effort to destroy an old picture and to reconstruct a new one he was sharply taken to task by Mr. Stanley, who averred that the true picture of Africa as drawn by Professor Drummond bore "no more resemblance to tropical Africa than the tors of Devon, or the moors of Yorkshire, or the downs of Dover represent the smiling scenes of England, of leafy Warwickshire, the gardens of Kent, and the glorious vales of the isle." In short, Nyassaland, the region traversed by the talented divine, is represented to be not Africa, but itself. And yet in another part of great Africa a more recent traveler, Mr. James Johnston, the author of a remarkable work entitled Reality *versus* Romance in South Central Africa, assures his readers that he "traveled four thousand five hundred miles, mostly on foot, and alone so far as a white companion is concerned, passing through numerous hostile and savage tribes, traversing areas hitherto reported too pestilential for exploration, surmounting natural objects which have been represented as insurmountable, and penetrating regions where no white man had ever gone before," and during this performance he never once found



A Caravan on its March.

himself prompted to fire a shot in anger, nor was he compelled to do so in self-defense against a human enemy.

With a feeling that my words will carry little weight with those who think otherwise, I venture to suggest that the Sahara is not exactly what it is commonly assumed to be; and yet in many ways it is not very different. Its first sands, when approached from the side of El-Kantara, are giant rocks, burned brown and red under the glow of the southern sun, standing out in wild pinnacles from the gently undulating surface. This is not the desert that is ordinarily pictured by the mind—that flat, endless expanse which fades off unmoved and unbroken to the limits of vision—but it is the desert, nevertheless, just as much as the mountain snows of the far North are a part of the great arctic "sea of ice." Beyond, however, is the great plain itself, its swelling undulations hardly relieving to the eye the appearance of absolute flatness which the picture offers. The truth is, the Sahara presents itself in a double aspect: that of the flat and sandy plain and that of the rocky ridge or mountain, the Hammada. It is the Hammada that is more particularly dreaded by the caravans, for among their wind-swept crags there are few oases, and only the blowing sands and a relentless sun are the companions of the foot-sore pilgrim. In many parts of the flat desert traveling is moderately easy, for over long distances the surface has become coated into a hard, slimy crust—a solid basement rock, one may call it. Along our route of travel there were no sand dunes of any magnitude, the highest perhaps scarcely exceeding fifteen or twenty feet, but I was informed by the distinguished French explorer M. Foureaud, who was then stopping at Biskra, that beyond Tuggurt they rise to the prodigious height of from twelve hundred to fourteen hundred feet. This speaks even more eloquently for the power of the winds than do the high-tossed sands of coral islands.

It has become customary of late with certain text-books to state that the Sahara is not so flat as it is commonly assumed to be, and that it is almost everywhere torn into ridges and rents. This is, however, an imperfect statement of the truth. The flat desert is almost interminably flat for days or even weeks of travel, with hardly a rise of a few feet for mile after mile of perspective. In vain the eye searches after some special object to give it relief; it does not find it, unless it be the far-off tufts of an approaching oasis. Often has the desert been compared with the sea, but probably to most persons such a comparison, except where it stands for magnitude, will be considered extreme. It is true that where the surface is illumined by the weird light of the mirage it may depict the presence of water with startling naturalness, but the deception belongs rather to the atmosphere carried by the desert than to the desert itself. I am not sure that these endless sands are truly imposing; wearisome they certainly are, but at times they present most exquisite pictures in the varying lights of the morning and evening sun. It is then that they seem to constitute a world of their own, speaking in color that belongs to them alone. We were not to any extent troubled by their presence, either as an impediment to travel or as freely floating discomforts in the atmosphere.

The journey which I had projected took the course of the great caravan route to Lake Tchad, passing by the deep depression which is occupied by the largest *chotts* of the desert, the possible reclamation of which by the Mediterranean has been the subject of much study on the part of French engineers—the dream and hope of M.

Roudaire. The road—for such the tread of the caravans may properly be called in this part—follows out the full north-and-south extent of Biskra, and almost immediately after leaving the last palm of the oasis enters upon that vast expanse of sand which, with the little green that belongs to it, constitutes the southern panorama. Being limited in time, we did not avail ourselves of the facilities of travel which the caravans afford—nor, in fact, did we feel disposed in a first effort to submit to the disarticulating motion of the dromedary—but arranged for a small cabriolet and two teams of horses, to carry us so far as this improved form of conveyance would permit. To insure a speedy journey, I had ordered one trio of horses to proceed in advance to Chegga, some thirty miles distant, there to await our coming on the following day. The morrow, however, was not to be as we had planned, and here again we took in a new lesson in physical geography. At the evening meal at Biskra information came to us that the relay of horses which had been ordered to our advance post had returned, not having been able to make the passage of the Djedi, the main waterway of southern Algeria. The course of this stream, when it exists at all, is directed southeastward into the depression of the Chott Melghigh, where its waters add still further to the accumulation of salt, which now lies some fifty to sixty feet below the surface of the Mediterranean. Ordinarily it offers no impediment to a passage, but now—and in the dry season—it had suddenly expanded to the dimensions of a lake, burying the surrounding country for miles beyond its legitimate banks. This was strange news, for who would have suspected a journey into the Sahara to be interfered with by an obstacle of this kind at this season of the year? The overflow of the Djedi was the result of a mountain storm which had preceded by three or four days, and only now had the waters expanded to their full volume. The Arabs had vainly attempted to force our horses across, and what they can not accomplish in this direction might safely be left untried; but we were informed that there would be a great *abaissement* of the waters in the next twenty-four hours, and that the relay would successfully pass in that time. Complacently, even though regretfully, we acceded to this forced delay, but we remained not a little suspicious as to the promised lowering of the waters. Pending the making of new arrangements occasional flashes of lightning broke through the western sky, and the raindrops pattered heavily on the great palm tufts that reared their heads over the garden court of our hotel. It was showering, and pleasant interludes were given over to sprinkling of hail. At another time, as students of geographical text-books and of special guides, we should have been surprised by the conditions as they presented themselves to us, but we had already been inducted into the mysteries of contradiction by the heavy rain which, on the day following our arrival (August 28th), had washed out the streets of Algiers, and by the storm which a few days later broke upon us in our crossing of the Djurjura Mountains. The fact is, as our charming hostess informed us, heavy showers are in this region by no means a rare occurrence, even at this season of the year.

Promptly on the morning of September 7th, when the oasis had yet hardly awakened to the call of dawn, we found our cabriolet waiting for us, its three sorry-looking horses bowed down to the work that had been prepared for them. A stalwart semi-Arab, uniformed in the white garb which is thought best to ward off the heat of the desert sun, stood for our driver, and it was fortunate for us that his linguistic attainments covered the French language as well as his native tongue. Like many of his tribe, he had accepted the language of his conquerors; but, again, like others, although without any good reason that he had to give, he was not disposed to look placidly upon the continuous march of civilization which the French had inaugurated. Being young in years, the good old times were merely a tradition with him—a tradition not in itself sufficient to warm enthusiasm within his breast, nor to eradicate that germ of laziness which had taken possession of his body. Ben-Sali was at times excruciatingly lazy, although at the start he served us and himself about equally well; later in the day, when the monotony of his work began to assert itself, and when the desert heat had almost continuously forced from his brow huge beads of perspiration, he withdrew to silent meditation and to the enjoyment of a lone pipe—at intervals goading on his horses to better work, at other times roundly berating them for their shortcomings. Poor animals! they had a hard work before them and accomplished it well, but they received no consideration from their driver.

The early start, giving us the better part of four hours before the sun succeeded in dissipating the banks of clouds which veiled the eastern sky, made the first part of our journey truly delightful. There was no desert heat to be distinguished from any other form of heat, and if anything, the morning could be more nearly called cool than warm—at least, so the outdoor air appeared compared with the confined atmosphere of our hotel rooms. Driving into the Sahara may appear strange to those whose only conception of the desert is based upon the old notion that it is an almost endless expanse of soft and shifting sand and nothing else. But drive in one readily can, and even behind a trio of horses whose vigor and strength were less marked than they were in our own animals. The roadway was fairly marked out for most of its course, appearing at times as the solid basement rock of the region, while elsewhere it was constructed of a firm setting of gravel and sand; only at rare intervals did it bury itself beneath an extensive sand covering, and even then it emerged, as clearly marked as before, to continue farther into the interior. The caravans have trod the line firmly, and their trail is a broad, open road; but the French have given stronger contour to its outlines by planting one hundred and seventy miles of telegraph poles, and to-day the service is being conducted still farther, to beyond Ouargla. The Arab chief, except in so far as he may be the leader of a caravan, has virtually disappeared from this section of the route; but at two or three days' journey the Tuaregs and other wandering tribes, to whom tribute is paid at the point of the spear, hold almost undisputed possession of the desert. It was along this route, considerably beyond Ouargla, that the scientific corps of General Flatters, sent out with a view of examining into the possibilities of railroad construction into the far Sahara, was virtually annihilated; and it is for this same route that the indomitable M. Rolland seems finally to have secured the practical co-operation of his Government toward building the road which has been so long outlined.

Not knowing the exact nature of the country, and least of all the conditions of security which govern traveling in a region so near to that in which unpleasant tragedies had recently been enacted, I applied for a military pass before leaving Algiers, and through a fortunate access to the good-will, in the absence of the governor-general himself, of his representative, Captain Lasson, obtained the following order:

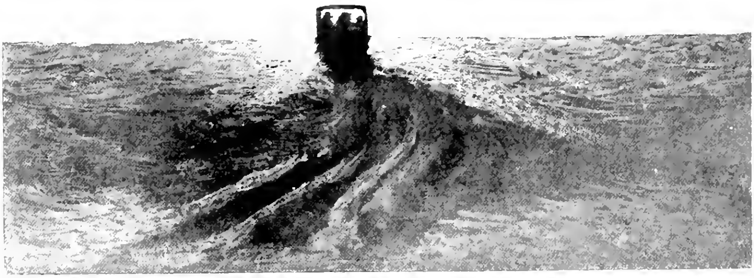
"The French Republic, General Government of Algeria:

"We, the Governor-General of Algeria, beg the civil and military authorities to give aid and protection in case of necessity to Messrs. . . . . . . and . . . . . . traveling to Fort National, Biskra, and Tuggurt.

"By command of the Governor-General, the Captain, Chief of Internal Affairs and of the Military Service. Algiers, August 29, 1896."

While this paper was naturally a very pleasant addition to the "documentaries" with which we had already provided ourselves, as so often proves the case with papers of its kind, there was no occasion to bring it into use—at least, not for the purpose for which it was prepared. We nowhere met with hostile tribes, and at the wayside caravansary—the *Borj*, *Burg*, or fort—received only hospitality and that simple attention which distinguishes the Arab. Humble refreshment, except coffee, is hardly to be obtained here, but the refreshing shade of the large stone building is at the service of the traveler, and it is not often that he is tempted to pass without availing himself of its expansive comfort. His animals are destined to fare less pleasantly, inasmuch as they are generally left to dry their bodies in the open sun, with a temperature beating over their heads of possibly not less than 130° to 140° F. This habit of denying to the animals what little comfort was to be had was a trait painfully apparent in our driver, but it could be said in his behalf that he differed in this respect little from other members of his tribe. What special object he had in allowing his jaded horses to wilt under a burning sun, when a few feet approach would have brought them a generous temperature thirty degrees lower, could not be ascertained.

Saada, whose position on a bank slightly elevated above the Djedi saved it from the recent overflows, is one, sufficiently typical



Our Wagon Plowing through Sahara Mud.

in itself, of a series of caravansaries which are scattered at intervals through the northern Sahara. A large quadrangular space, intended to accommodate a goodly assemblage of men and animals, is surrounded by a stoutly built wall of masonry, the inner side of which is variously subdivided into rooms and stalls, yielding clean shelter joined to a refreshing shade. Entrance is by a single gate, closure of which means the guarantee of safety to those in the interior. The whole is under the military administration of a handful of leisure-loving Arabs, who look to the wants of the traveling caravans, and presumably as much to their safety as to their comfort. Long before reaching Saada the effects of the late storm had made themselves disagreeably apparent. The road, or what there was to represent it, was washed into gullies by the recent overflow, and our wheels sank deep into the mire. The mud of the bottom valleys of our Western rivers would have been considered a feeble circumstance compared with this mud of the presumably dry Sahara. Side backwaters added still further to our difficulties, and for a time it looked as though we should hardly pull through; but with enough of "ee-yups" and "ees," joined to the cracking of the great whip, we finally reached the actual bank of the stream and were there helped across by an Arab who had come down from the caravansary to guide the horses. The river was running fast, turbid with yellow sediment, but it had contracted itself to its legitimate channel. We pulled up to the great portal of the *Borj* for our first halt, and immediately received the hospitality of the place—which meant stools to sit upon, in place of the gravelly earth, and the supporting back wall, of which the Arabs make such good use. We had hardly hoped to obtain refreshments here, as Ben-Sali had informed us that such would not be dispensed to travelers, but I ventured to ask for coffee, and in a short time we were served with the delicious beverage, prepared with that same consummate skill which is the art of native coffee-making in the north of Africa, and with the daintiest of foreign china. What changes in the civilization of the world are in progress!

Beyond Saada the road changes much for the better, and we kept the animals going at a lively pace. On either side was the gently undulating and hummocky sand, crowned by terebinth bushes and salsolaceous scrub, high enough to conceal the straying goats that were in places browsing upon them for their scant vegetation, and everywhere sufficiently dreary elements in the landscape. Two forlorn trees or treelets, seemingly olives, were left by the roadside, and the undulating plain, with its closely oppressed horizon, kept on for mile upon mile in its monotonous sweep. Despite its dreary and forlorn aspect, it had for us its attractions; its peculiar sterility—one can hardly say absolute barrenness—and uniformity were, if nothing more, inviting to study, and my mind frequently wandered forth in an almost wild contemplation of the scene. Our cabriolet was well suited to the special purposes of our explorations, as we could easily dismount for the examination of specimens, and even with a high temperature there was no special inconvenience in this. There was, however, little need to leave our seats, as, conformably with the landscape and the general character of the country, there was a marked uniformity in the geological and botanical features as well; a study of one section meant practically a study of the rest.

So far as the heat of the desert is concerned, it is an unquestionable reality; and yet, perhaps, in the month of our travel, the hot-test of the North African months, it was not so dreadful as we had anticipated. It is true that the mercury, whether by night or by day, felt little disposed to leave the region of the ninety-eights, unless it was in the direction of an upward journey. During the hours of midday it stubbornly clung to the division line of 110°, passing even beyond it slightly (although, perhaps, not in the most perfect shade); at Biskra, during our brief absence, it stood at 116°. While traveling we were subjected to even a much higher temperature, as at rapidly recurring intervals the heated reflections from the burning sands were blown bodily into us. This temperature was probably not less than 120°, and it was then that we remarked, "This is like an oven." And, in truth, it was very much so. The excessive dryness of the atmosphere doubtless conduced to render it bearable; at least it had the effect of checking excessive perspiration. On the other hand, its extreme quality brings to many a partly suffocating feeling—a feeling as though it were lacking in the proper amount or quality of oxygen. The parched palate asks for a moistener, and for repeated lotions in decreasing periods of time. Still, the whole is both bearable and supportable, and the foreigners who have located at Biskra seem to have acclimated themselves in a comparatively short space of time. What surprised me somewhat was the rather slight difference between the temperature of the open and that of the shade, probably not more than twenty degrees; the highest reading that we found was 132° F. The temperature of the sunny sands was at its highest 123°.

By the time we reached the relay at Chegga our horses had become well tired out; the thirty miles had told hard upon them, but, considering the quality of the road and the excessively high temperature, all of it the temperature of the open sun, we did far better than we had reason to hope for. At almost precisely noon we drew up beside the town walls, where the trio of fresh horses was waiting to meet us. An almost hopelessly dismal lunch, to which the distinctive flavor was given by bottled lemonade heated in the sun, prepared us for the further journey, and at one o'clock we were again *en route*. The surface of the desert now becomes more undulating, and the telegraph poles, marking the elevations and depressions, rise and fall in rapidly recurring intervals. Without these landmarks thrown against the sky it would have been difficult to detect the inequalities of the desert floor, which to many eyes would have appeared to roll off a flat expanse to the horizon. A feature which by its novelty repeatedly impressed itself upon our minds was the vegetation. A moderately green Sahara is certainly not the ordinary conception of the great desert, but thus far, except for very limited stretches, we had not yet passed the limit of vegetable growth, or even nearly approached it. It is true that the vegetation consists of scattered clumps of bushes, lowly in height and not over-luxuriant in foliage, but their presence is such as to relieve the landscape of the imputation of being a treeless waste. Along almost the entire line of our journey a generous supply of terebinth bushes, one, two, or three feet in height, covered the sand elevations, and with them was a sickly green salsolaceous plant, the exact nature of which I was unable to discover. And if we can fully receive war illustrations recently gathered from the pencil of a staff correspondent, the same feature must be a characteristic of the Sahara about Timbuctoo as well. There are, indeed, a number of spots where the vegetation is even more luxuriant—if a scattering of plants can in any way be called luxuriant—comprising a number of dry herbs, such as the rose of Jericho, which hardly rises a few inches above the surface; on the other hand, there are areas where the vegetation has been completely stamped out, or where it has been buried deep beneath its canopy of sand.

At about four o'clock we entered the depression that is occupied by the great Chott Melghigh. When we first beheld this salt pan from a distance of a few miles it broke upon the landscape with dazzling whiteness. The salt was upon the surface, and the eye failed to distinguish the presence of water. It was like a vast field of immaculate ice thrown into the sands, over which hung the images that were thrust into the sky by the rarely failing mirage. We did not see overturned buildings and trees, or even sheets of water, in these sky pictures; simple blocks of color, glowing in an intense pink illumination, were the expression of the light aberration, and yet they might readily have been taken to represent sections of fortification walls. The reflected images were very much like those which I had watched for hours among the ice of Melville Bay, the same quadrangular blocks cast up to no very great height above the horizon, and seemingly holding no definite relation to any object which was within the field of vision. At one spot only, and that, singularly enough, in the mountainous or broken part of the Sahara, did we see a mirage reflection simulating a body of water, and so true was the deception in this instance that nothing beyond an appeal to the known geography of the region could rid the mind of the false conception that was presented to it. The Chott Melghigh is the largest salt pan of the Sahara, and it occupies a position fifty feet or more below the sea level. It is here that the gifted Roudaire had hoped to bring the waters of the Mediterranean, and to give back to the sea that which once belonged to it. It was while passing this chott that we first experienced the hardship of pulling through the sands. The hollow had accumulated deeply of the desert, the shifting wind-blown sands, uniting with the sediment discharges of periodically flowing streams, finding here secure and lasting anchorage. Our wagon stuck and our horses stuck, and no ill use of the lash would for a time induce them to budge. Mr. Le Boutillier and I dismounted and applied ourselves to the wheels, but to little purpose. Coaxing, worrying, and pushing, we succeeded in making a few yards at a time, and then dropped to a condition of seemingly hopeless immobility. It really looked for a time as though we should be obliged to remain where we were until

THE PRAYER IN THE DESERT.

assistance picked us up, just when, or of what kind of assistance that was to be, we knew not. The sun had dropped very nearly to the horizon, its long horizontal rays illumining the desert with that wonderful glow of red which nothing but an artist's brush can picture. The whole landscape was suffused with mellow light, to the pure harmony of which was added the quiet of an almost absolute silence. No bark or howl of a lurking animal, no sound of bird, whether in twitter or song, broke upon the stillness of the evening hour; we alone were the offenders—not, however, with any intent to disturb Nature's slumbers, but merely to extricate ourselves from our uncomfortable position. Between coaxing, pulling, and straining, and a generous trudge through the sand, we succeeded in covering the few miles that lay between us and the next oasis, Mreir. This oasis counts about twenty thousand palms, and, like all others that we had seen, is divided up by garden walls into distinct properties, between which meanders the trodden way of the caravan.

Shortly before eight o'clock the great portal of the *Borj* was opened to receive us, and our first day's journey into that far-off land of the Sahara was brought to a close. We had covered sixty-three miles, more than is ordinarily accomplished in a good day's coaching on American highways.

To sum up a first day's impressions of the African desert is by no means an easy task. The multitude and variety of the scenes that present themselves do not admit of immediate appreciation; nor, perhaps, do they fasten upon the imagination with that intensity which is left by the pictures of other lands. Yet this ruddy Orient is in itself a picture of intensest moods, a lasting conception from which is carried to every mind that is brought in contact with it. The weather-beaten crags, the shifting sands, the sands of unmoving and monotonous silence, the slowly wandering caravans, the long and weirdlike shadows which stalk over the surface in the horizontal light of the rising or setting sun, are all pictures that impress by their individuality; and to these are added others which are hardly less interesting or picturesque in their local color. It is, however, the oasis that is the redeeming pearl of the desert. No poetic temperament is needed to prepare one for the enjoyment of its coming. From miles of distance the eye fastens itself upon the tree tops; the dark green is a break in the landscape, and like the black shadow of clouds it seems to go and come, the gentle undulations of the desert throwing it now and again out of sight. We had penetrated but a moderate distance into the desert, but the coming of the oasis was a relief that can hardly be described—those dense groves of date palms and the circulating streams of water. What must, indeed, the oasis be to those who have wearily plodded its sands for weeks at a time! When we entered Mreir the sun had just set behind the palm forest, illuminating the sky with that soft African yellow which is the special privilege of the brush of Edouard Frère. The tall tree trunks rose against this in specter shadows of brown, silent monoliths as if rising from a silent grave. A more entrancing scene could hardly be imagined, and yet how different was the picture from that which is ordinarily constructed on the guide line of books and narratives!

With a constant departure from the views of old that one has held, a doubt begins to steal over the accuracy of almost every supposed fact in our treasury of knowledge. Was there not some reason to question the existence of those skeletons—the weary relics of departed life—which have from time immemorial figured as one of the dominant features of the Sahara? We hardly dared entertain a doubt on this point, but yet felt somewhat uneasy in our minds. Our skepticism was of short duration. Its skeletons were there, bleached to whiteness under the burning sun, and in great part still carrying the dried-up cartilage and muscle which had not yet fully left their support. Here, perhaps, a leg, there a skull, elsewhere the full skeleton—each sadly reading the same history—the

At the "Springs" of the Desert.

attempted passage of the Sahara and the fall by the roadside. In the course of the day we came upon the parts of probably not less than fifty animals, most of them camels; the remains of a few mules and donkeys were added to these, but their scarcity plainly showed the resisting power of these beasts. Doubtless, many of the remains were ancient, for with the dry climate the decomposition of bone is a slow process; and there are no, or but few, hyenas to do away with the skeletons. The many parts lying about, therefore, hardly give a true value of the casualties of the travelers, inasmuch as they represent an accumulation of disaster reaching probably far back in years. But, such as they are, they are a grim and ghastly spectacle, and one not tending to give cheerful reflections to a leader of a caravan or to his hosts.

[*Concluded.*]

THE PHYSIOLOGY OF STRENGTH AND ENDURANCE.

By WILLIAM LEE HOWARD, M. D.

WHEN we read in the daily newspapers of the collapse of a celebrated athlete, or the breaking down during training of a young aspirant for arenic honors, we naturally surmise that fundamental knowledge of the physiology of the muscular mechanism of the human body is either submerged by the overpowering desire to make a record, or totally absent, among certain trainers and their pupils. The want of such knowledge is the cause of many sad conditions existing to-day among former strong and healthy individuals. A comprehensive idea of the physiology of growth, of the physiologic and chemic relations of strength and endurance to age and condition, would be of great value to the present horde of senile individuals—not senile in years, but senile in vessels and tissues—who strive to make their century runs, as well as to the adolescent whose central nervous system is often permanently injured by overexertion in attempting to make the records placed by carefully trained and intelligent athletes.

The human body is a wonderful piece of mechanism, which not only renews itself constantly, but whose strength and endurance and capacity for more work increase with increased use up to the point at which use becomes abuse. At what time and under what pressure this danger line is reached depends upon the individual. However, the approach to this danger line is governed in all cases by fixed and immutable physiologic laws. The athlete must always bear in mind that the length of time that the muscle cell can continue to work will depend upon the rapidity with which the energy-holding explosive compounds are formed by the cell protoplasm and the waste products are excreted (Howell). In other words, the capital must not be expended at a greater rate than it can be replaced; if it is expended at a greater rate, fatigue commences, and a continuance of this expenditure results in physical bankruptcy. The muscle is continually undergoing change of material. The minute substances which make up the muscle, and whose very actions keep it alive, are being continually cast off, fresh substances taking their place. The cast-off material is the fatigue poison. Without muscle rest this dead, poisonous detritus can not be replaced fast enough by the new products, and the result is an impoverished capital of potential elements. This does not apply only to the muscle in active use up to this point, but to all muscles of the body.

The energy products of food are delivered up to the muscle by the blood, and this fluid picks up and carries away the cast-off dead substances of the muscle. "If the working muscle has taken material from the blood, this material is lost to all the rest; and if the working muscle has given off to the blood poisonous material, this is added to the other parts" (Lombard; Howell's Physiology). These latter, the fatigue products, are only gradually eliminated from the blood. It will now be recognized that to keep on the right side of the danger line in exercise the muscle must have short intervals of rest. Nature so well understood the proneness of man not to heed advice that she placed the action of one muscle beyond his control. This muscle is so internally constructed and adjusted that it has its regular periods of rest, and only in disorder of the body can its expenditure be raised beyond its means. This muscle, the heart, though making contractions at the rate of seventy-two times a minute, is able to continue its work without fatigue throughout the life of the individual. Each contraction of this muscle is followed by an interval of rest, during which the cells recuperate. Push continually the heart beats to a very rapid rate and we approach the danger point at which the fatigue products can not be replaced by fresh cells; the intervals of rest are not sufficient. The same condition exists in every muscle. It is in the extreme rapid exercise, such as sprinting and certain phases of bicycle racing, that we often see either immediate or ultimate collapse followed by irremediable loss of health.

It should be impressed upon all young persons that during life each member of the body, in the very act of living, produces poison to itself. When this poison accumulates faster than it can be eliminated, which always occurs unless the muscle has an interval of rest, then will come fatigue, which is only another expression for toxic infection. If the muscle is given an interval of rest, so that the cell can give off its waste product to keep pace with the new productions, the muscle will then liberate energy for a long time. This latter condition is what we call endurance.

The power and endurance of the human machine is limited according to our understanding of the above facts, and also our recognition of its slowness in getting started. Like any other ponderous and intricate machine, the body requires time to get in harmonious working order. The brain, nerves, heart, and skeletal muscles must be given some warning of the work they are expected collectively to perform. Ignorance of this fact has broken down many a young man who aspired to honors on the cinder path. The necessity of getting all the parts of the body slowly in working order is well understood by trainers and jockeys on the race track, as is evidenced by the preliminary "warming up" they give their horses, although it is doubtful if the trainers could give any physiologic reason for this custom.

Of the substances supplied to the muscle by the blood, oxygen is one the want of which is soonest felt. The muscle contains within itself a certain store of oxygen, but one which is by no means equal to the oxidizable substances. The muscle's activity is dependent to a great extent on the character and force of the blood flow through the muscle. It must be clear of the waste products, as well as containing sufficient oxygen to continually keep up a renewal of energy. From what has been said it will readily be seen that the result of a muscular task which an athlete wishes to perform will depend primarily on his muscular bulk and on the condition of these muscles, and the rate at which he expends his capital; the test of his endurance will depend upon the condition of the other parts of his body, and how thoroughly and rapidly they will carry off the quickly formed poisonous products and supply fresh ones.

Nineteen pugilists have died in the ring the last seven years. Not one of these deaths was directly due to the force or severity of the blows struck, but because the fighters were "out of condition." The waste products caused by the rapid muscular work accumulated in their bodies, and, forced to go on with their exertion, they dropped exhausted to death—poisoned by material of their own manufacture. Less attention paid to mere muscular exercise, and more to the condition of the blood and other parts of the human machine, would have brought different results. These facts impressed upon a certain class of athletes would be of great moral and social advantage to the world in general. It means that these individuals must have fresh air to live in, clean skins, good, substantial food, a fixed number of hours for sleeping, and avoidance of stimulants. If it was well understood that no man could go into the exhibition ring, or into any contest requiring physical exertion, unless he could show, after a careful examination by a competent physician, that his condition would warrant a prolonged and severe muscular effort, the result on the moral and bodily habits of a certain class of young men would be superior to any persuasive or semireligious method that the world has yet premonstrated.

What has been said concerning poisoning by the non-elimination of effete products refers also to the nerves and the brain. As the muscles work faster, so do the central nerve cells which send the stimulating impulses to these muscles. These latter cells become fatigued sooner than the muscles. This is a grand feature of physiologic economy, for, did not this condition exist, the muscle would be worked to an irreparable point. The muscular differences noted in individuals are in reality the difference in the nerve cells, the action of the muscle indicating the activity of the central nervous system. When the muscles are being exercised the nerve cells are being exercised, and the effect of exercise on the nerve cells indirectly determines the muscular activity.

It is the general impression among athletes that exhaustion and "loss of wind" is due to the inability to consume sufficient oxygen and exhale rapidly enough carbon dioxide. When the muscle is moving rapidly and forcibly it is true that it demands more oxygen, and gives off to the blood more carbon dioxide than when at rest. When a man is running as fast as he can make his limbs move he is able to keep up the pace but for a short distance unless, like the hunted hare, he runs to his death. On account of the forced, vigorous, and rapid muscular action in this case, the poisonous materials are thrown into the blood, to be carried to all parts of the body—muscles, nerves, brain. The heart is affected by this poison through the nerve cells controlling that organ; the muscles of respiration are similarly disturbed. The panting, distressed efforts of breathing, sidelong tumbling, anhelation, and final semiconsciousness of the hunted stag or hare are a good example of acute auto-intoxication ending in death. This latter deplorable condition is not unknown among the annals of human strife for athletic honors, even with our present advanced knowledge of physiology.

One of the main "clearing houses" of the body, by which the blood is cleared constantly of all its poison, is the liver. The minute cells of this organ each have their own individual work to perform in transforming the toxic material into harmless substances. The cells of this "clearing house" are delicate little organs, and will not stand abuse.* All habits having a tendency to cause dyspepsia—eating

* Experience and investigation lead the writer to believe periodical inebriety to be a symptom of periodical insanity brought about by the accumulation of toxic substances in

rapidly, eating indigestible food, constant and intemperate use of alcoholic beverages, or excessive use of tobacco—disturb the normal work of the liver. Hence, one of the first aims of the athlete should be to keep this organ in the best possible condition. Any clogging or disturbance of the functional duties of the liver prevents the blood from being in a pure state. All parts of the body will show distressing symptoms of fatigue and exhaustion if the little cells of the liver have become diseased or useless through intemperate living and ignorance of the specific duties belonging to each separate organ of the human body.

The changes which take place in the nerves and brain, the changes in the irritability of the former, and the delicate relations which the latter bears to all forms of muscular work, are of too chemic and technic details to be dealt with in this paper. All forms of violent exercise require that the brain and nervous system should be in assured perfect health; that they possess all their normal attributes.

All neurologists have seen the unfortunate and distressing effects of excessive and violent exercise in persons unfit by training or nature for anything more than moderate exertion. The adolescent, the neurotic, and those who have passed their vigorous days, should exercise only under the advice of a physician. Let those who have entered into the false and foolish idea that "century runs" are an indication of prowess remember the ultimate sad consequences liable to follow in a few years. These misguided individuals should understand that to be an athlete for the time being does not mean that they will be healthy. Athletes are healthy, not because they are athletes, but because healthy individuals are athletes. For the average man past five and forty golf offers the best and safest exercise for the Anglo-Saxon. For those who imagine that this pedestrian and philologic game requires no mental effort, the statement made by a caddie to Professor Sellar will be instructive. When this distinguished Hellenist made his first appearance on the golfing green at St. Andrews, the mature caddie who accompanied him remarked, "Ye may be guid eneugh, professor, at teaching laddies Greek, but gouf needs a heid." *Festina lente* is a good rule in most of the concerns of life; it is absolutely indispensable in physical exercise.

the body. During this interval of mental and moral lycanthropy alcohol is consumed in large quantities until the poison has been eliminated or counteracted by the alcohol. This condition must not be confused with ordinary drunkenness, or the alcoholic condition exhibited in habitual drinkers. (See Alcohol as a Secondary Factor in Dipsomania, by William Lee Howard, M. D., Medicine, February, March, 1898.)

THE SECRET OF ATAVISM.

By F. L. OSWALD.

THE laws of Nature reveal themselves most plainly in the extremes of their manifestations, and a month ago the remark of an American press correspondent must have called the attention of thousands to a suggestive *curiosum* of hereditary influences.

"This city is decked with voluntary bunting in honor of the Czar," he writes from Wiesbaden; "and it is certainly a remarkable fact that the most amiable of the Romanoffs should be the son of a narrow-minded despot, while whole-souled Kaiser Friedrich, the modern Titus, the idol of his countrymen, was guilty of being the father of the most unpopular prince who perhaps ever succeeded to a hereditary throne."

At first glance the coincidence does look like an altogether exceptional freak of chance, but, on second thought, one is surprised to find the alleged portent recall analogies far too numerous to be classed with the exceptions that confirm a rule.

Peter the Great, a more absolute autocrat than the first Napoleon, was the son of the dawdler Alexis, a puppet in the hands of his tutor Morouzoff, and of favorites of the Buckingham type, a holiday prince not wholly adverse to administrative reforms, but with no more backbone than a man of straw.

Witty, skeptical Frederick the Great, the worshiper of Voltaire and the Muses, a genial host, but a political Iscariot and a shocking husband, was the undoubtedly legitimate son of an illiterate ruffian, a miser and bigot whose only redeeming traits were his conjugal fidelity and his temptation-proof loyalty as a vassal of his Kaiser.

And even slander-mongering Fouché did not question the legitimacy of the Duke of Reichstadt as the son, if not the primogenitus, of the Corsican demigod. The poor youngster, it is true, was saddled with Austrian tutors, selected by the *Cultus Minister*, with no special reference to modern culture; but decided talents would have asserted themselves in spite of such handicaps, and Dr. Hentzen, an intelligent and impartial observer, admits that the young exile was "modest, rather good-natured, but hopelessly indolent and *incurious*—indifferent alike to the marvels of Nature and art. But for a love of good cheer, not always distinguishable from gluttony," he adds, "one might suppose that he was pining away and had turned from earthly to hyperphysical hopes."

Indolent, good-natured, and gluttonous—the son of the man who would "dine on the wing of a chicken, and on that frail support fly through Europe in a cloud of blood and fire!"

It will not do to say that the vital energy of the Corsican Cæsar had exhausted itself in his forty campaigns, and that human prodigies are produced at the expense of the next generation. That explanation is neither irrelevant nor unsupported by facts, but it is inadequate; it would explain a *difference of degree, but fails to account for a difference of kind.* It might suggest the cause of the fact that sons of great men often fall short in their attempts to follow in the footsteps of their sires, but it does not solve the enigma why so many of them should persistently walk in the opposite direction.

Apollo did not differ more from a python than Wolfgang Goethe differed from the sluggish old philistine who coiled himself up in his Frankfort alley-den and hissed venomously at all dissenters from his antediluvian tenets. Carlyle's "dry-as-dust" does not begin to describe the idiosyncrasies of that old dragon; the dust on his soul did not cover lurid hopes or relinquished poetical aspirations; he was prosaic to the very tissue of his mental organism and so pig-headed that he once came near ruining his family by venting his ill humor on the commander of a military garrison who had ventured to express his opinions with the freedom of a privileged guest.

And Goethe's only son was *ein kalter Schleicher*—a frigid dullard, with only one passion, an inordinate fondness for the weed, which his father detested as one of the three chief curses of his existence.

"*Heroum filii noxæ*" was a Latin proverb, "The sons of heroes are public nuisances"; and not one of Charlemagne's sons seems to have possessed a single princely quality; while a little, shriveled-up señor in an owl-castle of the Pyrenees begat that meteor of splendid chivalry, King Henry of Navarre.

Voltaire's father, the notary Arouet, threatened to disinherit his son for preferring poetry to pandects, and avoided religious controversies with the anxiety of a Spanish Hebrew. He never ceased to lament the death of his eldest son, who he had hoped would climb the official ladder to the height of a *procurateur du châtelet*, and died without the least suspicion of having produced a champion destined to reach the pinnacles of intellectual fame and decide the litigation of ages as a procurator of reason *vs.* the powers of darkness.

The zealots who proposed to suppress that champion by a general ostracism of the Christianized world would never have got the consent of Dominie Nelson, of Burnham Thorpe, Norfolk, a happiest of country parsons, but also a meekest. In the little garden adjoining his parsonage he would amuse himself for hours digging up herbs and replanting them with a view to quaint color effects, white on sea-green, or pale yellow on blue, like stars on an azure sky. He was fond of guests, and liked to listen to an exposition of new theories, but could not be provoked into hot controversies, and missed several chances to assert his claims to preferment rather than run the risks incidental to an antagonism of interests.

And that most non-aggressive of mortals originated the sea-monster Horatio, a more insatiable fire-eater than any of the desperadoes that followed the fortunes of Frundsberg and Skanderbeg. During the siege of Calvi he marched a detachment within a stone's throw of a sea wall, to be on hand for a rush into the first breach, and stood motionless, watching the effects of the cannonade, till a shower of splinters struck him full in the face and knocked out one of his eyes. At Trafalgar he would not even button his overcoat enough to cover the insignia of his rank when the sharpshooters of the Bucentaur began their close-range target practice. "What's the matter, Wheeler—have you got the belly-ache?" he chuckled, when the captain of the deck battery conjured him to notice that five or six musket balls had knocked the splinters out of the mast close over his head. And when the overshot marksmen at last mended their aim, his first exclamation was one of military approval: "That's a good one! By Gotham, they've got me this time!"

"Energies bottled up (*represses*) in one generation are apt to explode in the next," says Chamfort, probably with the allusion to such cases as that of Hamilcar, who had sworn vengeance to Rome and passed his life hungering and thirsting for the opportunity which at last came to his son; or the elder Carlyle, an illiterate orator and amateur controversialist, hampered by the lack of the high-grade tools which education supplied to the author of the Latter-day Pamphlets.

But preacher Nelson experienced no fits of combativeness needing repression in stress of circumstances; he was pacific by instinct, and more averse to controversies than could always be reconciled with the exigencies of his situation.

Jean Jacques Rousseau was the son of a well-to-do artisan, more distinguished by his convivial disposition than by a lurking *penchant* for solitude or social revolt. Mirabeau, *père*, was a miser and bigot of conservatism, sticking to his Provençal country seat like a badger to his den, while his son exhausted his resources in extravaganzas and needed *lettres de cachet* to restrain his roving mania.

That revulsion from avarice to extravagance is, indeed, so frequent a phenomenon that Goethe seemed to consider it the normal result of a niggardly education:

> "Ist der Vater auf Geld versessen,
> Und nützt sogar die Lampen-Schnuppen,
> Kriegen sie dann der Sohn in die Kluppen,
> Gauner und Dirnen werden es fressen."

Mirabeau senior was wealthy enough to roam earth in a coach and four, but preferred his rural retreat; Marcus Aurelius, the philosopher on the throne of the civilized universe, could have found diversion from the cares of empire in the hunting grounds of three different continents, but the proconsuls of Pontus and Numidia invited him in vain; he stuck to his task like a slave to his treadmill, and shunned even music:

"Enjoyment from one entrance quite shut out;"

ignored panegyrics in honor of his virtues, and tolerated circus games only as a concession to the natural depravity of his subjects, who might riot in the atrocities of the amphitheater, while their ruler wore out his life with the elaboration of reform plans and sought recreation only in prose elegies and communion with the spirit of Zeno.

Now, the theory of exhaustion would have been strikingly confirmed if the offspring of the great altruist had been a rickety whimpy-owl, one of those listless youngsters supposed to be too good for the present world, but withal too indolent to aspire to the rewards of the next.

But the matrimonial venture of the sad-eyed philosopher resulted in a birth of a chuckleheaded *pupus* who grew up into a bull-necked and vindictive blackguard, a reckless egotist who passed his time with riots and the arrangement of festivals in honor of his own merits. When one of his sycophants remarked that his moral and physical perfections had never before been united in a human being, he did not hesitate to enroll himself among the Olympian gods. He wasted the revenue of a province on a single circus pageant, and not only bade grumblers go to hades, but sent them there by scores and hecatombs. "The Prætorian Guards have been pacified by an enormous bribe," said the prefect Perennis, "but had we not better do something to allay the resentment of the people, something to perpetuate our names in the memory of posterity?" "Well, you can change the name of Rome to Colonia Commodiana," said this son of a modest father.

A son of the Inquisitor Hæmmerlin was indicted for heresy, and there is a tradition about a Syrian wood devil ("satyr") who was converted by a sermon of St. Eusebius and reared a family of saints.

But from Syria comes also an anecdote that suggests a solution of the inversion puzzle. "That's Lot's wife," said Professor Bertholet's guide, pointing to a rock-salt pillar forty feet high and about four yards in diameter. "Is that so?" said the witty Frenchman. "Then I'll bet gold to copper that Mr. Lot wasn't more than five feet high."

Again, a multitude of analogies confirms the aptness of the conceit. Bruisers are attracted by Mignons, light-weight dandies by two-hundred-pound peasant girls, stoics by shrews, polyhistors by unsophisticated Gretchens, saints by flirts, metaphysicians by tomboys, grimy Vulcan by Venus, moral or physical anomalies by their opposite extremes. One-sided men, as it were, instinctively seek their *complement* in the interest of the next generation, and it so happens that nearly all great men are one-sided—one or two of their faculties having been phenomenally developed at the expense of the rest.

And to complete the explanation, moral and intellectual preeminence are frequently attained at the cost of the physical organism:

> "The restless spirit, working out its way,
> Fretted the feeble body to decay;"

and Marcus Aurelius, yielding to instinct, selects a Faustina whose vital vigor gives her a superior chance to transmit her physical and moral characteristics.

Hence the portent of disparity, the *toto-cœlo* contrast between legitimate sons and such fathers as Cromwell, Bonaparte, Humboldt, Goethe, and Dante. Hence, also, the phenomenon of atavism: the necessity of neutralizing anomalies by an alliance of opposite extremes tends to repeat itself in successive generations, and two inversions may thus result in the re-establishment of a strange ancestral type.

VERACITY.

By WILLIAM HENRY HUDSON,
PROFESSOR OF ENGLISH LITERATURE IN THE LELAND STANFORD JUNIOR UNIVERSITY.

IT is worth our while at times to turn aside from the investigation of the newer theories and problems of conduct, to examine a little carefully some of the older but not less weighty matters of the law. Familiarity is said to breed contempt in social and domestic intercourse; it certainly has its peculiar dangers in the domain of thought. We may grow so accustomed to a fact that it gradually loses its meaning for us; we may live so long in intimate association with a life-giving idea that little by little it lapses into dry and sterile commonplace. When this happens, it is well to force such fact or idea out again into the current of freshening inquiry, that the mind may play actively about it for a season, and its full significance be thus revealed.

If this general doctrine be recognized as sound, it may be regarded as not altogether waste of time to consider briefly the ancient and well-established ethical principle of truthfulness, or veracity.

It will not do to say that we all know that it is wrong to lie, and right to speak the truth, and that there the whole matter ends. For we shall discover, if I mistake not, that in the rediscussion even of a topic so old and apparently threadbare as this we shall come upon some points of theoretical and practical importance which, if not altogether new, may derive an element of novelty from restatement, and which at any rate will be found to furnish food for thought.

What, then, do we mean by veracity? In nine cases out of ten the answer given would be: By veracity we mean simply telling the truth; or, in other words, the making of such statements only as we believe to accord with facts. Now, this rough definition gives what we may describe as the solid substratum or foundation principle of veracity, though it is, in common affairs, rarely pressed to its full meaning. Hence we may accept it as far as it goes. Veracity will always signify, on the positive side, telling the truth; and on the negative, the avoidance of statements not in harmony with facts. But, ethically considered, while it denotes all this, it also connotes a good deal more than this; and some of its more important implications call for distinct formulation.

The complete conception of truthfulness, then, must in the first place be taken to embrace, not only the habit of saying that the thing which is so is so, but also constant care in conveying at all times the correct impression in regard to facts, and that impression only. That in every kind of prevarication, dissembling, and evasion we fall short of strict veracity, even when no directly false statement is made, is a commonly accepted principle; and in current parlance we condemn also as immoral the silence which leaves another in ignorance or with a distorted notion of reality, when we are in a position to set him right. But it is not so generally recognized that overcoloring of any sort, introduced for any purpose, exaggeration, the trick of extravagant epithets, the indiscriminate use of expletives, are to be adjudged as untruthful. How difficult it is to keep the straight line in these matters every one knows who has had occasion to tell a number of times over the story of any adventure or curious experience. Before long the magnifying tendency is almost certain to show itself; the adjectives grow a trifle stronger, the language a shade more pronounced; and unconsciously we presently begin to mold our material with an eye not upon accuracy, but upon effect. Then, after a while, like the redoubtable Tartarin de Tarascon, we lose sight of the plain and simple facts, and take our own more or less imaginative version of the story as correct in outline and color, thus deceiving ourselves.

Our common carelessness in ordinary conversation is revealed by the random employment of superlatives, characteristic of all of us, but of women perhaps more than of men; the highly charged phrases of praise or blame, generally to be pronounced excessive; the irresponsible rhetoric of fancy and caprice. Nor do we need, in illustrating this point, to confine ourselves to everyday intercourse. Literature furnishes numerous examples of the vice of overcoloring, even where we ought least to expect to find them—in the writings of historians. Witness Carlyle and Macaulay. The work of the former is frequently rendered unveracious not only by personal passion, but also through the abuse of his enormous vocabulary of invective; that of the latter, as well by willingness to sacrifice the finer shades of analysis to the production of brilliant antithetical effects, as by the occasional irruption of bias and prejudice. Of neither of these men could it be rightly said, in Mrs. Browning's splendid phrase, that he possessed in full degree "the conscience of the intellect."

Pushing the matter still further, we should say that the conception of veracity involves, in the second place, not simply the habit of keeping close to what we believe to be fact, but due inquiry into the basis of such belief. It is one thing to stick consistently to what we take to be truth; another, but equally important thing, to make certain that we are fully justified in accepting and proclaiming it as such. There are many people who, in the daily intercourse of the world, will never be found guilty of willful prevarication or misstatement, but who none the less seldom take the time or trouble necessary to sift the stories they hear and repeat, and test the exact relation between what is reported and what has actually occurred. As "evil is wrought by want of thought as well as want of heart," so also are we often confused and misled, sometimes regarding issues of serious moment, by the mental laxity, inertness, or inattention of ourselves or others, no less than by positive falsehood or malicious dissimulation. How little this side of the question appeals to most of us is clearly shown by the circumstance that the defense, "I thought is was so and so," or, "Well, I didn't know any better at the time," or "Such and such a person told me so," is currently urged and accepted as sufficient answer, when any statement, subsequently proved to be incorrect, is traced back to its immediate source. But no such excuse is ethically valid. The proper rejoinder in all such cases is: "You ought to have known; you ought not to have made allegations or offered opinions until you had been at proper pains to convince yourself of the soundness of what you said." Matthew Arnold once remarked that the English are very good in following their consciences; where they are not good is in finding out first of all whether their consciences are leading them right or wrong. But, in view of the fully developed principle of veracity, we must hold a man responsible, up to the uttermost limit of his opportunity, for knowing the truth as well as for speaking it; for investigating the grounds of his beliefs and judgments, no less than for frankness and courage in the expression of them. In a word, we must insist on enlightenment—on the intellectual as much as the narrowly called moral aspect of the matter.

And this leads us to the conclusion that veracity, at bottom, signifies nothing less than the cultivation of a love of truth for its own sake, and is, therefore, fundamentally synonymous with intellectual integrity, absolute soundness and sanity of mind. Observe, then, the further implication. To complete our conception of veracity we have to remember that it means not alone speaking the truth, not alone proper care in ascertaining what is truth, but also thoroughgoing, unhesitating readiness to accept fact as fact, no matter how unpleasant it may seem to be. This point needs emphasis; for, hard as it may appear to have to say so, there are very few of us who are not, at some times, under some circumstances, guilty of imagining that what we like is the final measure and criterion of what is; few, therefore, who in practice live up to that ideal of complete mental honesty which demands repudiation of all prejudice, snap judgment, self-delusion, make-believe, a stern determination to see things as they are, and the corresponding willingness to adjust ourselves resolutely and without murmur to what is shown to be reality. Presented with a new idea, we are too often inclined to ask—not, What is the evidence for or against it? but, How will it suit my tastes?—not, Is it true? but, How is it likely to affect my present creed? But only when we feel able to declare with Clough, "Fact shall be fact for me, and truth the truth as ever"; to realize with Amiel that "the world must adapt itself to truth, not truth to the world"; and acknowledge with Froude that "whatever the truth may be it is best that we should know it"; and, at the same time, carrying these principles out into practice, make them the impelling and guiding forces of our lives—then, and then only, have we a right to say that our intellectual foundations are deeply and firmly laid.

But such a result requires self-culture of the widest as well as the severest kind, for it calls for balance and regulation of feeling no less than for mental alertness, vigor, clearness, and honesty. Before we can "see life steadily, and see it whole," we must have the entire nature under the complete control of that conscience of the intellect to which reference has been made; we must have trained ourselves up to a degree of fortitude sufficient to bear without flinching what Bagehot once described as the sharpest of all pains—the pain of a new and unwelcome idea. Often enough a fresh truth will bring us not comfort or the sense of satisfaction, but the reverse of these—doubt, misgiving, heart-anguish, agony of mind. The peace and joy which we once found in an older order of thought may henceforth be ours no longer; while, in place of a philosophy of life which had grown rich and sacred to us through association, we may have to accept a new theory of the universe and man which for a time at least may seem chilly and bleak and depressing. In such a crisis as this—and few serious-minded men of our generation can hope to escape some mental upheaval attendant upon the progress of thought—we must nerve ourselves with the high doctrine of veracity: "Let fact be fact, and life the thing it can"—first, the truth as we can learn it, and then, whatever happiness or comfort may be gained from it for ourselves and others.*

Even this is not quite all. Strict adherence to veracity, still further analyzed, will be found to include not simply fortitude in facing new truths for ourselves, but also the faith that, in the long run, truth will always be better than error for the world at large. Here, of course, we touch a question of acknowledged difficulty, and one of which no adequate treatment can be undertaken in this place. Yet the difficulty must at least be presented. Given a creed or scheme of life which seems to bring hope and comfort to "the complaining millions of men," and many of us, while ourselves convinced of its unsoundness, will more or less deliberately cherish the opinion that it is, on the whole, best that the world should be left unenlightened; and we find a kind of theoretic basis for our position in the modern evolutionary doctrine of the congruity which exists in the average of cases between culture and belief. Many of the older ideas out of which past generations drew strength and inspiration may appear to us to be forever discredited. But shall we, therefore, carry our conclusions out into the common places of life—into the streets, the markets, the schools? Shall we force them, from the outside, upon those intellectually and morally unprepared to receive them? Shall we preach them as truths "to those that eddy round and round"? How great is the responsibility of each of us in these matters will be felt at once by all to whom the present problems in conduct are something more than questions for academic speculation. Is there not, it may be urged, a time and a season for all things—even for speaking the truth? And though it may never be conceived as part of our duty to state publicly what we know to be false, may we not oftentimes be justified in holding our tongues?

I need hardly say that this is a difficulty to which thoughtful men have been fully alive from the time of the Greek and Roman moralists onward. In our own day it has been powerfully presented in one

* Noteworthy examples of courage shown in the acceptance of what the writers deemed truth, though unpalatable truth, will be found in James Thomson's sonnet, A Recusant; the last chapter of Romanes's Candid Examination of Theism (published under the pseudonym of Physicus); and the concluding paragraphs of Pearson's National Life and Character.

of Ibsen's strangest and most enigmatical plays, The Wild Duck. What I have elsewhere written about this extraordinary work bears so directly upon the issue now before us that I may be pardoned for reproducing a portion of it here: "After all, I do not think that it is very difficult to see the point of connection between this play and the body of Ibsen's work. It seems to me to have been the writer's purpose to clinch the ideas already set forth in Hedda Gabler, though allowance must be made for the presence and coloring of an even more dejected mood. Truth may prove destructive; but then it will be the fault not of truth but of ourselves. Its boasted liberty is a blessing to those only who are fit for liberty; to many it may prove nothing more than a short cut to ruin. Men must be educated, not only in truth, but for truth. You can not make people free from the outside. They must achieve freedom for themselves, by inward growth. You may strike off their shackles, but this will only give a man who is a slave by nature an open chance to plunge into a still more desperate servitude. It is useless, worse than useless, to offer new knowledge where the recipient lacks spiritual strength and flexibility to adjust himself to the larger claims which it will undoubtedly force upon him. Gregers Werle, in the play, makes ideal demands upon an individual mentally and morally unable to rise to the level of the occasion; what marvel, then, that the experiment proves fatal to all concerned? It is, therefore, perhaps fair to regard The Wild Duck as a kind of complement or sequel to An Enemy of Society. In the latter drama, Ibsen boldly proclaimed his right to speak out, come what might of it; in the present work, on the other hand, he mournfully acknowledges that the gospel he brings to the world—true gospel though he conceives it to be—may none the less be fraught with vast and incalculable dangers for a society made up for the most part of people like those we meet in the play. . . . Is it not best, he seems to ask, just to leave them as they are? Who shall shoulder the responsibility of uttering the new word, knowing that while it is potent to save, it is also potent to destroy?"

Thus, as well as I am able to read it, runs Ibsen's thought; and the doubt which it expresses must from time to time have been felt by most of us. To proceed further with the discussion of the question thus opened up would here commit us to an unwarrantable digression into casuistry. It therefore must for the present be left where it is.* I have raised it with a view only to completeness—that is, to show that the full conception of veracity implies faith in truth as well as love for truth; whether we can any of us declare

* The reader desirous of following up this part of the subject will be glad to be reminded of John Morley's extremely able essay On Compromise.

ourselves in favor of absolute veracity in this respect is quite another matter.

We may now regard our subject from a different point of view, briefly considering veracity under the three partially independent forms distinguished by Mr. Lecky—the industrial, the political, and the philosophical.*

1. Industrial Veracity.—By this we may understand, with Mr. Lecky, "that accuracy of statement and fidelity to engagements which is commonly meant when we speak of a truthful man." The description of this kind of rectitude as "industrial" may, however, cause some surprise, since the idea that the industrialization of life has cultivated not candor, but mendacity, is deeply rooted in popular thought, and finds numerous expressions in literature—as, for instance, in Pope's line—"The next a tradesman, meek, and much a liar." † And that this common notion is apparently supported by many conspicuous facts can not be denied. We are all of us too familiar with the countless abuses of trade as they come home to us in our own experiences—with the tricks and subterfuges to which all classes of dealers resort, the adulteration of almost everything we eat and drink, the lying advertisements of our newspapers—to need to be reminded that the commercial spirit is not in these days marked by any profound respect for truth. Might it not even be urged that, in this particular respect, we have lost by the encroachments which industrialism has made upon the old chivalrous code of honor? That code—at least as we know it through romance—insisted upon a certain integrity of character, squareness of dealing, honesty even with enemies. But a moment's thought will convince us that, after all, these manifest facts give us only one side of the matter. It is equally certain that, whatever results may reveal themselves in practice, nations come more and more to recognize in theory the need and importance of veracity as their relations grow more and more industrial. Mutual confidence, like justice, is a prerequisite condition to industrial development; and mutual confidence is possible only when people as a whole fulfill their promises, keep their engagements, and to some extent stick to the truth. Even the abuses of trade are, in a certain sense, evidence of the growth of general veracity. The liar depends for the success of his lying upon a broadly accepted tradition of truthfulness; the dishonest trader is as much interested as those whom he cheats in the honesty of other people. If no one were expected to speak the truth, false statements would lose their value;

* European Morals, third edition (New York, 1891), vol. i, pp. 137–139.

† Moral Essays, i, 152. See also Tennyson's vigorous denunciation of commercial morality in Maud.

if we all ceased to believe in fair dealing, the deceiver's occupation would be gone. As Mr. Lecky says, in industrial societies "veracity becomes the first virtue in the moral type, and no character is regarded with any kind of approbation in which it is wanting. It is more than any other the test distinguishing a good man from a bad man. . . . This constitutes probably the chief moral superiority of nations pervaded by a strong industrial spirit over nations like the Italians, the Spaniards, or the Irish, among whom that spirit is wanting. The usual characteristic of the latter nations is a certain laxity or instability of character, a proneness to exaggeration, a want of truthfulness in little things, an infidelity to engagements, from which an Englishman, educated in the habits of industrial life, readily infers a complete absence of moral principle." We may even go with him when he adds, "The promotion of industrial veracity is probably the single form in which the growth of manufactures exercises a favorable influence upon morals."

It is important to note the almost entire absence of this kind of veracity among the Greeks, because this fact shows us that truthfulness is not necessarily the result of a high state of civilization, but only of a state of civilization accompanied by such life conditions as tend to make truthfulness a habit. And if we inquire what such conditions are, we shall probably find that they depend, more than upon any other single cause, upon the gradual subsidence of the *régime* of mutual antagonism, and the rise of the *régime* of mutual help.* So far as industrialism has abated the struggle for existence among individuals and nations, it has promoted veracity; while to the extent to which it only keeps this struggle alive under changed forms, it merely perpetuates the untruthfulness which was from the first a concomitant of such struggle.

2. Political Veracity.—By this, still following Mr. Lecky, we mean the spirit of impartiality which, in matters of controversy, desires that all facts, arguments, opinions, should be freely and fully stated—in a word, the spirit of fair play. We call it "political," because it is undoubtedly to be interpreted as a growth, immediately, out of developing freedom in political life. Democratic progress, then, provided it be democratic in reality as well as in name, will favor the spread of this particular form of truthfulness; coercive rule (whether it come through the tyranny of the one or of the many) will always prove hostile to it. It suffices here to observe these connections, without undertaking any analysis of the relations subsisting between forms of government and social activities. A free platform

* For evidence on this point, see Spencer's Principles of Ethics, Part II, chapter ix. Mr. Spencer, of course, connects the growth of veracity, directly or indirectly, with the decline of militancy and the spread of peaceful activities.

and press, open debate, the habit of challenging, sifting, criticising—these are the conditions which foster the spirit of political veracity; where they do not exist we shall search for it in vain. The famous conversation between Tom Brown and Harry East on the ethics of lying, with the conclusion of the latter that there is nothing wrong in deceiving a master if you can do it with safety, simply expresses in little what is everywhere exhibited at large by the moral history of the world. For the spread, therefore, of this form of truthfulness we must look to the decline of despotic authority and to the democratic habit of unchecked discussion; and we must expect to see it accompanied, on the one hand, by increased self-dependence and insistence on one's own right of thought and speech, and, on the other hand, by a wider and more generous toleration of the opinions of other people.

3. Philosophical Veracity.—This may be defined as the most abstract and disinterested form of truthfulness—the simple love of truth for its own sake. The conditions of its development are complete emancipation from prejudice and party contentiousness, freedom from the disturbing influences of passion, tradition, personal and other kinds of bias, the cultivation of a calm and judicious spirit in all matters of controversy, and that steadiness of mental vision which enables us to envisage without wavering the hardest and most disagreeable facts. It is this pure and unreserved devotion to truth as such—this complete willingness to follow whithersoever it may lead—that more than anything else distinguishes the man of the highest mental character from those of lower types—which marks off the philosopher, properly so called, from the heated partisan, the bigoted sectary, the whole crowd of ignorant, ill-reasoning, or indifferent adherents of churches, classes, schools. It is to be considered as the last and noblest of the intellectual virtues—the very flower and fruitage of the finest developments of thought.

This form of veracity, it is evident, then, is possible only in certain high states of civilization, wherein mental freedom and alertness, a wide interest in every field of inquiry, and the largest and most solid intellectual culture, combine at once to establish the ideal, and to bring about and maintain the conditions necessary to its attainment. But we must not rest content with these rather vague and general statements. We must investigate a little more closely the habits of life and thought, and particularly the kind of mental discipline, by which philosophical veracity is fostered and strengthened.

After all, the question thus introduced is, fortunately, a very simple one. If, remembering that we have here to do with a love of truth as such, with the desire to know all that is to be known about any subject, and with the willingness to accept whatever is proved to be fact, no matter whether it may fit into our preconceived theories or make havoc of them, we ask: How best are these high qualities to be cultivated? What is the method and training by which such results are to be secured?—we shall find that in the very terms of our statement the answer is clearly given by implication. It is in the scientific spirit, and in the spread of scientific ideals, methods, and habits of mind, that we have to seek the ultimate cause of philosophical veracity. Of this austere virtue, science itself offers the one great training school. We are there taught, as we are taught nowhere else, to estimate evidence and weigh hypotheses; to discount ready-made conclusions, and set aside authority and tradition; to look steadily at facts and theories, and hold lightly to creeds and systems as, in the nature of things, nothing more than provisional. Such drill, such training in mental conduct, is bound to affect the whole life, nurturing patience, reserve, precision of observation, thought, and statement, care in forming opinions, the judicial temper of mind, on which stress has been laid. Nor is this all. Science furthermore teaches us, and beyond all things else, to seek fact as fact, allowing the judgment to be in no way swayed or disturbed by any consideration of its real or supposed consequences. Elsewhere, truth may be made subordinate to social convenience, established philosophies, pet theories of man, nature, and God. In science, it is sought for its own sake, and from first to last is held supreme.

The difference between the scientific and the non-scientific spirit in these important matters is made clear when we remind ourselves that almost every great conclusion established by scientists has at the outset been angrily denounced on account of its imagined bearings upon questions of conduct or the creeds of the organized churches and schools. When, to take only a single conspicuous illustration, Darwin published the results of his investigations into the origin of species and the descent of man, pulpits and newspapers all over the civilized world vehemently attacked the new doctrines because "they made a personal God unnecessary," or "debased man to the level of brutes," or "tended to materialism," or "contradicted the first chapter of Genesis," or did something else equally impertinent, equally subversive of preconceived ideas. And even where no rancor was shown, the position too often assumed was no less fatal to genuine veracity. "Here is the established creed of my party and church; as this is truth, whatever does not harmonize with it must be false; the Darwinian hypothesis does not harmonize with it—it is therefore false; it only remains in one way or another to disprove it; let me cast about to see how this can be done." This, I think, is no unfair description of the popular plan of campaign; and it is easy to see that here we have the intellectual attitude and temper, not of the calm, unprejudiced judge, but of the interested, brief-holding advocate—an attitude and temper which must inevitably lead to prevarication, special pleading, evasion, and the innumerable evils of sophistry.

In the so-called conflict of science and religion—which in reality is the conflict of newly discovered truth with older and exploded theories of things—we are thus shown again and again that while the finest discipline for philosophical veracity is to be found in the growth of the scientific spirit, its worst foe is always to be sought in the diametrically opposite spirit of theology. "Science abhors finality in belief," said a distinguished English clergyman,* "but this is precisely what theologians like. Science discovers facts, but theology accepts revelation, and clings to creeds." Exactly; and the contrasted mental results brought about by such conditions respectively need scarcely be specified. Science has no creed to support; theology has always had, and always will have. Science, therefore, is free to look at all theories from the point of view of facts; while theology is bound to look at all facts from the point of view of accepted theories. In this simple circumstance lies a part explanation of the everlasting warfare between them.

But the spirit of theology is hostile to strict veracity for other reasons than this finality of belief, this tenacity in regard to established creed. Theology professes esoteric knowledge of what lies beyond the reach of verification, and thus breeds contempt for the processes of verification and disparagement of their importance. It labels all sorts of things which transcend knowledge, or contradict accumulated evidence, "mysteries," thus dismissing them from inquiry and encouraging looseness of thought. It fosters undue reverence for tradition, authority, the "wisdom of our ancestors," and therefore tends to mental dependence, sluggishness, and debility. It postulates belief as the ideal of the intellectual life; proclaims implicit faith the greatest of virtues; teaches credence in default or in spite of testimony; and so condemns the skepticism, balance of judgment, reservation of opinion, acknowledgment of nescience, in the absence of which the quest for truth is impossible, and which are often the last results that the truthseeker is able to offer as the reward of all his toil. Finally, theology, by its familiar device of "reconciling" science with its own postulates when the conclusions of science are no longer to be ignored or abused, undermines frankness, straightforwardness, the sense of honor and fair

* Dr. Magee, late Bishop of Peterborough.

play, and cultivates that habit of equivocation, subterfuge, hair-splitting, and forced interpretation, than which nothing can be more disastrous in its influence on the intellectual life.

We do not wonder, then, that in the "ages of faith"—in the days when theology held undisputed sway—truth should have been so little prized, and falsehood, provided only it were falsehood in a good cause, held so venial. John Sterling's uncompromising words on leaving the priesthood—"No, I can not lie for God"—are very far indeed from describing the mental attitude of the early and mediæval Church. "By the fourth century," says Mosheim, "the monstrous and calamitous error" had taken possession of the ecclesiastical world, "that it was an act of virtue to deceive and lie when, by that means, the interests of the Church might be promoted." The history of the Church and councils, and of the growth of Christian doctrine, only too clearly shows to what extent this principle was put into practice.* "This absolute indifference to truth," writes Mr. Lecky, "whenever falsehood could subserve the interests of the Church, is perfectly explicable, and was found in multitudes who, in other respects, exhibited the noblest virtue. An age which has ceased to value impartiality of judgment will soon cease to value accuracy of statement; and when credulity is inoculated as a virtue, falsehood will not long be stigmatized as a vice. When, too, men are firmly convinced that salvation can only be found within their church, and that their church can absolve from all guilt, they will speedily conclude that nothing can possibly be wrong which is beneficial to it. They exchange the love of truth for what they call the love of *the* truth." † Thus, under the predominating influence of theology, men came to care more for creed than for veracity; and among the countless evils which followed as a matter of course, the habit of persecution sprang up and grew apace. Strictly logical, from the theological standpoint, this habit simply carried accepted principles over from theory into practice. In attacking opinions with the strong arm of civil authority, in punishing them with bodily torture, men merely treated the quest of truth as a social crime, when already it had been denounced as a religious sin.

So far as philosophical veracity is concerned, therefore, we have to conclude that its growth must depend almost wholly upon the decline of the theological and the spread of the scientific spirit. And, indeed, whatever else the expansion of science may do for men in the years to come, it is probably just in this extremely important

* On the mendacity of the early Church and the way in which it forged prophecies and fabricated evidence, see, e. g., Lecky's History of Rationalism, vol. i, pp. 434, 435.

† History of European Morals, vol. ii, p. 213.

particular that its influence will be most pronounced and most beneficial in the intellectual life of the world at large.

This little essay has been intended simply to give some of the most important principles of veracity in a purely abstract statement. Special questions and problems have, therefore, been purposely left untouched. All moralists, it may be assumed, will agree that, in the actual ordering of life, there are occasions when not only are we not called upon to speak the truth, but when even by direct lying we incur no proper reproach. To mislead the would-be robber concerning the exact whereabouts of the family plate is clearly justifiable; and so, too, is the false statement of his condition by means of which, as every physician knows, a patient is often given a better chance of recovery. Numerous cases of these or other kinds will occur in common experience; there is unfortunately no single rule of conduct which can be taken as inflexible and universal in its applicability; and we must each of us face the individual crisis when it arises as best we can. But meanwhile it may be useful sometimes to consider general and fundamental principles in ethics without relating them to exceptional issues. After indulging in such a discussion as the foregoing we may, it is possible, be inclined to say that, as Rasselas was convinced by Imlac that no human being could ever be a poet, so are we fully convinced that we can never be wholly and consistently truthful. Yet it may help us none the less to have the ideal distinctly set before us, and whatever difficulties may be in the way of our approach to it, it will never cease to be our duty to hold it steadily and bravely in view.

After Heinrich Hertz had gone to Munich to study engineering in 1877, he wrote back to his parents that he wanted to change his plans and return to the study of natural science. He felt that the time had come either to devote himself to this entirely or else to say good-by to it: for if he gave up too much time to science in the future it would end in his neglecting his professional studies and becoming a second-rate engineer. His parents consented to his desire and his course of studies was changed in conformity to it. A year later he wrote from the laboratory that the greater part of the time spent there was devoted to "things which are very useless, or at any rate don't teach one much, such as cutting cork and filing wires, and the observations themselves are naturally not very delightful. Possibly it may be doubtful whether it is quite right for me to spend so much time at these things when I still have so much to learn. And yet I feel that it is right; to get information for myself and for others direct from Nature gives me so much more satisfaction than to be always learning it from others and for myself alone—so much more that I can hardly express it. When I am only studying books I am never free of the feeling that I am a perfectly useless member of society."

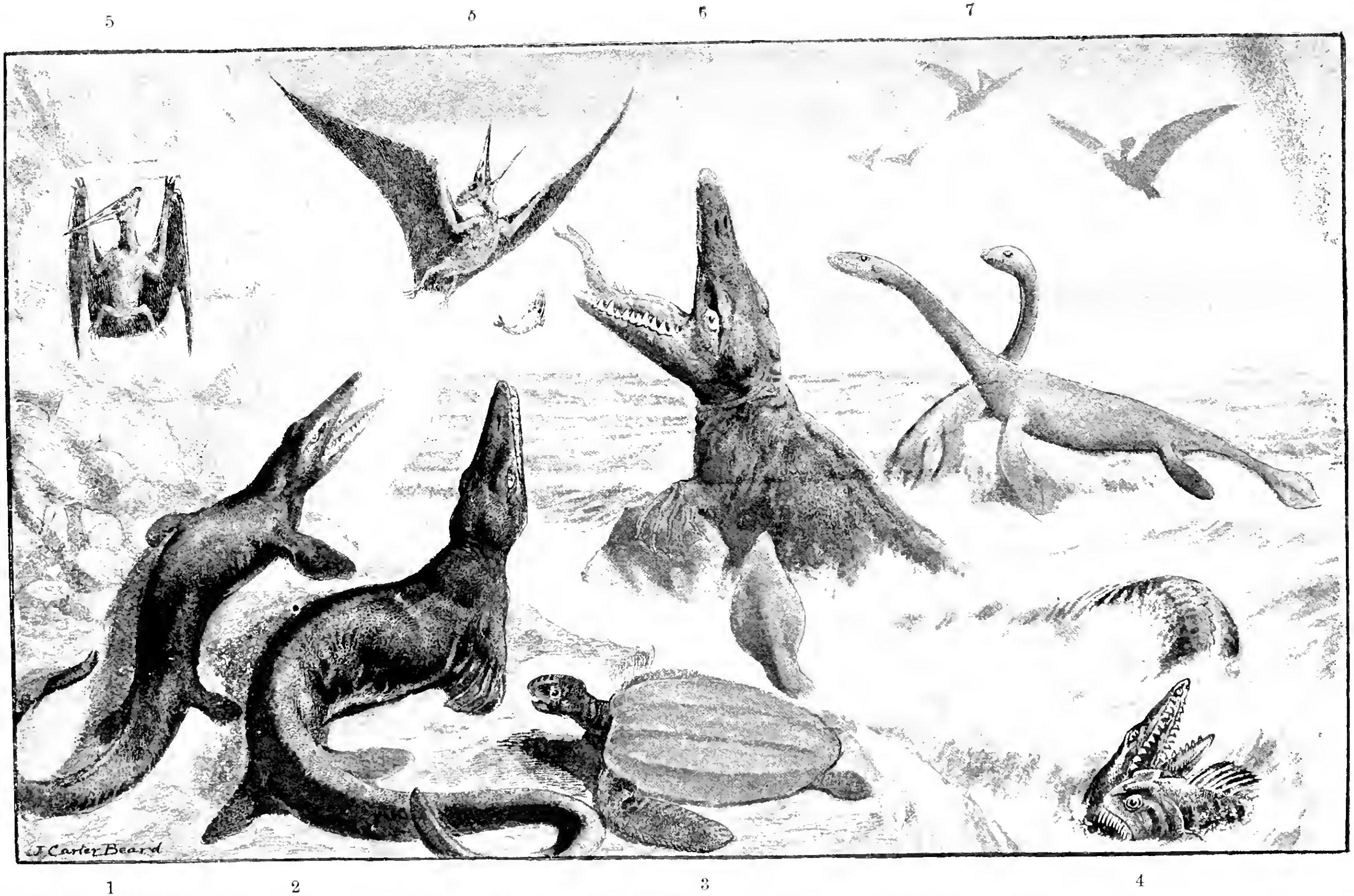
THE SERPENTLIKE SEA SAURIANS.

By WILLIAM H. BALLOU.

IN the latter part of the Mesozoic age there was a great inland ocean, spreading over a large part of the present continent. The lands then above water were covered with a flora peculiar to the times and were inhabited by some of the animals which later distinguished the Cenozoic age. In the seas were reptiles, fishes, and turtles of gigantic proportions, armed for offense or defense. There were also oysterlike bivalves, with enormous shells, three or four feet in diameter, the meat of which would have fed many people. In time, this great ocean, swarming with vigorous life, disappeared. Mountain ranges and plains gradually arose, casting forth the waters and leaving the monsters to die and bleach in Tertiary suns. As the waters remaining divided into smaller tracts, they gradually lost their saline stability. The stronger monsters gorged on the weaker tribes, until they, too, stranded on rising sand bars, or lost vitality and perished as the waters freshened. In imagination, we can picture the strongest, bereft of their food supply at last, and floundering in the shallow pools until all remaining mired or starved. It would be interesting to know how much of the great Cretaceous ocean forms a part, if any, of the vast oceans of to-day. If any part so survived, what became of the saurians carried forth into new ocean areas? Were they beaten on jagged rocks by powerful currents and destroyed, or did some of them escape only to perish in after ages? Water, as a rule, seeks its level; sometimes it is evaporated. If the Cretaceous ocean merely drained off into other areas before rising lands, it is perhaps not unreasonable to suppose that the descendants of some of the saurians might have survived in the Atlantic or Pacific as they had existed in the Mesozoic age. We can therefore only assume that the Cretaceous seas evaporated or gradually freshened until all the life they contained became extinct.

During the past twenty-five years explorers have collected tons of skeletons of the stranded sea serpents, or better, perhaps, serpentlike sea saurians. A sensational world has ever been on the lookout for sea serpents. It is possible that such tendencies are inherited from a very remote ancestor, a primeval, manlike animal, whose curiosity was aroused by glimpses of some surviving pythonomorph.

Almost everywhere on the expanse of the Cretaceous ocean might have been seen the snakelike forms of the elasmosaurs, the heads arrow-shaped, upheld by swanlike necks, rising from ten to twenty feet above the surface and scanning the sea or air for prey or enemies. The prey located below, they dived; the enemy seen



The Great Cretaceous Ocean. Drawn by J. Carter Beard.

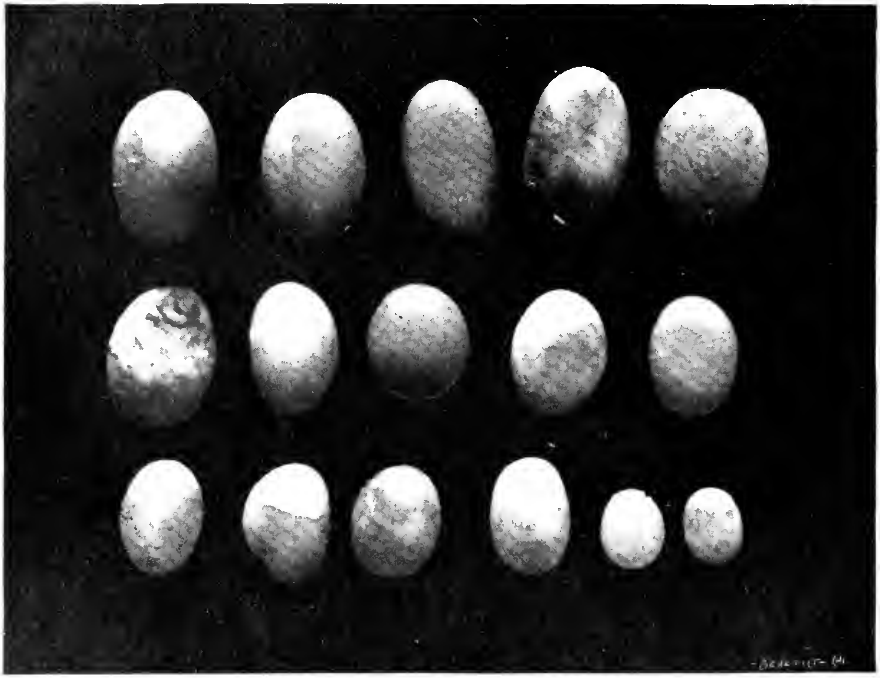
Mosasaurs: 1, *Platecarpus coryphæus* (Cope); 2, *Tylosaurus proriger* (Cope); 6, *Mosasaurus horridus* (Williston): all restored by Williston. 3, Marine turtle: *Protostega gigas* (Cope), restored by Case. 4, Bulldog fish: *Portheus molossus* (Cope). 5, Pterosaur: *Pteranodon*, or *Ornithostoma ingens* (Marsh), restored by Williston. 7, Plesiosaur: *Polycotylus latipinnis*, as restored by Dames.

approaching, they swam away with incredible speed. A flock of them must have resembled the shipping of a harbor with tall masts yellowing in the sunlight. At the base of the long necks were elephantine bodies, and behind, long, tapering tails. Forward and behind were two sets of paddles, perhaps terminating with webbed digits. With the forward paddles Cope thought that they might have seized prey; with all four paddles they swam. From thirty to sixty feet in length, they were well adapted to the deepest waters and to breast the waves of the seas. Like swans and Floridian snake birds, they plunged their necks downward for prey, the body perhaps remaining on the surface as an anchor. Carnivorous, the elasmosaur ate what it could seize, and to-day, with its bones, are found the bones of its victims, usually fishes. Somewhat similar were the cimoliosaurs, even longer necked at times, but with shorter and more powerful tails. Their paddles were long, and as swimmers they must have had few equals in speed. Smooth silicious pebbles to the amount of a peck or two have been found in numerous instances associated with the remains of plesiosaurs of various kinds. They evidently formed a part of the contents of their stomachs, but their use is not clear. But the real rulers of the Cretaceous ocean were the pythonomorphs, or mosasaurs, more like the typical serpents of to-day, and more entitled to be called sea serpents.

The mosasaurs were more elongated and graceful in form. Their heads were large, flat, and conical, with the eyes directed laterally. The tails were long. They had fore and aft paddles with webbed digits, attached to the body with wide peduncles. With paddles and flattened tails they swam with ease and speed. Like snakes, they had four rows of formidable teeth on the roof of the mouth, not for mastication, but for seizing prey and holding it. Like snakes, they swallowed their prey entire, but, unlike snakes, they had not elastic throats. The jaw was, however, so articulated, jointed so far back between the ear and chin, ball-and-socket fashion, that the immense opening made up for the lack of expansibility of throat. The ends of the jaws were bound by flexible ligaments, permitting the passage of large fish or other prey. The mouth of the gullet was prolonged forward while swallowing, evidently being loose and baggy. The same habit pushed forward the glottis, or opening of the windpipe in front of the gullet. Like a serpent, the mosasaur hissed, owing to these formations. The tongue was long and forked, and when at rest was inclosed in a sheath beneath the windpipe and thrown out when the jaws were in motion. And thus, too, are the nearest living forms.

The mosasaurs attained great length, reaching from ten to fifty feet. They had long, projecting muzzles, somewhat like that of the blunt-nosed sturgeon of to-day, although the branches of the lower jaw were correspondingly massive. With such ramlike jaws the mosasaur possessed terrible powers of collision. They were scaled animals, and fragments of their hide and scales have been found in good condition of preservation.

The first mosasaur discovered was found by Major Drouin in 1776, on the banks of the river Meuse, near Maestricht, Germany. On this specimen was founded the genus *Mosasaurus*, given it by Conybeare in 1822, although the skeleton was previously described



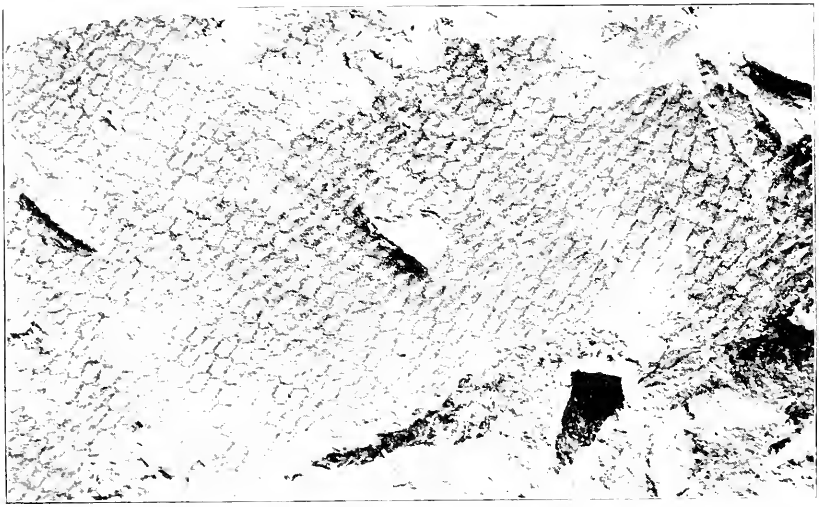
Silicious Pebbles from the Stomach of a Plesiosaur.

by Cuvier in 1808. The interesting history of the specimen, which created a profound sensation in the world of learning and became mixed up in the history of nations, is herewith reduced from Owen. The skull was found in the quarries of St. Peter's Mount by M. Faujas Saint-Fond, Commissary for Sciences of the French Army of the North. In one of the galleries or subterraneous quarries in which the cretaceous stone of St. Peter's Mount was worked, about five hundred paces from the entrance and ninety feet below the surface, the quarrymen exposed part of the skull in a block of the stone which they were engaged in detaching. On this discovery they suspended work and went to inform Dr. Hofmann, surgeon of the forces of

Maestricht, who for some years had been collecting fossils at this quarry, remunerating liberally the workmen for the discovery and preservation of them. Dr. Hofmann arrived at the spot and saw, with extreme pleasure, the indications of a magnificent specimen. He directed the operations of the men so that they worked out the block without injury to the skeleton, and he then with his own hands cleared away, by degrees, the yielding matrix, exposing the extraordinary jaws and teeth, which have been the subject of so many drawings, descriptions, and discussions. This fine specimen, which Hofmann had transported with so much satisfaction to his collection, soon, however, became a source of chagrin to him. Dr. Goddin, one of the canons of Maestricht, who owned the surface of the soil beneath which was the quarry whence the fossil had been obtained, when the fame of the specimen reached his ears, pleaded certain feudal rights in support of his claim to it. Hofmann resisted, and the canon went to law. The whole chapter supported their reverend brother, and the decree ultimately went against the poor surgeon, who lost both his specimen and his money, for he was made to pay the costs of the action. The Canon Goddin, leaving all remorse to the judges who had pronounced the iniquitous sentence, became the happy and contented possessor of this unique example of its kind. But justice, though tardy, comes at last. When the town was bombarded by the French, directions were given to spare the suburb where the famous fossil reposed. After the capitulation, the grenadiers discovered, seized, and bore off the specimen in triumph to the commissarial residence. The excellent soldiers always knew how to appreciate and respect the monuments of art and science. The mosasaur was transplanted and still remains in the Museum of the Garden of Plants, Paris, and is the subject of more literature than any extinct animal.

Remains of the mosasaurs were first discovered in England in 1833, at Lewes. In America, mosasaurs were first found in the cretaceous beds at Great Bend, Missouri, about the year 1820, by Major O'Fallon, Indian agent. He found a fine specimen, and took it to his home in St.Louis. Dr. Goldfuss first described it in 1843, with accompanying plates, the skeleton having been taken to Germany by Prince Maximilian. He defined the parietal and jugal arches, pterygoids and vomers, the position of the quadrate, and the presence of the sclerotic plates. Since that time our knowledge of the mosasaurs has been largely increased by the explorations and efforts of Cope, Marsh, Dollo, Owen, Leidy, Williston, Baur, Merriam, Gaudry, Gervais, and others. Cope, perhaps, defined the largest number of species. Marsh defined the stapes, columella, transverse and hyoid, and the presence of hind limbs. Dollo has materially increased the data of mosasaurs and has added four new genera. Baur gave the first complete description of the skull of a species of *Platecarpus*. Williston and Case first described the vertebral column and extremities and the general form of mosasaurs. The former has contributed most to our knowledge of mosasaurs in the Kansas Cretaceous, and made the first correct restoration, which is made one of the bases of this paper.

Professor S. W. Williston, University of Kansas, because of his perfected restorations and wide studies of the sea-serpentlike saurians, the mosasaurs and other marine saurians, must rank as the highest



FRAGMENT OF SCALED SKIN OF MOSASAURS. Natural size.

authority. It is largely on his material that it is possible to present something like a complete view of the gigantic monsters that swam the Cretaceous seas and gave origin to our notions of mythical sea serpents. Kansas is the great center of the Cretaceous time of occupation, and it is within its borders that the largest number of species and genera of sea serpents have been discovered. It is natural, perhaps, that living in the vicinity of the most prolific Cretaceous remains, Professor Williston should be better able than scientists more remote to complete our knowledge of marine saurians.

There are three groups of the serpentlike sea saurians—the ichthyosaurs, plesiosaurs, and mosasaurs. Of the mosasaurs, Kansas has produced the largest number of species, twelve of which have been satisfactorily described. New Jersey, Alabama, Carolina, and Mississippi have perhaps ten valid species. Dakota has favored us with three species. It is estimated that of fifty species attributed to North America, about twenty-five or thirty will be distinguished as distinct. It is expected that in the Fort Pierre formation of the Dakota region other species will be found, as it has been but imperfectly explored. Europe has about a dozen species, and New Zealand several more. Probably only about forty species of twice as many alleged to have been discovered in the world will stand the test of critical examination.

Of plesiosaurs, America has produced about ten and the Old World many more species that will stand. Many species of ichthyosaurs are recorded from Europe, India, Africa, Australia, New Zealand, and the arctic regions, and one or two in America, the toothless *Baptanodon* from the Jurassic of Wyoming being the type. All three groups had paddles with webbed digits, but none had claws. Williston thinks that the ancestors of the mosasaurs were land lizards. Dollo thinks that the ancestors were the peculiar group of lizards which appeared in the commencement of the Cretaceous known as *Dolichosauria*. Baur would derive the mosasaurs from even more specialized lizards, and believes that their relationship is very close to the monitors of the present day.

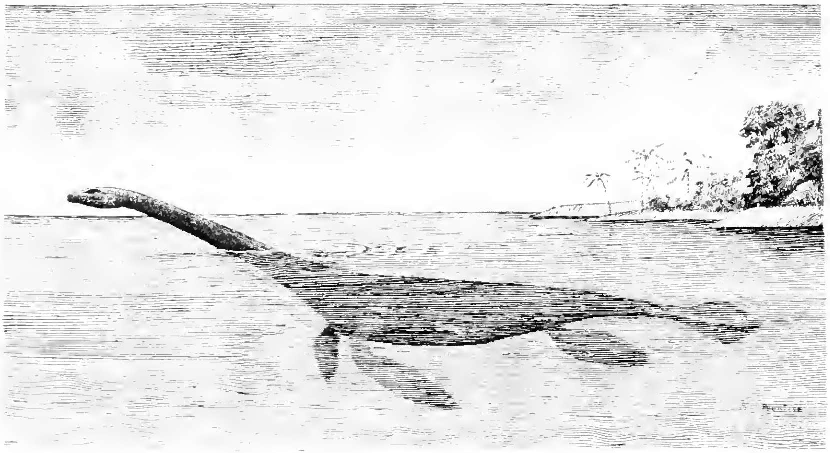
The ichthyosaurs are thought by Cope to be derived from *Homœosaurus* (beakless lizards) of the Jurassic; and these from the *Palæohatteria* (ancient hatteria), a rhynchocephalian (snout-head) which flourished as early as Permian times; and these from the *Labitosaurus*, an ancestor below the Carboniferous in the Palæozoic age; from which also sprang the lizardlike saurians, the dimetrodons (*Otocœlius*), which gave origin to the turtles (*Testudinata*). Some members of the group to which the plesiosaurs belong were land animals, and hence the origin of the whole group is clearly from land species. It is not now presumed that the marine saurians had much power of progression on land, but they may have climbed on to the beaches to lay their eggs. It is further presumed by Morris that in later times the eggs of saurians were devoured by other animals,* contributing to the extinction of all saurians.

Three species of representative genera of Kansas mosasaurs have been restored by Williston from material in the University of Kansas.

Clidastes velox (Marsh) is a typical mosasaur, the perfected skeleton of which is twelve feet in lenth. *Pumilus*, of the same genus, is given as six feet in length, which would rank it as perhaps the smallest mosasaurian. The clidastes of Kansas had short, powerful propelling tails, which would indicate a lesser speed than that of their longer-tailed contemporaries. The clidastes had small hind limbs, showing further deficiency in speed. The animals were

* Thought by Cope to have been the multituberculate *Prototheria*.

slender, with short heads. The vertebræ were firm, closely articulated with the best system of interlocking of any of the mosasaurs. The limbs were flexible and strong, with closely articulating bones and fully developed tarsus and carpus. The aggregate of these characters indicates the most snakelike form and method of progression through water of all the mosasaurs. The genus *Clidastes* was founded by Cope in 1869, but may ultimately give way to the genus *Mosasaurus* of Conybeare. Cope's views of Clidastes conclude that the animals were not as large as those of the genus *Liodon* (Owen), but more elegant and flexible, with an addi-



RESTORATION OF THE PLESIOSAUR BY PROF. S. W. WILLISTON.

tional pair of articulations at either end of each vertebra—the zygosphenes—to prevent dislocation by contortions. A larger and still more elegant species was *Clidastes tortor* (Cope), with lithe movements which enabled it to capture fish by means of its knife-shaped teeth, which were very numerous. Tortor was very slender, with a long and lance-shaped head. It was upward of twenty feet in length, with a head two feet and a half long, the vertebral column elongate and the head narrow and pointed.

The second-type mosasaur perfected by Williston is *Platecarpus coryphæus* (Cope). Its special characteristics are a short muzzle, slender vertebræ, and an imperfect interlocking zygosphene. The hind paddles are smaller than those forward, but thought to have been more powerful propelling functions than those possessed by other genera. A type skeleton measures fourteen feet, and may have been a young animal. The teeth were very curved and pointed, and formed effective weapons. The neural spines, not closely connected, indicate flexibility. The general characters suggest a powerful predaceous sea serpent. The genus was founded by Cope in 1869; it has a wide distribution, and seven or eight species belong to it.

Tylosaurus proriger (Cope) is the third of Williston's type Kansas specimens perfected in restoration. It is considered the most specialized of the mosasaurs. The skeleton in hand is twenty-three feet in length, and shows a wholly cartilaginous carpus and tarsus, more elongated digits, and a greater number of phalanges than possessed by any other genus, the result of long aquatic habits. The hind paddles are the largest, and the fifth digit has undergone but little reduction, indicating characters of a very primitive rank. The vertebræ are more flexible than in other genera, but they are relatively smaller and not at all strong. The skull is more elongated anteriorly. In the same genus was a much larger species, *T. dyspelor* (Cope), which was one of the most formidable of the mosasaurs. Another perfected sea serpent of terrible powers was *Mosasaurus horridus* (Williston), which had a ram nose, and evidently battered its foes when he could get at them. Williston's perfect skull from Dakota enabled him to correct many errors in vogue. The new genus *Brachysaurus*, formed by Williston, contains one species defined by him—*Overtoni*, from Dakota. It had a stout, very broad head, stout jaws and teeth, and stout, broad paddles. In appearance it suggests a terrible fighter, unadapted to rapid pursuit or flight.

A number of remarkable skeletons of mosasaurs have been discovered of late, some of which are expected to develop new species and, perhaps, new genera. Few of the "finds" of explorers create such sensational interest in scientific circles as the unearthing of the gigantic saurians. Three new skeletons were lately taken by an exploring party of the American Museum of Natural History. Prof. W. T. Lee, of the University of Denver, was so fortunate not long since as to secure the first skeletons of mosasaurs ever taken in Colorado, and adds so much to the geographical distribution of the animals. One skeleton was taken at Flagler and another at Canyon City. The Flagler specimen was exposed for sixteen feet, the vertebral column containing ninety vertebræ. There were also taken portions of the head and paddles. Flagler is situated in the St. Pierre Cretaceous in all probability. The specimen, not yet named, has a massive jaw and teeth, the latter very compressed. The vertebral column is one of the most complete yet unearthed. The tail is particularly fine, and gives a good impression of depth and compression.

Williston thinks that the food of the sea-serpentlike saurians must have consisted of fishes of moderate size, with occasional victims of their own kind. He says: "While the flexibility and loose union of the jaws undoubtedly permitted animals of considerable size to be swallowed, the structure of the thoracic girdle would not have permitted any such feats of deglutition of which the python and boa are capable. The animals must have been practically helpless on land. They were not sufficiently serpentine to move about without the aid of limbs, and these were not at all fitted for land locomotion. They lived in open seas, often remote from the shores. Their pugnacity is amply indicated by the many scars and injuries they received, probably from others of their own kind."

Among the fishes which were the prey of mosasaurs was *Portheus molossus* (Cope), the most formidable, and whose bulldog teeth and looks indicate that it leveled matters of justice by capturing smaller mosasaurs at times. The head of molossus was twice as large as that of a grizzly bear, the jaws deeper in proportion to length. The muzzle was stouter and deeper than a bulldog's. The teeth had sharp, cylindric fangs, smooth and glistening and of irregular size. Occasionally the teeth projected three inches above the gums, sinking one inch into the pits, as long as the fangs of a tiger and more slender. Two pairs of these long fangs crossed each other on each side of the snout.

Over the water were the flying saurians of formidable proportions, and which may have been both pursued and pursuer, according to size of mosasaur and pterosaur. The pterosaur had a wing expanse of eighteen to nineteen feet, as instanced in *Ornithostoma umbrosum* (Cope), the largest in size, and *O. ingens* (Marsh). The pterosaurs flew with leathery wings over the waves, plunging to seize unwary fishes or perhaps to be seized by mosasaurs, or soaring at a safe distance while watching the combats of swimming saurians. At nightfall they trooped along the shores, at last to suspend themselves to the cliffs by the claws of their wing limbs.

If tortoises were food for mosasaurs, there were plenty of marine turtles to choose from. The turtle was the boatman of the Cretaceous seas. The *Protostega gigas* (Cope), figured herein from a drawing by Prof. E. C. Case,* of Wisconsin, was the largest, its flippers having a spread of fifteen feet. Wieland has recently described an immense species, *Protostega ischyros*, from Wyoming.

Inasmuch as the earlier skeletons of mosasaurs were so incomplete as to leave the matter in doubt, it is interesting to note Professor Williston's discoveries of quite perfect fore and aft paddles of mosa-

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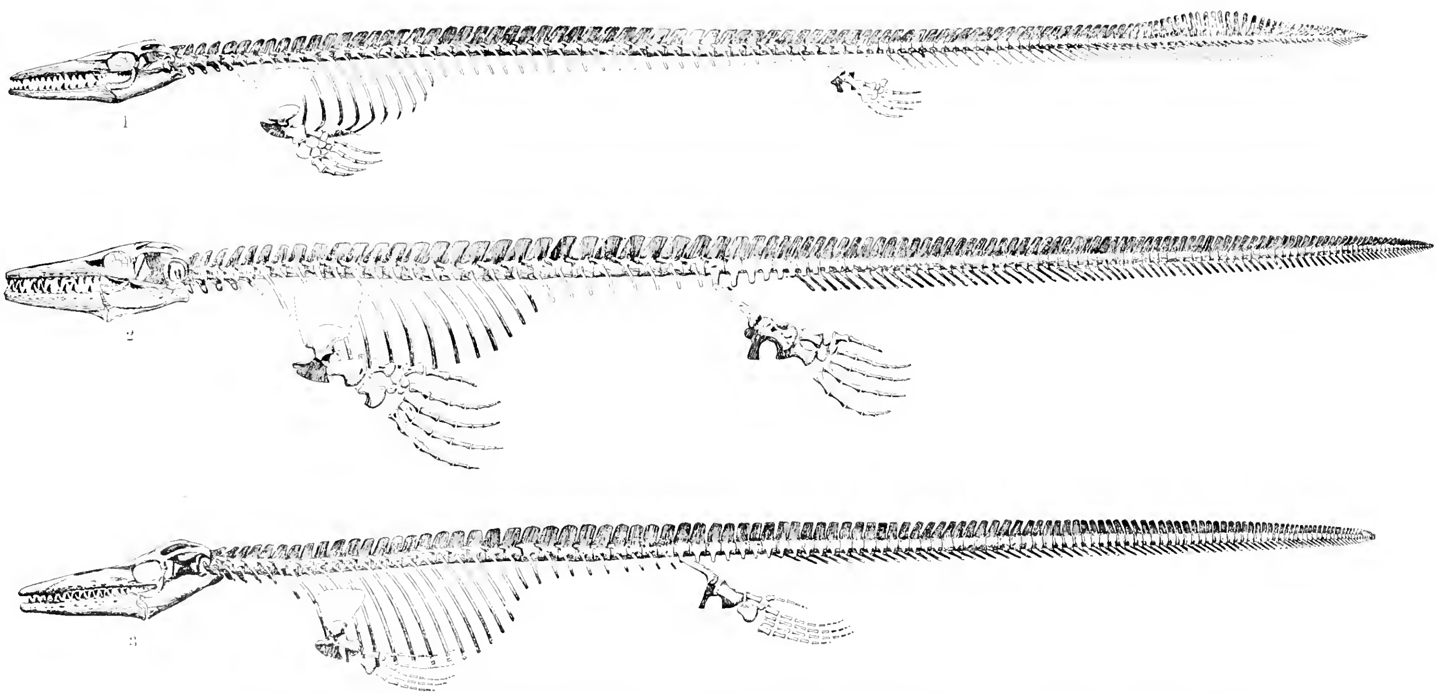
* Professor Case, the authority on this marine turtle, says: The skin must have been smooth and leathery, with supporting ridges or folds of dorsal integument to strengthen the back, perhaps two or three on either side of the central ridge. The back must have been quite flat. There were no claws on the front foot. The skull was as represented in the drawing.



Skeletons of Mosasaurs: 1, *Clidastes velox* (Marsh); 2, *Platecarpus coryphaeus* (Cope); 3, *Tylosaurus proriger* (Cope).

saurs, and the fact that marine saurians had scale-covered skins. The paddle was formerly a matter of conjecture, and, in the absence of such remains, the saurians were supposed to have had marine turtle-like flippers. Prof. O. C. Marsh, of Yale College, was the first naturalist to discover sufficient of the missing parts of skeletons to determine that marine saurians propelled themselves with paddles rather than flippers. As to the scales and skin found perfectly preserved by Snow, they do not differ materially from those of the Old World lizards, the monitors, existing to-day. The paddles, skin, and scales are very delicate functions, and it is remarkable that they should have been preserved through millions of years. Williston says of the paddles: "The specimen figured by Chancellor F. H. Snow, of the University of Kansas, has been thoroughly cleaned from the matrix, enabling an accurate drawing to be made, also a photographic reproduction as it lies on a chalk slab. The parts concealed beneath the ribs and vertebræ have been carefully laid bare from the opposite side and their position shown. The position of the paddle is a natural one, and the fact is of interest as showing the general expansion and curvature of the digits." The limb is very flexible, with considerable space between the bones, which were but partly filled out with cartilage, and must have had very free articulations. The remains of the skin were found between the bones, indicating a thin, pliable membrane, and extending fully between the fingers to their tips. Small scutelike scales extended as far as the metacarpals. The fifth finger is long. The paddles are slenderer, more flexible, and relatively longer than in other genera, which, with other characteristics, would show that *Tylosaurus* was the least lizardlike of the *Pythonomorpha* (Cope). As to the structure of the hind paddle, it is of interest in having five functional toes, although Williston thinks that the fifth toe was undergoing reduction, and that the first toe was not as long as in the front paddle. He concedes five toes to the hind paddle of *Platecarpus* (Cope), but doubts, in the absence of a complete skeleton, if *Clidastes* had more than four functional toes, as in *Mosasaurus*. Upon this character, together with the absence of a sternum, he has established two families, *Tylosauridæ* and *Mosasauridæ*, and the two typical genera, representing the extremes of development of this order of reptiles.

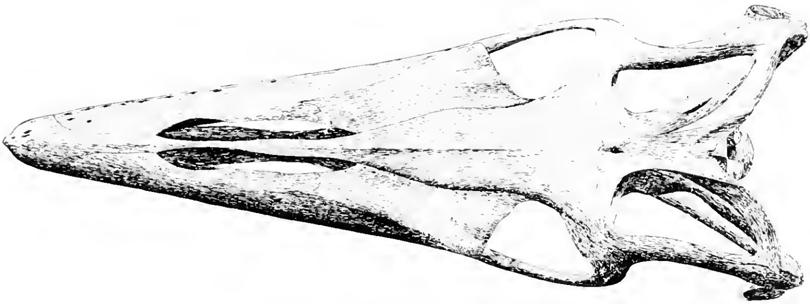
Mosasaurs are known to have existed in many parts of the world, New Zealand, North and South America, and Europe, the oldest being regarded as the New Zealand types, *Liodon* and *Taniwhasaurus*. Dollo thinks that New Zealand was the center of their irradiation, where they appeared in the end of the Cenomanian,* to appear in America in the Turonian,* whence they migrated to

* Subdivisions of the Cretaceous formation.

Europe and appeared in the Senonian,* and finally became extinct there in the Mæstrichtian.* They also have been reported from South America in the Purus * of the Amazon, corresponding to the Mæstrichtian * times. Professor Marsh's *Baptosaurus* appears to be the last of the American forms, found in the Upper Green Sand * of New Jersey and the Niobrara * of Kansas.

In this connection it is interesting to note the views of certain scientific men of the times in which these gigantic sea serpents existed.

The views of Prof. Frank C. Baker, curator of the Chicago Academy of Sciences, follow: "At the time the great sea lizards lived, North America was shaped something like the following: It



Top of Skull of Clidastes velox (Marsh).

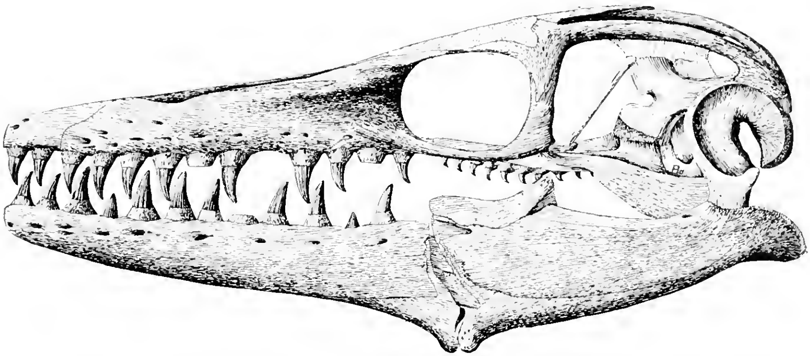
included all of northeastern Canada and Nova Scotia; the shore line was the same as at present as far as New York, where it was deflected to the southwest and went through the western part of New Jersey, Delaware, and Maryland, and then went directly across the middle of Alabama, north again to the mouth of the Ohio River where it meets the Mississippi River, then north into Iowa, and finally north and northwest across the United States and British America. Herein existed a great inland sea in which the sea lizards lived. The past history of the world tells us that thousands of animals of gigantic size lived in the ancient seas. In old Jurassic and Cretaceous times we had such queer combinations as *Ichthyosaurus* (or fish lizard) and *Plesiosaurus*. Not only were reptiles found in the water; they flew about in air. The latter were represented by the *Rhamphorynchus*, a birdlike reptile which had wings like a bat, teeth like an alligator, and the tail of a lizard. In the Connecticut Valley we find the footprints of huge reptiles in the red sandstones whose feet measured from those of a few inches in length to the footprints of the gigantic *Otozoum*, which measured twenty-two inches in length, having a step of some five feet."

* Subdivisions of the Cretaceous formation.

An immense amount of literature has been printed on the subject of the Cretaceous formation and its inhabitants. Very recently there have been immense advances made in the restoration of species existing in Cretaceous times. This article, therefore, is in the nature of scientific news, and a separation of facts from a mass of errors. In looking over the works of others, one is impressed by the many mistakes made by specialists, owing to imperfect skeletons and collections. A careful study of these errors has been made in the light of the latest skeletons reconstructed and the latest discoveries made.

The Kansas University, in securing three perfect type specimens of three genera of mosasaurs, presents three important items of scientific news. These skeletons teach us the errors and pitfalls into which specialists have fallen who lacked certain parts of the skeletons and filled out the gaps by aid of the imagination. Only recently the country was startled by the alleged discovery of the skeleton of a supposed reptile, having a length of two hundred and fifty feet. The newspapers gave startling pictures of the supposed appearance of this reptile while on earth. Professor Williston naturally wanted to see this gigantic animal, the largest ever discovered. On examination of its bones he saw at once that it was a whale. It can safely be asserted that no animal ever attained a length of two hundred and fifty feet. Perhaps as serious errors as this may be found in many of our text-books and monographs, due, of course, to former incomplete skeletons. The appearances of the skulls, the jaws, and the teeth have been painfully distorted in like publications and on charts in class rooms, and demand a thorough overhauling before our youth are further taught errors. With late complete discoveries, we have now exact appearances of the functions of the heads from which we can derive correct views. It was formerly thought that the eyes of the mosasaurs were directed upwardly; to-day it is known that they were directed laterally, as in living lizards. It has been supposed that mosasaurs attained a length of one hundred feet; no skeleton has been found which would show a length of more than fifty feet. The great majority of skeletons taken range from sixteen to twenty feet in length. It was formerly supposed that mosasaurs had the powers of running, springing, and climbing on land; it is now known that they were wholly confined to salt water, and merely climbed the beaches in order to lay eggs. It is not an easy step from mosasaurs to modern snakes; it is an utter impossibility. Professor Marsh formerly thought, and it has been taught in the class rooms, that the bodies of mosasaurs had bony scales; they had skins, and were scaled throughout like modern lizards and snakes. The *Rhamphorynchus* has been held up to us as a "lizardlike bird"; it was no more like a bird than is a bat; it was a birdlike reptile. These suggestions certainly point to the necessity of a revision of the text-books and charts in use in class rooms, which in many instances should become obsolete because of perfected restorations.

Specialists regard the marine saurians as having existed some millions of years ago. They conclude that these animals had at least a million years of existence in various forms. While it may be ventur-



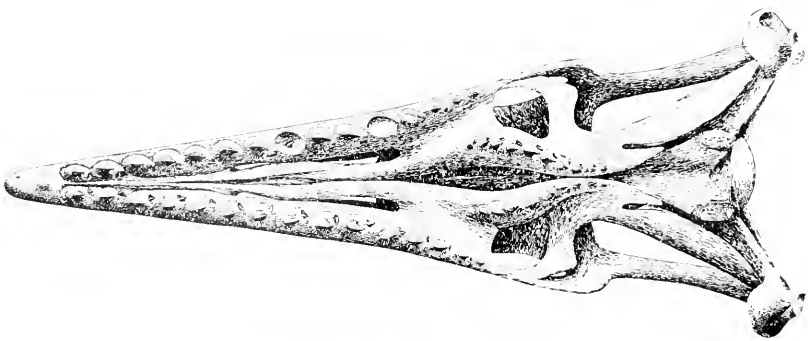
Skull of Platecarpus coryphæus (Cope).

ing into the domain of the encyclopædia to state the causes of these conclusions, a word here may not be out of place. The Cretaceous formation, in which the marine saurians are found, is of chalk, green sands, etc., and ranges in thickness from ten thousand to twenty thousand feet or more. It existed in the last part of the Mesozoic realm. From the thickness and position in geological strata scientists deduce its age and place in Nature. As the remains of marine saurians are found only in the Cretaceous deposits, specialists speak of them as existing several million years ago. At that time were numerous fishes, birds, reptiles, and plants.

On previous pages some remarks have been passed in reference to origin and distribution of the sea saurians. It may not be out of place to exploit further the evolution and sequence of other saurians existing before and contemporaneously with the salt-water group. To do so in a brief way presupposes that the reader has some general knowledge of the times in which these remarkable animals existed. The evolution of animal life can only be discussed in general terms, as completer skeletons are needed to determine the whole subject.

The duration of saurians extended from the Carboniferous period of the Palæozoic realm through the entire Mesozoic realm which followed. The original saurian, so far as discovery to date shows, was a cotylosaur, found in the coal measures of Ohio by the late Professor Cope. This ancestor, *Isodectes punctulatus* (Cope), was eight inches in length, resembling somewhat the farm-fence lizards of to-day. In the Permian era, closing the Pelæozoic realm, other cotylosaurs appeared in numbers, first of moderate size, then gradually increasing in bulk. Of these were the larger *Theromera*, such as the lizardlike *Dimetrodons*, some with forty-inch spines on their backs, and the shell-backed, lizardlike *Otocœlidæ*, the ancestors of the marine turtles (*Testudinata*), ranging from three to ten feet in length. The Mesozoic realm, following, was the most extraordinary period of earth for its forms of animal life. In its first section, the Triassic, the saurians that appeared assumed wide orders, functions, and greater proportions. These lizardlike saurians were termed *Palæoctonus*, *Ætosaurus*, *Dystrophaeus*, *Thecodontosaurus*, and *Palæohatteria*.

The Triassic, Jurassic, and Cretaceous formations, following, formed the most remarkable period of types of animal life. An examination shows that the marine Jurassic beds of Colorado were overlaid by a former fresh-water area, or lake, in which abounded iguanodons, megalosaurs, and cetiosaurs of diverse species, which swarmed in vast numbers and grew to gigantic proportions. The forests and jungles abounded in saurians which walked upon four legs and were so armed as to preserve peace while they fed on vegetation. The Cretaceous agathaumas resembled somewhat in form the rhinoceros, and the Jurassic stegosaur partook of the bulk of the elephant.



Under side of Skull of Tylosaurus proriger (Cope).

Agathaumas had a powerful skull, with two long horns over the eyes pointing upward and one over the nose pointing forward. The stegosaurs had a wonderful dermal armor of plates and spines arising along the spinal column. Such were the more specialized types of the forest. The plains and fields swarmed with saurians which ran or leaped on two hind legs and tail, tripod fashion, and whose fore limbs were used for seizing prey or supports. Those of the kangaroo type are represented by the Laramie Cretaceous *Lælaps incrassatus*

(Cope), which preyed upon the Western *Hadrosaurus mirabilis* (Leidy), and the Cretaceous *Lælaps aquilunguis* (Cope) of New Jersey, which preyed upon the Eastern *Hadrosaurus Foulkii*.

The lakes were infested with saurians which waded or swam, either or both. These types are represented only in the Jurassic. The *Amphicœlius altus* (Cope) was one of the largest of dinosaurs, which waded but never swam. It traveled mainly on the bottom of the lakes, raising its long neck and head occasionally to browse upon the overhanging branches, but never venturing ashore, where its weight would have caused a collapse of its structure. It doubtless could not swim. Amphibious and omnivorous, it ate everything edible it could reach or seize—a saurian in structure, everything in habits.

The Cretaceous ocean teemed with the serpentlike saurians which form the subject of this article. With the Mesozoic realm terminated the period of existence on earth of all the large saurians. In the following Cenozoic realm their successors appear in the diminutive saurians, snakes, and crocodiles.

PEACE AS A FACTOR IN SOCIAL AND POLITICAL REFORM.

By FRANKLIN SMITH.

ONLY by the application of an induction of Herbert Spencer, hardly less important and brilliant than his law of evolution, is it possible to introduce order into the complex and obscure phenomena of social and political life, and to distill from them trustworthy guidance for human conduct. In the light of the truth that out of the conflicts of war come one set of thoughts, feelings, and institutions, and out of the pursuits of peace come another set entirely different, the complexity and obscurity pass away. To the former we can trace with unerring certainty and precision the intolerance, brutality, dishonesty, and despotism that afflict the world; to the other, the enlightenment, forbearance, integrity, and freedom that give promise of a better day. But because of the flagrant disregard of this truth, not only by the ignorant and demagogic but by the literate and philanthropic, there is the gravest danger of a loss of the achievements of civilization and a restoration of the evils of barbarism.

I.

The facts in support of the militant origin of barbarism and the pacific origin of civilization, like the facts in support of any other induction of science, be it in physics or astronomy, are not new. They are to be found in every volume of history, whether ancient or modern, narrative or analytical, and when once pointed out thrust themselves into consciousness with resistless force. Not otherwise could it be. The historian that sought to transfer to his pages the phenomena of social and political life in any country or age could no more fail to contribute the data that enabled Mr. Spencer to frame his induction than the physicist and astronomer that contributed to Newton's great achievement. When he described a war, he had to describe the butchery, plunder, devastation, and degradation it entailed; he had to note the enlargement of the power of the monarch or oligarchy that carried it on with the most success. When he described the return of peace, he had to describe the revival of industry and prosperity; he had to note the impatience of the people under the restraints that the necessities of conflict always impose, the refinement of their feelings, manners, and tastes, the growth of their intelligence in depth and breadth. But only a mind unusually skilled in the art of interpretation could grasp the significance of these varied phenomena, and bind them with the indissoluble bond of an immutable law of social life.

Now that Mr. Spencer has done this memorable service for science, it is possible for minds of less power and originality to scan the pages of history, and to observe for themselves the play of the forces that make for barbarism. As they follow the path that he has blazed, they will see that nothing could be more obvious than the relation of cause and effect between the ravages of war and social degeneration. The very word war, which General Sherman once defined as hell itself, conjures up a picture of economic, social, and moral devastation that does not require the aid of poets or orators to heighten. The avowed object of this form of human activity is destruction pure and simple—destruction of property and destruction of life. The obvious corollary is the destruction of everything in the social fabric that conserves either life or property—freedom, honesty, virtue. Most vividly does Motley, who had no social theory to defend, bring out the truth in his story of one of the fearful raids of Alva in the Netherlands. "The page which records that victorious campaign," he says, speaking of the attack on Groningen at the opening of the struggle with Spain, "is foul with outrage and red with blood. Not one of the horrors which accompany the passage of hostile troops through a defenseless country was omitted. Maids and matrons were ravished in multitudes; old men butchered in cold blood. As Alva returned with the rear guard of his army, the whole sky was red with a constant conflagration; the very earth seemed changed to ashes. Every peasant's hovel, every farmer's house, every village upon the road had been burned to the ground." The histories of all the wars ever fought are only variations of the same hideous theme. However much they may be studied, they can not be forced to yield a profounder secret.

Out of the devotion of all the resources of society to the sole object of destruction spring momentous and far-reaching consequences. One of the most important and conspicuous is the creation of a powerful central authority to wield the resources of society, and the pursuit of a policy at home and abroad that shall insure the most effective use of those resources. Never was a war fought that did not bring into existence a strong executive, or make still stronger the executive already in existence. Troops must be raised and commanded; taxes must be levied and collected for their support; all needful political machinery must be created to facilitate both. Only one man, like Cæsar, Frederick the Great, or Napoleon, or a very small body of men like the Spartan ephors or the Venetian Council of Ten, aided by obedient subordinates, can do such work. It was in unconscious recognition of this fact that the liberty-loving Dutch, when hard beset by the forces of Spanish bigotry and despotism, turned instinctively to the Prince of Orange. Had he accepted and exercised the authority that they urged upon him, he would have been as autocratic as Philip II. In obedience to the same pitiless law of militant activity, the opponents of the despotism of Charles I fell under the despotism of Oliver Cromwell. That it has not ceased to operate in times much more recent, there is ample proof in the records of the civil war. By the stress of that conflict, Abraham Lincoln was forced to exercise an authority in shocking disregard of the principles of American freedom. Even the violence of the great strikes in the last few years has led to a strengthening of the hands of the executive that has evoked the severest criticism.

The law that despotism, like the destruction of life and property, is an invariable product of war, is as immutable as the law of gravitation or the persistence of force. It is as potent and universal in the interpretation of the phenomena to which it applies as either in the interpretation of the phenomena to which they apply. True of every age, of every country, of every people, it throws a light upon constitutional history that shines from no other quarter. Flooded by its powerful rays, the cause of the destruction of the Roman Republic and the establishment of the Roman Empire becomes a commonplace. The incessant wars of the Roman people could have produced no other effect. It is obvious, too, that feudal despotism was only the natural product of mediæval disorder. "Royalty," says Guizot, reaching out feebly after the law that Mr. Spencer alone has firmly grasped, "is admirably adapted to epochs of vigorous and fruitful anarchy . . . when society desires to form and regulate itself, without knowing how to do so by the free concord of individual wills." After the long and bloody wars of Charles V and Francis I, so quickly succeeded by the more ferocious and devastating wars of the Reformation, the universal extinction of freedom in Europe was inevitable. "The traditional liberties perish," says Guizot again, summing up the history of the period, "and new and more concentrated and regular powers arise." These powers were, of course, the powers of despotism—the powers that became most completely personified in Louis XIV. Hardly had they begun to yield to the emancipating influences of peace before the Napoleonic wars came to give them new life, and to fasten upon Europe a despotism that required the Reform Bill in England and the revolutionary movement on the continent to weaken and partly overthrow. But with the Crimean War and the other great contests that followed so quickly, there has been a return to despotism again, particularly in France and Germany.

Like a powerful poison, the despotism called into existence by war diffuses itself through every part of the social fabric. Upon the penalty of defeat or extinction, society must be so organized politically, industrially, and ecclesiastically as to enable the central authority to summon to its aid every resource with the least possible delay. The organization best adapted to this purpose is the organization of feudalism. At the head of the nation stands the despot himself; over each great division, a prince or duke; over the lesser divisions, the counts, viscounts, and barons; finally, there is the great mass of people, whose duty it is to provide without complaint or protest the soldiers that constitute the army and the means to sustain them in the field. Hence the quickness of the movements of Francis I compared with those of Charles V and Henry VIII. "Before his enemies were ready to execute any of their schemes," says Robertson, bringing out the superiority of a despotic organization of society over a condition of popular freedom, "Francis had assembled a numerous army. His authority over his own subjects was far greater than that which Charles and Henry had over theirs. They depended on their diets, their cortes, and their parliaments for money, which was usually granted them in small sums, very slowly and with much reluctance. The taxes he could impose were more considerable, and levied with greater dispatch; so that . . . he brought his armies into the field while they were only devising ways and means for raising theirs." What was true of the great struggle between these potentates is true of every other. The nation most perfectly organized, other things being equal, will be the most successful in war.

To war, therefore, and not to the wisdom of philanthropists, may be traced all those regulations of industry and commerce that have cursed and still curse every civilized nation. It was the author of customhouses, of cruel taxes, like the taille and gabelle, and of all the licenses and monopolies ever invented. While the plunder of enemies often contributes, as it did in the case of the Romans, to the military chests of a nation, it is upon the taxation of industry and commerce, a form of internal aggression always accompanying the external aggression, that the despot must depend for certain and definite revenues. To make sure that both are conducted in a manner most advantageous to himself as well as to his subjects, he assumes the right to regulate them. Since the exportation of commodities would diminish his own supplies and increase those of his enemies, he prohibits it; since their importation would drain his kingdom of the precious metals, indispensable in war, he prohibits that also. "Considering that our enemies might profit by our provisions and it is important to leave them their merchandise," said St. Louis, "we have ordered that the former shall not be exported nor the latter imported." Sometimes industries fall under the blight of royal protection because they provide commodities useful in war; sometimes, to make the state independent of supplies that might be cut off by war; sometimes, to establish monopolies to get the ready money required in war; sometimes, to stimulate production in order to make easier the burdens of war; sometimes, as was once proposed in France in regard to the silk industry, to prevent a form of toil that might unfit men for war. But whatever the regulation or the industry regulated, it is always war that gives the first impulse to this exercise of despotism, and the more a country is given up to war, the more despotic the regulations. It was so in Spain, where those of Charles V and his successors ruined industry; it was so in France, where those of Boyleau, Sully, and Colbert paralyzed industry; it was so in Germany, where the Great Elector and the other princes pursued the same ruinous policy. Only in England and Holland, where despotism throve the least, did industry thrive the most.

War also is the origin of those distinctions of society based, not upon character and ability, but upon occupation and birth. As long as it was the chief or only pursuit of man, it was the only calling of respect and honor. All other pursuits were more or less ignoble and debasing. Soldiers fight and die for their country. Only slaves work. Toilers, consequently, become objects of scorn and contempt. Not even philosophers were able to rise above the prejudices born of war. "Nature," said Plato, describing the inhabitants of his ideal republic, "made neither shoemakers nor blacksmiths. Such occupations degrade the people that engage in them. . . . As to tradesmen, accustomed to lie and deceive, they will be suffered . . . only as a necessary evil." In the opinion of Xenophon, "the manual arts are infamous and unworthy of the citizen." Cicero believed commerce to be "a sordid affair, when it is of little consequence," and "only tolerable at best, when conducted on a large scale and to supply the country with provisions." Despite the maxim of the monks, *Laborare est orare*, the same vicious views prevailed during the middle ages. In the militant countries of to-day, especially Russia and Germany, they have hardly begun to pass away. But the forces that operate to divide a nation into warriors and workers operate also to divide each into other classes. Not only is there a hierarchy of the nobility, but also an ecclesiastical and industrial hierarchy. If we have princes, dukes, counts, and barons, we have cardinals, bishops, canons, and the minor clergy. Above the slaves and serfs there are various trade and professional guilds, where pride of occupation seeks to make hereditary the barriers it has raised. To emphasize these distinctions in state, church, and industry, to enable the members of one class to observe the deference due the members of another, titles, costumes, decorations, and the other insignia of rank are invented and made obligatory by law.

The despotism that cramps and paralyzes social activity, cramps and paralyzes intellectual activity. In the first place, the necessities of war make it impossible as well as useless to give thought to matters that do not contribute to success in battle.* Therefore, the Spartans had neither literature nor philosophy—neither science nor art. Pursuit of these subjects was effeminate; it unfitted men for the better business of fighting. "Instruction in the sciences," said the barbarians that conquered Rome, anticipating a favorite opinion

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* Did space permit, it would be pertinent to show at some length how war diverts attention from all subjects not related to it, and how, even when it does not divert attention from them, it colors them. But any student of sociology will discover abundant proof of this truth in the phenomena growing out of the war with Spain. Take, for example, the New York Evening Post of Saturday, May 7th, a newspaper that was opposed to the war in its inception and does not favor it now. But it has been forced to yield to the war spirit to such an extent that of the four leading articles on the first page of the supplement, especially designed for general family reading, three relate to war. On the second of the news pages will be found another long article on "the signs of its (war's) permeation of city life," showing how even "confectionery and embroidery (are) affected." On the editorial page will be found still another article on War Books, showing in like manner that the effect of the war on the publishing business "is depressing," and that while "books old and new about Spain and Cuba, about strategy, and the navy and sea power, manuals for the naval reserve, works on tactics are firm to higher, as the market reports say," "*belles-lettres*, criticism, history, essays, even the novel, are flat and weak, if not stale and unprofitable." Indeed, the student will find in the phenomena in question, including the bitterest intolerance and a startling perversion of the moral sentiments in regard to the taking of life and property, a complete verification of all the principles that I have set forth in this section of my article.

of Old Fritz of Prussia, "tends to corrupt, enervate, and depress the mind. He who has been accustomed to tremble under the rod of the pedagogue will never look on the sword or spear with an undaunted eye." In the second place, the pursuit of studies and the growth of beliefs not in conformity with those in honor with the central authority, would provoke discord, and, as in the case of Charles V and Henry VIII, make it more difficult to mobilize and wield effectively against an enemy the resources of society. Not only must the political opinions of subjects be those of the monarch, but there must be adhesion also to his religious beliefs. That was the contention, for example, of Philip II and Louis XIV. To dissent from them was to be guilty of treason; it was to merit death. Hence the paralysis of the French and Spanish intellects that Buckle describes. Hence the rigid censorship that prevails to-day in Germany and Russia and also in Turkey and Persia. It was war, therefore, not religion, that produced Torquemada and the Inquisition, that led to the massacre of St. Bartholomew, the persecution of the Dutch, the extinction of the Albigenses, and the perpetration of all the other crimes committed in the name of Christianity. The same truth explains also the check to Protestantism after the outbreak of the wars of the Reformation and the revival of Catholicism in all the countries that remained loyal to Rome. When we remember that war is the parent of despotism, and despotism the parent of intolerance, we can understand, too, why Protestantism repudiated its allegiance to the principle of private judgment, and like its rival resorted to the rack and fagot to keep the minds of men in subjection.

"I should be content," said Frederick the Great during the most trying period of the Seven Years' War, giving a clew to the origin of the moral evils of society, "if I could only first inflict a part of the misery I endure." Since the first object of war is destruction of life and property, anything that promotes this end is right. Indeed, it is not only right, but it is noble. "They boast," says Ammianus Marcellinus, alluding to the Huns, "with the utmost exultation of the number of enemies they have slain, and as the most glorious of all ornaments they fasten the scalps of those who have fallen by their hands to the trappings of their horses." If enemies can be deceived by false statements or sham movements and lured into a trap for easier and safer slaughter, it should be done. If they become prisoners, they should be killed or enslaved. If their wives or daughters are ravished or consigned to a harem, it is only an exercise of legitimate rights over the persons of the conquered. If their property can not be carried away and its further use in resistance to attack prevented, it should be burned. "The northern invaders," says Macaulay, describing the condition of the Italians during the invasions of the French, Spanish, and German armies, "had brought want to their boards, infamy to their beds, fire to their roofs, and the knife to their throats." But there was never a people that practiced the ethics of war against their enemies that did not practice the same code against themselves. The members of the upper classes prey upon the members of the lower, and the members of each class prey upon one another. Everywhere there are deceit, baseness, cruelty, and every crime of violence. "No language," says Draper, speaking of the condition of Rome, "can describe the state of that capital after the civil wars. . . . The social fabric was a festering mass of rottenness. The people had become a populace; the aristocracy was demoniac; the city was hell. No crime that the annals of human wickedness can show was left unperpetrated—remorseless murders; the betrayal of parents, husbands, wives, friends; poisoning reduced to a system; adultery degenerating into incest, and crimes that can not be written." But a like demoralization was the fruit of the civil war in England and the long wars in France, Germany, and Italy. It is not, therefore, at the door of Adam but at the door of Mars that the sins of the world are to be placed; they are not due to the fall in Eden but to the plunder and murder on the field of battle.

II.

Thus far I have indicated how war leads directly, inevitably, and invariably to despotism in government, ignorance and intolerance in political and religious thought, and crime and degradation in social life. Let me turn to the fruits of peace, which include all that constitutes civilization. The connection between the two is likewise direct, inevitable, and invariable. Wherever peace stays the hand of destruction and resumes the work of creation, forces are put in operation that transform the thoughts and feelings as completely as they transform the pursuits, manners, and institutions of men. Released from the burdens and insecurity of war, society, like a body delivered from the fever and waste of disease, revives and grows strong. Industries flourish. Pressing against the cords with which the state and church have bound them, they pant and struggle for freedom. The mind responds also to the new life. Becoming enlarged with the enlargement of its activities, it refuses to submit to the bondage in which political and ecclesiastical despotism has placed it. It insists upon exploring every nook and corner of the universe and bringing to light every discovery. It rejects traditions and superstitions, and proceeds to construct the splendid edifice known as modern science. At the same time, it manifests its joy in creations of the imagination—poetry, music, painting, sculpture, architecture. These pursuits of peace introduce new relations among men. Industry and commerce make it necessary for them to approach one another, not with a dirk or spear, but with the hand and look of welcome and friendship. Thus manners become more gentle, and feelings more sympathetic. There is a better recognition of rights and obligations. With a better recognition of rights and obligations pass away the slavery, deceit, vice, crime, and other evils that war engenders.

Like the deductions from the ruin of war, these deductions from the recuperation of peace have the sanction of historians that never heard of Mr. Spencer's social philosophy. "It is with human activity as with the fecundity of the earth," says Guizot. "With the least glimpse of order and peace, man takes hope, and with hope goes to work. It was thus with the towns," he adds, alluding to the diminution of anarchy that came with the establishment of feudalism. "The moment that feudalism was a little fixed, new wants sprang up among the fief-holders, a certain taste for progress and amelioration; to supply this want, a little commerce and industry appeared in the towns of their domain; riches and population returned to them; slowly, it is true, but still they returned." Robertson makes a similar contribution to the pacific origin of civilization. "Commerce," he says in his famous view of Europe before the reign of Charles V, "tends to wear off those prejudices which maintain distinctions and animosity between nations. It softens and polishes the manners of men. It unites them by one of the strongest of all ties, the desire of supplying their mutual wants. It disposes them to peace by establishing in every state an order of citizens bound by their interests to be guardians of public tranquillity. As soon as the commercial spirit acquires vigor and begins to gain an ascendant in any society, we discover a new genius in its policy, its wars, its alliances, and its negotiations. . . . In proportion as commerce made its way into the different countries of Europe, they successively turned their attention to those objects and adopted those manners which occupy and distinguish polished nations."

An appeal to the facts of history that led Guizot and Robertson, as well as other writers ignorant of Mr. Spencer's social philosophy, to these important inductions does not impair their validity; it only strengthens them and makes them the more impregnable. Wherever peace can find a refuge from the violence and uncertainty of war, industry and commerce take root and work their miracles. No matter whether it find protection on the slopes or in the valleys of mountains, among the sand dunes or in the marshes of the sea, behind the walls of a city or away from the path of marauding invaders, the result is the same—civilization. Had not the Dutch been able to escape from the anarchy beyond the borders of their barren and inhospitable land at the mouth of the Rhine and the Scheldt, no Motley would have had occasion to write the history of their immortal republic. It was because the Alps furnished protection from the barbarians that plundered the adjacent countries that the Swiss became famous in the history of freedom. But for the lagoons of the Adriatic barring the advance of foot and horse, the world would never have heard of the Venetians, who maintained their state for more than a thousand years. The populations in all the countries of Europe, especially those of northern Italy, where modern civilization made its earliest and most glorious conquests, that were able to raise a wall against the floods of disorder that raged about them, soon passed from the shadows of barbarism, and only returned to them again because of the ferocity of political dissensions and the devastation and degradation of war. In southern France, where Roman civilization suffered least from the inroads of the barbarians, the people became much more enlightened and civilized than in northern France, where it suffered most. The energies of the northern boroughs were devoted to a struggle with feudalism, and, as a consequence, municipal freedom and civilization made little headway. Those of the southern were devoted, to use the words of Guizot, to "internal organization, amelioration, and progress." The inhabitants thought only of establishing "independent republics."

As here implied, peace is the progenitor of political freedom. It destroyed the monopoly of power enjoyed first by the one and later by the few, and conferred upon the many a voice in the control of their lives and property. The pacific states of antiquity were free states —Athens, Corinth, Rhodes, and Carthage. The industrial populations that escaped the anarchy of the middle ages were also free. When war ceases to be the main business of life, there is a relaxation of the bonds of despotism. They are not required to resist aggression nor to promote it. By useless and vexatious regulations they interfere with production and exchange. Moreover, a people trained to the management of their private enterprises, learn to manage public enterprises and demand a share in the work. The genius shown by the Dutch in the art of self-government was acquired during the centuries that they were left to themselves and their industries. The charters granted to them by their rulers conceded nothing new; they confirmed only the prescriptive rights and privileges evolved from industrial needs. The free governments of Venice, Barcelona, and other industrial cities of Europe, particularly those of the famous Hanseatic League, had a similar origin. "The cities are the work of the traders," says M. Pirenne, an eminent Belgian scholar; "they exist only because of them. Whether of Roman or non-Roman origin, seat of a bishop, monastery, or castle, free or subject to the law of the demesne, they began to acquire a municipal organization only at the moment when, along with the primitive population, a foreign population became established that maintained itself by industry and commerce." Because of the absence of the fighting populations of Europe during the Crusades, the pacific and industrial populations left behind gained the strength and wealth that enabled them to break the chains of feudal despotism, and to purchase the liberties that make the fourteenth and fifteenth centuries the gateways to modern civilization. It was after the slow recovery from the devastating wars of the sixteenth and seventeenth centuries that the agitation in behalf of freedom ended in the terrific explosion of the French Revolution and the restoration of the rule of the despots. Again, it was after the long peace following the Napoleonic wars that the agitation was renewed, and, in England, led to the passage of the Reform Bill, and, on the Continent, to the demand for popular constitutions.

Peace is also the progenitor of intellectual freedom. The forces that shattered the despotism of the autocrat and aristocrat shattered the despotism of the ecclesiastic. Since the power of the latter grew out of the same conditions that produced the power of the former, the establishment of the new conditions was certain to be fatal to both alike. As soon as men began to think and act for themselves in industrial matters, they began to think and act for themselves in ecclesiastical as well as political matters. Accordingly, we find everywhere that the revolt against the church as well as the state started in the industrial centers. "In European history," says Thorold Rogers, "discontent with existing religious institutions and the acceptance of heresy on speculative topics have always been characteristic of manufacturing regions. It was the case in Toulouse in southern France, in Flanders, in eastern England. The French Huguenots were the manufacturers and merchants of the country in the seventeenth century, and when they were expelled carried with them their skill and capital. Only Italy is an exception," he adds, "and Italy profited so greatly by the papacy that it was not disposed to quarrel with the institution, although it had no love for the representative of it." The era of comparative peace that began with the establishment of feudalism and the opening of the Crusades and ended with the conflicts between Charles V and Francis I gave a powerful impulse to industry and commerce, and these again to the human intellect. Without the cessation of the anarchy that followed the downfall of Rome, the awakening of the minds of men that flowered in the Renaissance and the Reformation would not have been possible. But before they could gain their freedom, the mediæval conception of the duty of the individual toward the political and ecclesiastical powers, intertwined almost inextricably, had to be overthrown. All the theories of Nature and society, all the absurd and hideous superstitions that disgraced the mediæval intellect, had to be modified or destroyed. To prevent such a revolution, which was certain not only to wipe out the moral abuses but to reduce the enormous power and revenue of the state and church, the fiercest conflict of modern times was precipitated. Although the battle was a drawn one and brought about a reversion to intellectual and political despotism, the human mind was not destined to be reduced to its old enslavement. It had made acquisitions in freedom and knowledge that subsequent wars, subversive as they were, could not take away.

The social revolution that accompanied the action of the forces set in operation by peace and industry was as great and far-reaching as the political and intellectual. It swept away that vast, complicated, and artificial system of class distinctions that prevailed in every feudal country. Birth ceased to be the only title to rank, and the profession of the soldier the only profession of a gentleman. The creation of wealth outside of land, which was the only form of property that could not be destroyed or carried away, brought a new standard of social worth into the world. Other pursuits besides the noble one of murder and pillage established a claim to social consideration. Men of character and ability engaged in industrial and professional occupations began to rank with the warrior and noble. Merchants, bankers, and lawyers that rose to wealth and eminence received the same honors that were bestowed upon men that won renown on the field of battle. Like the Fuggers in Germany and Jacques Cœur and Jean Ango in France, they became the friends and confidants of kings and princes. "Louis XI, like Charles VIII," says Pigeonneau, "surrounded himself with men of the middle class; he knew that they had more special knowledge, more docility, more fidelity, 'because they could not outrank him.'" So great was the esteem in which industrial pursuits were held in the Netherlands that even Philip II created the Order of the Golden Fleece to reward the men that had achieved eminence in them. Alarmed at the havoc that industrialism was working with the social hierarchy in France, the Duc de Sully, the chief minister of Henry IV, complained that "the confusion of ranks" and "the degradation of people of quality" were among the evils that endangered the monarchy. As early as the reign of Francis I, which had been preceded by the great outburst of national prosperity that followed the close of the Hundred Years' War, a similar complaint had been made. "Because of the opulence and peace that prevail in France," says a writer of the time, "the pride of all classes has increased more and more. . . . The bourgeois of the cities, both men and women, insist upon dressing like noblemen and ladies, noblemen as sumptuously as princes, and the inhabitants of the village like the bourgeois of the city." To prevent the political catastrophe involved in such a dangerous "confusion of ranks," very stringent sumptuary laws were enacted. But they were all in vain. The progress of peace and industry has wiped them out. In democratic countries like the United States, character and ability are the test of social worth, and the establishment of this test has abolished those distinctions of dress so important to the feudal mind.

If war makes ethical every act of destruction, peace makes ethical only acts in conservation of life and property. When men stop killing one another and undertake to supply one another's wants, a new code of morality begins to influence their conduct. As commerce brings people in contact with foreign nations, especially those known as heathen, a relaxation of religious and national prejudice occurs. Opposition to war against them springs up. Friendly relations are advocated. A grave charge brought against the Venetians, whose intercourse with other nations had made them enlightened and humane, was that they tolerated the Jews, obstructed one of the Crusades, and deprecated attacks upon the Mohammedans. A further step toward civilization is the advent of international agreements to prevent disputes and thus forestall conflicts. Here the pacific nations were the pioneers. The earliest commercial treaties extant are those of industrial Carthage with Rome. The first codifications of trade regulations were those of industrial Rhodes and Barcelona. The study of international law itself received its greatest impulse in industrial Holland. With the diminution of aggressions abroad and the growth of international jurisprudence occurred a diminution of aggressions at home and the growth of domestic jurisprudence. Courts were organized for the settlement of disputes and the punishment of crime. Here, again, the pacific nations were the pioneers. Hallam cites the significant fact that judicial combat never prevailed in England to the extent it did on the Continent. After saying that the moment a man entered the gates of one of the Italian republics of the twelfth century "he might reckon with a certainty on finding good faith in treaties and negotiations," Sismondi adds that he might also reckon upon "an energy in the people to resist by common exertion every act of injustice and violence." The militant nations were the last to abolish slavery and serfdom, and also judicial torture and the burning of witches and heretics. They were the last to cultivate commercial honor, personal purity, and the other virtues of a pacific life. Although the Dutch were often obliged during their terrific struggle with the Spaniards to raise large sums of money at a heavy discount, they never repudiated, as did Queen Elizabeth and Philip II, a single obligation. While the Jews were most cruelly persecuted by the militant exemplars of piety elsewhere, they welcomed them. Like Athens before her degradation by war, they welcomed also every alien laborer and every product of alien industry. Protection of their own industries was a form of foreign and domestic aggression to which they never resorted in the hour of their direst needs. Among them the relations of the sexes offered the most striking contrast with those of Prussia, Italy, France, and Spain of the same period. "They hold adultery in horror," says Guicciardini. "Their women are exceedingly circumspect, and are constantly allowed much freedom. They go alone to make visits, and even journeys, without evil report." It was in industrial Holland that labor received its most generous reward, and the poor and sick their most solicitous care; it was there, too, that crime was the most rare and its punishment the most humane. Her prisons are described as more like schools than jails, and their inmates as oftener foreigners than natives. It was, finally, of this wonderful creation of peace and honest toil that Thorold Rogers said that "the debt which civilization and liberty owes" to her "is greater than that which is due to any other race."

III.

Setting forth the business of physical science, Prof. Ernst Mach says: "It endeavors by comprehensive and thorough description to make the waiting for new experience unnecessary; it seeks to save us the trouble of experimentation by making use . . . of the known interdependence of phenomena, according to which, if one kind of event occurs, we may be sure beforehand that a certain other event will occur." That is precisely the business of social science. Only as it serves that purpose has it any title to the name it bears, or any value as a guide to human conduct. By a study of social phenomena, it seeks to discover their interdependence, and then to frame such a comprehensive statement of that interdependence as to permit without further study or experiment the prediction of the results of any dominant form of social activity. But such a statement is to be found in the induction of Mr. Spencer that if the dominant activity of society be militant, the thoughts, feelings, and institutions of men will be those of barbarism; if it be pacific, they will be those of civilization; or, if there be a commingling of the two, as is now the case in Europe and America, they will be a compromise. That is to say, in proportion as society is militant or pacific, in precisely that degree will there be freedom or despotism, honesty or dishonesty, humanity or inhumanity, morality or immorality. As I have shown, no part of society is exempt from this law. Whatever the character of the forces in operation, they will govern all classes alike; they will govern them despite the precepts of moralists, pedagogic or ecclesiastic, or the regulations of despots, autocratic or democratic.

However closely history may be interrogated, it can not be made to disclose a truth more profound or important. Yet it is one not only seldom admitted but constantly violated. With amazing perversity, social reformers close their eyes to the significance of the fact that the dominance of pacific activity since the days of mediæval disorder has slowly brought about, without particular effort on their part and often in spite of them, the social and political ameliorations that now exist. Scornful of science and impatient of delay, they refuse to act upon the commonplace that human society in the future is to be bettered in no other way than it has been in the past. Hence they do not attempt to promote the growth of the free industrial institutions of peace that have lifted society to its present level. On the contrary, they strive to promote the growth of the discredited institutions of political despotism. What the result of this policy will be requires neither experiment nor experience to tell. The law of social science, whose operation I have attempted to illustrate, warrants the prediction that it will be disastrous. For, differing in degree, not in kind, the aggressions of government are as vicious and destructive as the aggressions of conflict. Be the motive ever so noble, not the smallest sum can be taken from a man for an object he does not approve without the commission of an act as repugnant to justice as the theft of a marauder. Nor can he be forced to take the shortest step from a line of conduct, not because it violates the rights of his neighbors but because it fails to accord with their notions of duty, without enslavement. Neither can the political contests made necessary by this aggression be carried on without the discipline of an army and the ethics of devastation. When, therefore, it is proposed to revive the institutions of feudalism, the products of war, to add to the wealth and happiness of men, the products of peace, only a return to the evils that have never failed to impoverish and degrade them can possibly occur.

But the extension of the free industrial institutions of peace threatens no such disaster. They involve no aggression; they permit neither theft nor enslavement. Being voluntary organizations to which a man may belong or not, just as tastes and interests incline him, he is not forced to part with his property except in one of the ways that must prevail in all societies truly civilized—namely, by gift or contract. Although membership of an organization, no matter what it be, requires a surrender of freedom to a greater or less extent, it is not compulsory, and the rights surrendered may be resumed at any moment. Under the *régime* of such institutions, the object of social activity is not, I repeat, the destruction but the conservation of life and property. The man seeking to supply his own wants can do so most effectively only as he supplies the wants of his fellows—that is to say, in striving for his own happiness, he must, in spite of greed or indifference, aid in their attainment to the same state of content. But the prevalence of misery about him tends to pain him as it does its victims, and only as he helps them to escape it can he do so himself. Therefore, the very necessities of existence do not simply constrain him to undertake in the myriad forms of industrial enterprise what will contribute most powerfully to his own happiness, they constrain him also to undertake in the myriad forms of charitable enterprise what will alleviate most perfectly the sufferings of those less fortunate than himself. Thus, while peace and industry compel the abandonment of every vice that leads to barbarism, they compel the observance of every virtue that leads to civilization.

What the duty of people is must now be as plain as it is simple. They should set their faces resolutely against any extension of the authority of the state. With all the strength at their command they should work to abridge as much as possible the authority with which it has already been wrongfully intrusted. Only by voluntary effort, such as is exhibited in every private industrial and charitable enterprise ever undertaken, should they attempt a solution of the problems of life. No one then will be called upon to surrender without his consent either his property or his freedom.

Among the extracts from the diary of Sir Andrew Crombie Ramsay, given in Sir Archibald Geikie's Memoir, is this pretty picture of a group of famous men of science at play. Ramsay was at Darwin's, and the others were his fellow-guests: "Rose betimes, had a walk in the gardens, and came in to breakfast. . . . After lunch, Forbes, Owen, Lyell, and I had a walk in Sir John Lubbock's park, and saw a number of things pleasant to look upon, in spite of a tendency to drizzling. Nice, cozy chat, too, before dinner. Darwin is an enviable man—a pleasant place, a nice wife, a nice family, station neither too high nor too low, a good moderate fortune, and the command of his own time. After tea Mrs. Darwin and one of her sisters played some of Mendelssohn's duets, etc., all very charming. I never enjoyed myself more. Forbes came to my room before going to bed and gave me a sketch of his coming lecture on generic centers. Lyell is a much more amusing man than I gave him credit for. Mrs. Lyell is a charming person—pretty, and full of faith in and admiring her husband. Mr. and Mrs. Lyell told some capital stories about America, but on the whole all tending to the honor of America. He is quite enthusiastic about it, especially in all that relates to the liberal spirit of the New Englanders. Boston seems to be in all the world his favorite city."

LITERATURE OF THE AFRICAN NEGROES.*

By M. MURET.

THE researches of students of folklore in Africa have been directed to all branches of popular literature, and a rich collection has already been accumulated of proverbs, enigmas, songs, national legends, religious traditions, stories, animal fables, and other works. The literary merit of all this production is not very great, but it is interesting in that it exhibits certain peculiarities in character. Proverbs are especially noteworthy in this respect. They express general and simple ideas in concise form, under familiar figures, and truly represent the first instinctive effort of man in search of a literary language. The thoughts revealed in these proverbs indicate a state of mind in the blacks quite similar to ours, while the greater part of them find their counterparts in the proverbs of other races. For example, there is a saying of a tribe of the Bantu, "He who goes into a strange country will not sing a solo but a chorus," which corresponds with the European, "He who goes with the wolf will learn to howl," or, "When you are in Rome, do as the Romans do," and nearly with the Mussulman Arabian, "If you find yourself in a country where they worship a calf, pull grass and feed it." The English and French say, "God tempers the wind to the shorn lamb"; and the people of Nupe, where the ox has no tail, "God keeps the flies away from it." We say, "Don't sell the skin of the bear before you have killed it"; the Suaheli, "Don't cut the gown before the child is born." While speaking of the Suaheli we may mention one of their adages that is full of sadness and resignation: "The poor man's hen lays no eggs; if she lays them, she does not sit on them; if she sits on them, they do not hatch; and if chickens are hatched, the hawk catches them."

It is sometimes said that slavery, polygamy, and the custom of purchasing the wife have destroyed the family feeling among the negroes. The following proverbs of the Suaheli prove that this affirmation is too absolute: "Thy mother is thy second God"; "A son, even if he be deformed, is the joy of his parents"; "Who is not willing to hear his son cry will cry himself." The enigmas or riddles of the negroes are simple, like these, among many, which have been collected by the German missionaries at Hohenfriedberg, in Usambara: "There! there it is! catch it! What is it?" (answer, "The shadow"); "What house has no door?" (answer, "An egg"). Sometimes, however, riddles are presented in such an allegorical form as to become fables, like the following, which an English writer

* From an article in the Bibliothèque Universelle et Revue Suisse.

obtained from the Zulus, and which resembles Menenius Agrippa's famous apologue: "Guess this: A person is invested with the functions of a king. He does nothing; his people work for his profit, while he continues idle. He tells them what they have to do, since he sees for them. It is he who directs them to where there is something to eat, then his people bring the food to the house; but he himself does nothing; he remains the sovereign, and only deigns to help his subjects. One day they rebelled. They came to the king and said: 'You ought not to be our sovereign and to be doing nothing; we do not feel any good from your power.' He answered: 'Very well; since you will not have me for your king, I will be still and look on the ground, and it will not be long before you find out that I am indeed your king; you will fall over precipices, you will be eaten up by wild beasts, and you will starve to death because you can not find anything to eat. You will go blind if you try to fight against me.'

"Then the rebels saw indeed that he was a sovereign if he could talk that way. And they said: 'We will recognize you as our ruler so that we may live, since, if we starve to death, the royal majesty we claim for ourselves will do us no good. A man is no king if he is not alive.' So he was recognized as sovereign by all the country, and his kingdom was happy.

"He was a person who never worked, and always stayed at home. If he fell sick, all his people were in danger of starving; nobody left his house, for fear of falling into a pit; every one prayed for the recovery of the monarch, and rejoiced when he was well."

The answer to the riddle is, "*The eye.*"

Songs are abundant among the blacks, and fill partly the functions of the Greek comedies in the time of Aristophanes and of newspapers in modern states. They denounce suspected persons, glorify victorious soldiers, and abuse the enemies of the country. Sometimes the singers improvise variants and celebrate the praises of their hearers, but this very rarely happens with respect to the whites, for the negroes generally cherish a great aversion against them, and they apply satirical verses to Europeans. For example, a Hottentot pupil ridiculed his European master: "O son of a little woman—who never had milk enough—you were sent among us! The white man first examines carefully the place where he is going to sit—and only then helps you. Oh, the little man—son of a little woman—our people are sons of lions."

The songs vary much in construction according to the tribe. They consist of strophes and are generally rhymed. Among some peoples, however, the ear is gratified with a simple assonance. The musical sense is much developed among the blacks, and a European who hears their music for the first time is annoyed, but as he becomes accustomed to it he enjoys it. Bishop Steere says that the music of a very popular song among the Suahelis resembles that of the Gregorian chants.

While the proverbs and the riddles are generally too truthful in expression to let the personality of the authors be seen in them, in the songs, on the other hand, the man appears behind his work; he relates by preference adventures in which he has been the hero—victories over his enemies or great successes in hunting.

Sometimes the author gives a pompous eulogy of himself; and even when he sings the praises of the lady of his heart he begins with proclaiming that he is no less a brave champion than an excellent poet, and declares himself ready to defend his double reputation in single combat. He takes the part of one or another of the personages he puts in the scene, and makes personal observations of his own concerning their conduct—as, for example, in mentioning some horrible crime, he says, "So it is told, but it is hard to believe that the story of such a crime can be true."

The higher classes of the blacks, as the caste of the Magi, or of the doctors and noble families from whom the members of the government are chosen, are jealous custodians of the history of the tribe and its cosmological traditions. These cosmological myths, in which are unfolded the origin of the universe, the creation of man, the entrance of death into the world, the alternations of the seasons, and other natural phenomena, undoubtedly date from a very remote antiquity; it is not certain that they have always existed in the same form they have now, but it is probable, from the veneration with which they are regarded, that they have been preserved substantially intact. They confirm the opinion that primitive mankind had a common fund of ideas which varied very little in different places; and, indeed, the mythological representations of the negroes may often lead us back to a prototype which is also that of similar representations among the Aryan peoples.

The Timmi, for example, have a giant who resembles the Atlas of our mythology. He has to sustain the earth, which is disk-shaped. In the long course of the bearing of this burden the head of the giant and the earth have become one body; the grass which we tread upon and the trees that cover us with their shade are the hair of the giant; and the animals of every kind are the unwelcome guests of his hair. When the giant, tired of standing all the time in the same position, turns quickly, there is an earthquake. The traditions of the Timmi, like those of the Judæo-Christians, teach that evil and death came into the world in consequence of the sin of one man, while there was nothing terrible in the matter at first.

God permitted man to remain on the earth seven or eight hundred years. Then he sent one of his servants to warn him to prepare to go. The man took leave of his family, and serenely started on the journey to the other world. The legends which give the explanation of natural phenomena are, as may be imagined, extremely ingenious. Take, for instance, the Suahelian account of the ebb and flow of the tides: "An enormous fish, named Keva, lives under the sea; a great rock stands upon its back, and upon this an enormous ox with sixty thousand horns and forty thousand legs. His feet are planted on the rock, his nose rests upon the water, his hair sustains the earth. The animal breathes once a day, and as the volume of his body increases with his inspirations and diminishes with his expirations, so the level of the sea rises and falls."

African literature is very rich in fables of animals, which may be divided into the two categories of moral apologues and simple narrations. In the former such an identity is noticeable with stories of the peoples of Asia and Europe as almost to cause us to think that both proceed from a common source whence they were drawn in prehistoric times. To this may, however, be opposed the hypothesis of an original and simultaneous origin in different places; a question for the discussion of which we have not yet all the elements. One of the most brilliant of the African apologues comes from Somaliland, and is perhaps better than the corresponding European fable: "The lion, the hyena, and the fox went a-hunting, and caught a sheep. The lion said, 'Let us divide the prey.' The hyena said, 'I will take the hinder parts, the lion the fore parts, and the fox can have the feet and entrails.' Then the lion struck the hyena on the head so hard that one of his eyes fell out, then turned to the fox and said, 'Now you divide it.' 'The head, the intestines, and the feet are for the hyena and me; all the rest belongs to the lion.' 'Who taught you to judge in that way?' asked the lion. The fox answered, 'The hyena's eye."

In the second category of animal stories no hidden moral is proposed, but adventures are related corresponding to the character of the animals to which they are attributed. In Africa, as in Europe, the principal cycle is formed of what is called the Romance of the Fox; only there is no complete epic, but merely a number of isolated anecdotes, in which the hero is usually the fox, but sometimes the jackal, the hare, or the rabbit.

In the fables of the Hottentot tribe of the Nama, the jackal is directly glorified as a national hero, as the incarnation of the race of the Nama, and by his astuteness overcomes all his adversaries, first among which are the wolf and the "man of the white race." It is in place to observe here that when the primitive versions of the fox romance began to be current in Europe, the fox, with his thievery, was odious to those peoples which, like the Germans, held brute force in high esteem. To call a man Reynard was regarded among the Franks as a grave offense, to which the Salic law attached a severe penalty. The negroes of Africa, on the other hand, set astuteness away above force. This idea dominates in all their literary production with which we are acquainted; and this confirms the assertions of travelers, who agree in saying that the Africans, when they try to get rid of their enemies, use force only when cunning fails. Herr Olpp cites the following fable of the tribe of the Nama: "It came to pass one day that the jackal, having made away with some object, fell into the hands of the white man. He was carefully bound and condemned to death. Then the jackal asked his judges, 'How do white men perform executions?' They answered, 'We beat the culprits to death with clubs.' The jackal replied: 'It is a very poor way of putting people to death; take my advice: when you want to put anybody to death, begin by making him eat tallow and fat; then grease him outside, and make a fire on a rock; take him by the tail and throw him into the fire.' The white men did as the jackal had told them, but their hands slipped on his skin, and he escaped. Thereupon the dogs chased him, and the fugitive had barely time to get into a cave. The white men, who had come up, stuck their hands into the hole, and one of them took the jackal by the tail and called out, 'We have got you, we have got you!' The jackal said, 'Oh no, my friends, you have not got me, but a root.' The white man holding on to the tail answered, 'No, it is you.' The jackal answered: 'I tell you it is not me. Get a sharp stone and then come back and cut what you have in your hand. You will see that it is a root.' The white man ran to get a stone, and the jackal went farther into the cave. So he saved his life."

This very succinct summary of the researches of the students of folklore of the African school may go to show that thought does not abound in the traditions of the negro tribes; the few flowers that are found here and there form only a very poor garland. —*Translated for the Popular Science Monthly from Minerva (Rome).*

DESCRIBING to the London Physical Society his observations on the Peak of Teneriffe, Prof. T. C. Porter gave an account of his method for measuring the diameter of the earth. It consists in observing the shadow cast by the peak upon the sea, and measuring the time that elapses between the moment when the apex of the shadow touches the sea horizon and the instant when it is eclipsed by the shadow of night. He observed, further, that the heated air ascending from the peak casts a shadow, seen as a faint prolongation of that of the peak.

SCIENTIFIC INSTRUCTION IN GIRLS' SCHOOLS.

By CAROLINE W. LATIMER,
INSTRUCTOR IN BIOLOGY, WOMAN'S COLLEGE OF BALTIMORE.

IT is impossible to turn one's attention in the direction of education to-day without being reminded that the present century has been characterized not only by a steady advance in our knowledge of the natural sciences, but by an ever-widening popularization of that knowledge. And one of the facts that strike us most forcibly in connection with this educational growth along scientific lines is that it has been coincident in time with the recent extension of educational rights and privileges for women. The physical sciences have therefore assumed prominence in women's education from the time that public attention was first focused upon them, and scientific instruction given to girls has been, from the time it was introduced into their education, in no way different from, or inferior to, that provided for their brothers.

The late Professor Huxley, in his speech on Scientific Education, delivered in 1869, described very forcibly the movement then arising toward a reform in school education from the side of natural knowledge—a movement which owed its existence in large part to his own persistent exertions. "The head masters," he says, "of our public schools—Eton, Harrow, Winchester—have addressed themselves to the problem of introducing instruction in physical science among the studies of those great educational bodies with much honesty of purpose and enlightenment of understanding, and I live in hope that, before long, important changes in this direction will be carried into effect in those strongholds of ancient prescription." Such was the provision, or lack of provision, for scientific training in the English public schools little more than a quarter of a century ago; and it is only necessary to glance at the prospectus issued by any one of the secondary schools for either sex, on both sides of the Atlantic, in the present year of grace, to find abundant evidence that, so far as "important changes" are concerned, Professor Huxley's very modest hope is now more than fulfilled. So radical a change in the old order could not, however, be effected without opposition; and this opposition found its most distinguished supporter in a man whose efforts toward the improvement of education were no less earnest than Professor Huxley's own. In 1871 Matthew Arnold wrote as follows: "If there is any other body of men which strikes one . . . as having before it a future still more brilliant than its present it is the friends of physical science. Now, their revolt against the tyranny of letters is notorious.

To deprive letters of the too great place they have hitherto held in men's estimation, and to substitute other studies for these, is the object of a *sort of crusade with a body of people important in itself, but still more important because of the gifted leaders who march at its head.*" The revolt here spoken of has certainly been accomplished and the changes inaugurated by it are fully in operation to-day. Thoughtful people, however, are now beginning to ask themselves whether these changes have really been followed by the beneficial results which Professor Huxley anticipated. And, if the introduction of scientific training into school education is not fulfilling the brilliant promise of its early years, what reason can be assigned for its failure to do so The Italics in the passage just quoted from Literature and Dogma are our own, and they have been inserted in order to call attention to words which are full of significance; for they suggest, though perhaps unconsciously to their author, an explanation of this very problem which confronts us to-day. The *principles* leading to the introduction of the physical sciences into school education proceeded, as was natural, from the "gifted leaders" of whom Matthew Arnold speaks. Our present difficulty has arisen from the fact that the *execution* of those principles has been carried out by the followers in the crusade, who are, almost invariably, as far from a right understanding of the cause which they support as was the unreasoning multitude led forth by Peter the Hermit. In their nineteenth-century ardor to see justice done to natural knowledge they have approached Dame Science cap in hand, crying: "This way, madam; every hill shall be made low, and every valley shall be exalted for your feet," until our present position is akin to that which Mr. Augustine Birrell tells we hold in regard to philosophy, and which he illustrates by an anecdote very applicable to our present purpose. There was once, he says, a native Westerner who paid a first visit to the Eastern States, and described his impressions of Boston to his friends upon his return. "It is a city," quoth this product of Western civilization, "in which Respectability stalks unchecked." According to Mr. Birrell, this is just what philosophical theories are doing among us to-day, but the idea is capable of extension. We can now be convicted on another indictment: that of having, so far at least as girls are concerned, permitted Science to stalk unchecked through our so-called secondary schools.

If we turn our attention to the details of scientific instruction in these schools to-day, we shall find it is almost characteristic of one which keeps abreast of the times that the natural sciences shall occupy a large place in its curriculum. The branches generally taught are physics, chemistry, physical geography, astronomy, botany, zoölogy, and physiology. I am not now concerned with the injury done to natural knowledge by the existing custom of placing the instruction on these many and divergent subjects in the hands of one "general science teacher," for the subject has recently been ably treated in the Educational Review. There are two other considerations which are sufficient to occupy us at present: First, that if the time spent upon scientific training is to be divided among so many different branches, it is impossible that the real purpose of such training should be carried out. Second, that the attempt to take up all these subjects is actually detrimental to a scholar's mental growth; for it must be remembered that during the same space of time in which scientific instruction has made such rapid strides, the requirements in all other branches of knowledge have been in no way diminished; on the contrary, their tale of bricks has been in some respects increased.

There seems to be a general agreement that the importance at present attached to scientific knowledge is but the fitting recognition of its value as an educational agent. If we analyze the matter, however, we shall find that this agreement does not exist as to the exact nature of the value which is so universally admitted. There are, in fact, two distinctly different conceptions as to the use and purpose of scientific training, and it is very necessary to a right understanding of the questions we have just placed before ourselves for consideration that we should distinguish between these. One of the aforesaid theories is that of the physical scientists themselves, the "gifted leaders" who so earnestly advocated reform in their own line. Their views are best stated in the words of the man who led their advance guard, and whose just claim for the introduction of science into education we have already quoted. "The great peculiarity of scientific instruction, that in virtue of which it can not be replaced by any other discipline whatever, is this 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. The other studies which enter into education do not discipline the mind in this way." This opinion, even though it is that of the highest authorities, is unfortunately held by a very small minority—in fact, only by the authorities themselves. The second theory as to the purpose of scientific instruction, to which the majority adhere, is that of the followers in the "crusade." These are the blind leaders of the blind; they are men and women whose actual knowledge of the natural sciences is almost *nil*, but they advocate the introduction of all of them into school training, because they consider that in a liberal education no educational stone should be left unturned.

Now, if the value of scientific knowledge lies, as Professor Huxley tells us it does, in its usefulness as a means of educational discipline, then the methods by which it is learned must be such as to train the eye in observation, the hand in dexterity, and the mind in deduction and verification. Otherwise no educational discipline can be expected from it. It is obvious that these ends can only be attained by practical work; and for practical work two things are absolutely essential—time and apparatus. Four hours a week spent in practical work, together with one or two hours of more didactic instruction, is the least amount of time from which any real benefit can be derived. Furthermore, the practical work must be arranged for in periods of *two consecutive* hours, otherwise a large part of the benefit will be lost; and, if the seven branches of science now forming part of a girl's education are to be taught with any degree of thoroughness, this amount of time must be consumed in the case of each and all of them. It seems needless to say that such a state of things does not, and without injustice to the non-scientific side of education can not exist. We are come, then, to a deadlock. To carry out the principles laid down by scientists for scientific instruction in a number of branches requires an amount of time which no student can afford to give, and an amount of apparatus which few, if any, schools can afford to provide. Yet it is a matter of daily observation that, in some way or other, educational institutions have succeeded in including all the different scientific studies before mentioned in their graded courses of instruction. The explanation of this condition of things lies in the fact, already alluded to, that the executive side of scientific instruction has been left entirely in the hands of the people of liberal minds, whose fixed idea it is that no scholar should be allowed to reach the conclusion of her school career in ignorance of the broad outlines of *all* the natural sciences, for she knoweth not the day nor the hour when a superficial acquaintance with some one of them may be required of her. In the present system of instruction, which has been developed in accordance with this theory, girls acquire a knowledge of science in the same way that they acquire a knowledge of all the other studies in their school education—by studying a lesson in a text-book and reciting it to a teacher, who under favorable circumstances accompanies it with some limited amount of demonstration. Yet book work, as any competent judge in scientific matters will agree, is destructive to the vital principle which gives to natural knowledge its use and dignity. Nor is it any more likely to serve the purpose of non-scientific educators, for scientific information thus acquired makes no lasting impression on the mind, and can not exercise any broadening intellectual influence.

From what has been said we hope that the truth of our first proposition has been demonstrated—namely, that the present methods of scientific instruction are urgently in need of reform. It remains to show that the practice of crowding so many different sciences into the brief period of school life is causing serious injury, not only to the sciences themselves but to education as a whole. This injury is especially due to the practice, which is part and parcel of the present system, of introducing scientific studies into the work of each one of the seven or eight years of school education. Nearly as much time is now devoted to science in the early years of school life as in the later, and before any real improvement can take place in scientific instruction the impression at present obtaining, that the earlier physical science is made a part of school education the better, must undergo some modification. This idea is based on the fact, which is a matter of common observation, that young children display great curiosity in regard to natural phenomena, and derive much pleasure from information in response to their questions concerning causes and results. But while this constitutes an excellent reason for encouraging the spontaneous activity of childish minds in the direction of Nature's laws, it hardly affords adequate ground for incorporating systematic scientific instruction into the routine work of their early years. It seems to be pretty generally agreed that the object of school education is to train the intellect to act readily as the servant of the will in that life-work whose honorable fulfillment is the aim of all education, and to store the mind with knowledge on the many subjects where ignorance would be prejudicial to success in that life-work. Now, the first of these objects is not likely to be furthered by allowing the studies most agreeable to a pupil to take precedence of others which require more effort, and therefore constitute a better mental training. There is a great deal of sound common sense in the old nursery rhyme which tells us:

> "The twelve Miss Pelicoes, you plainly see, were taught
> To do the things they did not like, which means the things they ought."

To be taught to do the things we do not like is a very important element in our education, especially in the education of our early years, for if that part of our training is neglected then, it can never be really made up to us, and we are at a disadvantage in adult life as regards the habit of self-restraint which constitutes the best basis for ultimate success. I do not apologize for obtruding what may appear a truism, for the neglect of the vital principle it contains is fast becoming a crying evil in the education of young children. As regards the second object of education, that of informing the mind, it can only be achieved by prolonged and vigorous exertion in the acquirement of many kinds of knowledge besides that of natural science; which knowledge, while it may be less interesting to a young child than science, is really better suited by its nature to the mental activity of early years. The integral defect of the old-fashioned system of education (in which the Miss Pelicoes were so carefully trained) was its being based upon an excessive amount of pure memorizing; and from this error we have undergone in recent years a strong revulsion of feeling. Unfortunately, this has led, like all effective reactions, to the commission of faults in the other extreme, and we are now in danger of losing sight of the fact that the acquirement of knowledge *by memory* must, and ought to, constitute a large part of early education. So much has been said of late as to the duty of imparting to children a right understanding of natural laws, that we overlook the necessity of storing their minds with a knowledge of many subjects other than science. In the brief span of school life it is imperative to teach a fair amount of ancient and modern history; to cultivate the gift of tongues; to discipline the mental faculties in the precision of mathematical thought; and to instill a moderate acquaintance with the literature of English-speaking people, together with a reasonable facility of expression in the English language. Now if, in addition, it were possible to provide for a number of scientific studies the time necessary to derive from each one of them its special educational advantage, then indeed no effort would be too great to accomplish such an end. But it is not possible. Neither the mental nor the physical capacities of youth are equal to such a strain.

But, some one asks: Is not good scientific training of greater importance than other branches of education? Why should not a large amount of time be devoted to practical work in science from the beginning of school life, even if other subjects are set aside for the purpose? I answer, because the minds of young children are peculiarly apt at the kind of study in which the exercise of memory (I do not, of course, mean memorizing) plays an important part. In our recent and highly commendable efforts to reform the practice of learning largely by rote, we have undervalued the educational significance of the fact that children are able, by the *intelligent* exercise of their memories, to acquire information with ease, and to retain it securely, while those who have passed the point where the brook and river meet learn in this manner only with wearisome effort, and even then remember but imperfectly. Precisely the reverse obtains in scientific training. The qualities of mind which enable a student to reap the full benefit of observation and deduction grow with mental growth and strengthen with intellectual strength. If the non-scientific side of education is curtailed in the early years of school life, the pupils will be greatly the losers in all matters within the province of art and letters. If, on the contrary, their scientific training is postponed to a late period, they will find it a gain rather than a loss. There is abundant evidence in support of this statement in our colleges for women. In them experience has shown that not a few of the students who have displayed marked aptitude for scientific work in their collegiate education, and some of those who have successfully carried on individual research, have had very little instruction in science before entering college. On the other hand, students whose choice in collegiate work is non-scientific, whether their choice be mathematics, classics, or modern languages, find that, unless their early training has been prolonged and thorough, the difficulties in the way of their ultimate success are almost insuperable.

If it is agreed, then, that scientific instruction under the present methods already consumes time which should be devoted to letters, it is evident that reform in these methods can not be instituted at the expense of the non-scientific side of education. There is, therefore, but one road to a better state of things. The existing system must be reorganized in such a manner that the whole, or at least a large part, of the time that justice allots to natural knowledge shall be spent on not more than two branches of science. This is really the only way in which a student can derive any training of the eye, the hand, or the deductive faculties, and, as the benefit which a student derives from such training is largely dependent on her being of an age to profit by it, the instruction must be given during the last two years of her school life. Five to six hours a week is, as was said before, the minimum amount of time from which good results can be obtained; and if this time were divided into not more than three periods, it would be possible to arrange something of the nature of laboratory work. Under such a system it is almost impossible that a pupil should not make real progress toward the end in view—that is to say, her mind would be brought into direct relation with Nature at the period of her school life when she is most responsive to the stimulus of such contact.

Already I feel my elbow jogged by the men of liberal minds, who urge that such a method as that just described would permit students to enter into life halt and blind as regards those of the physical sciences which were not selected for instruction. There is an element of truth in their argument that no girl ought to be in such complete ignorance of any natural science that she is unable to comprehend an incidental allusion to it. But this theory of the purpose of scientific knowledge can be carried out with a very small expenditure of time. The facts which the student needs to grasp are not many, and they ought to be encumbered with as little detail as possible. If, during the two school years immediately preceding those in which systematic instruction in science is to be given, one or two simple lectures were delivered each week on the outlines of such of the natural sciences as were not to be studied later on, the object of non-scientific educators would be fully attained. Such lectures ought to be quite unaccompanied by book work. The native curiosity of childhood in regard to natural phenomena can be fully depended on to secure attention at the time, and remembrance afterward. It must be added, however, that an interesting lecturer is essential.

If only two branches of natural science are to be introduced in detail into school education the question of selection becomes of importance. The biological sciences are undoubtedly those which bring the mind into the widest and deepest relations with Nature; and this would seem to constitute a sufficient reason for preferring them. I am aware, however, that in giving precedence to these sciences I put myself in opposition to the idea, now much in favor with the colleges, that physics and chemistry are more suitable for school instruction; but I do so because we are now concerned with the education of girls, not of boys. Everything that has been said so far applies indifferently to the training of either sex, but we have now reached the point where the little brook arises which by and by forms the mighty stream that separates and must always separate the life-work of women from that of men. The practical uses of an acquaintance with physics and chemistry are so great in many of the trades and professions by which men earn a livelihood that even an elementary knowledge of these subjects will often give its possessor an advantage in the race. There is also reason in the statement of the colleges that physics and chemistry form the best basis for future scientific work within their precincts. But these trades and professions are not, as a general thing, adopted by women; and so far as collegiate work is concerned it must be remembered that the number of girls who go to college is but small, and of these the proportion who devote themselves to scientific work is still smaller. It is not our present business to discuss the question whether a college education for women is ever likely to become general. The case as it stands now is that, for the large majority of girls, the science they learn in their school years represents for them all the science they ever acquire. Hence it should be of the kind that is most likely to minister to their necessities. If the biological sciences then are most suitable for their instruction, one of the branches chosen should be either botany or zoölogy; the other always and invariably physiology, because, I repeat, we are now discussing the education, not of boys, but of girls. The recognition of any difference between the education of the two sexes is, I know, not a popular idea. But there is surely some inconsistency in the fact that the friends of women's education who have done so much to establish a high ideal of life for women should receive with such disfavor any hint that, whatever changes may occur in outward conditions, girls will always be, as they always have been, potential wives and mothers. The fact, however, remains that the charge of young and helpless humanity belongs by nature to women, and that much, if not all, of the well-being and happiness of children, both present and future, depends on their physical necessities being rightly understood. To a woman who lives her life under the domestic conditions which it is now unfortunately the thing to consider narrow, it is of little consequence whether she understands the principle of a Torricellian vacuum or the significance of the periodic law, but it means much both to her and to others that she should have a correct knowledge of the natural laws that govern physical well-being. This remark is of an old fashion, but the truth it contains is eternally new, and therefore it is not only strange, but sad, that the grace of the fashion of it should be in danger of perishing.

Scientific instruction, then, in girls' schools to-day is not carrying out the honorable intention with which it was introduced into education. The "crusade" spoken of by Matthew Arnold is indeed responsible for much of the harm he ascribes to it. But, just as Wilkes claimed that he had never been a Wilkesite, so the "gifted leaders" would probably be little in sympathy with much that is done in their name. It is only by conforming to their original conception of the purpose of scientific instruction that we can succeed in avoiding the rock of complete neglect of natural science, and at the same time escape falling into the whirlpool of injury to art and letters. From the former of these perils we have indeed been recently delivered, but the force of our recoil has been such that there seems at present some danger of our being swept into the latter.

One point remains upon which to comment in conclusion: it is essential to the success of any reform in scientific instruction that the movement toward it shall proceed from the general public as well as from the school authorities. I hope, and from certain signs of the times I believe, that an impulse in this direction is now stirring in the minds of both educators and parents. That the time is now ripe is indeed my excuse for the existence of this article, which it is hoped may offer some suggestions as to the cause of an educational difficulty that seems to be felt at present even more by parents than it is by educators. But it is of course only one of the many such difficulties that beset the close of the nineteenth century. Indeed, the whole question of girls' education has now become so complex that a conscientious father to-day must often be ready to echo the words of the old song in the Beggar's Opera:

> "I wonder any man alive
> Should ever rear a daughter!"

THE ROMAN HIGHWAYS.

By D. R. McANALLY.

THE Romans were noted for many things, but for nothing do they better deserve fame than for the system of roads which connected every part, even the remotest province of the empire, with Italy and the capital. During the golden days every road literally led to Rome, for outside the limits of the Roman world there were no roads worthy of the name, and within its limits every highway was but a part of the system which had its center in theAppian Forum.

The system was worthy of the conquerors of the world. Starting from the Forum, the great Appian Way, the first which was built, passed through the Porta Capena and swept off to the south, through the Three Taverns, where Paul met the Christian Church, through Terracina, through Capua to Brundisium, where sailing craft and rowboats were always ready day and night to take the traveler over to Dyrrachium. Landing on the Macedonian coast near the modern city of Valona, the traveler might traverse a good Roman highway in an almost direct line seven hundred miles to Byzantium. In Asia the great highway again began, trended off to the south, followed the coast to Troy, sent off branches to numerous and populous cities of Asia Minor, across the mountains to Ancyra, followed the coast to Tarsus, thence to Antioch, to Tyre, and to Jerusalem. It is probable there was also a highway from Jerusalem to Alexandria in Egypt. There were certainly roads from Jerusalem east to the Euphrates, and up and down that mighty stream. Egypt had its own system of roads, beginning at Alexandria and continuing south to the Cataracts, while North Africa was also provided with internal arteries of commerce, starting from various seaports and penetrating the interior until lost in the sands of Sahara.

The Appian Way was the great highroad to the south of Italy and to the East, but the empire was provided with a northern system also. The northeast road started from Rome, crossed the Apennines on the upper waters of the Tiber, and continued through many important cities to the base of the Alps. South of Trent the road divided: one branch turned east, passed through what are now the territories of Austria, Bosnia, Servia, and Bulgaria to the Black sea; the other continued to the north and traversed the terrible passes of the Tyrol to the lower lands of South Germany. There was yet another great central highway which started like the others from Rome, went directly north, continuing, however, east of the Apennines, and following the east coast passed through or near the present cities of Genoa, Nice, and Marseilles. There it divided: one branch turned north directly through France, passing by many important cities till it reached a point near Boulogne, where, as at Brundisium, boats were always in readiness to carry passengers to Britain; the other branch, starting from Marseilles, traversed the Spanish Peninsula to its remotest part. England had its own roads; beginning near Dover, a leading artery ran to the north almost straight to York, while the others traversed the island from east to west.

The length of the Roman system of roads from the Wall of Antoninus in Britain to Jerusalem was four thousand and eighty miles, and, to the extreme limits of the empire on the Euphrates, about four thousand five hundred miles. From city to city the Roman roads usually went in a straight line, property being condemned and appropriated for the public use without the slightest regard for the feelings or rights of its owners, while natural obstacles were almost ignored. Mountains were tunneled, morasses filled with stones and earth; up one side of a hill and down the other went the road, for, as travel was altogether on foot or on horseback, and wheeled vehicles were not used in the country, a steep grade was no objection. Bold arches of heavy, solid stones were thrown across the smaller streams, while great bridges spanned the rivers. Trajan's bridge over the Danube had twenty-one piers of stone built on piling; each end was fortified by a camp and outworks, and when the structure was destroyed its ruins blocked the river. Many Roman arches over mountain gorges and smaller streams are still in existence. In Wales, the Devil's Bridge near Aberystwyth bears testimony to the solid and lasting character of the work done by Roman engineers; in Spain and Portugal many Roman arches remain to show that honest building could be done in the days of the Cæsars. Here and there in the Alps, in the Pyrenees, in the Tyrol, in the Balkans, the remains of a Roman road lead up to the side of a mountain where a half-closed or entirely blocked tunnel once pierced the giant mass. Here and there in the lowlands of the Danube, in the plains of the Po, on the lower waters of Belgium, the trace of a highway leads into the depths of now impassable quagmires, which, however, were no obstacles to the indefatigable road builders.

They did their work well. When a route had been surveyed and a line of road from eight to twenty feet wide was staked out, the surface of the earth within the inclosed limits was all removed until the clay bed was reached. This was densely packed with rammers: a layer of small stones was placed in position and rammed into the clay with heavy mallets, then another layer of stones and sand with cement; then a layer of sand or gravel with lime mortar; then layer after layer of broken stones cemented into one mass, and above all these layers, aggregating more than two feet in thickness, were placed bowlders of basalt or granite, from the size of a man's head to that of a half barrel. The sides were roughly trimmed to make the joints even; the tops were hammered to present a smooth surface to the foot of the traveler, and the whole was cemented together with such skill that after two thousand years of wear many of these roads may still be used. Near the cities more pains were taken; the granite blocks were hexagonal, carefully trimmed and evenly jointed. On the Appian Way the pieces were so neatly fitted together that even to-day it is difficult to detect a joint. The center of the road was the highest; on each side were gutters to carry off the water; if the road ran through a flat country, the gutter became a ditch; if through a country where the fidelity of the inhabitants was doubted, a breast-high wall on either side of the road made it an almost unassailable fortification. In country districts no house might stand within two hundred feet of any road, nor were any trees or bushes allowed to grow in the same limits, for the Roman highway must be safe, and robbers and evildoers must have no place of concealment in its immediate vicinity.

The country roads had at every half mile a block of stone placed by the wayside for the convenience of the traveler in remounting. On the Appian Way, for a distance of twenty miles from Rome, stone seats were placed for travelers at every forty feet; wherever a spring sprang from the earth near a road, a well was hollowed out and a cup provided at the well, and chained to a large stone, in order that travelers might quench their thirst and leave the cup for the next comer.

The roads were military in their character, the prime object being to facilitate the march of the legions. No country was considered conquered until roads had been constructed in every part, and an evidence of their value may be found in the fact that the first step taken by rebels in every local insurrection against the Roman power was to tear up the roads and destroy the bridges. These efforts were generally unsuccessful, for only gunpowder can prevail over such layers of stones and cement as constituted a Roman road, and the barbarians had no powder. In times of peace, the legionaries were employed in road building to keep the men out of mischief, but soldiers were not the only road workers. Criminals and slaves were set to work to make and mend the highways, and, where none of these were available, persons were hired to repair and construct the roads. Every governor of a Roman province had the strictest orders to see to the roads, and when a new line was projected through provincial territory it sometimes happened that the whole male population was summoned to assist in the undertaking.

Captives were frequently employed on the road. After the destruction of Jerusalem by Titus, the spectacle of Jewish chain gangs at work on the highways was a common sight all over the empire, and the spectacle again became familiar to Roman travelers sixty-five years later, after the unsuccessful rebellion of Bar-Chochebas, when the Romans, after almost incredible butcheries, determined to depopulate Judea as the best way of solving the question in that province.

Although the prime object of the roads was military, the emperors availed themselves of these admirable highways to obtain quick intelligence from all parts of their extensive dominions. All roads were divided by mile posts, and at every fifth mile on the Roman highway stood a posthouse. Forty horses were always in readiness at each station, and with rapid changes it was possible for an imperial messenger to travel one hundred miles a day, or even more. During the reign of Theodosius a messenger bearing news of a dangerous revolt rode post from Antioch to Constantinople, leaving the former city at night and arriving at Constantinople on the sixth day at noon, thus traveling seven hundred and twenty-five Roman or six hundred and sixty-five of our miles in five days and a half. Sometimes the use of the emperor's posts was granted to ministers, and to favorites whom the emperors delighted to honor. It was, however, a rare favor. Pliny sent his wife on post horse from Rome to the country, and, although a minister, came near having trouble with the emperor in consequence of doing so, for the post horses were as a rule employed only on government business. It was one of these posts that brought Augustus the news of the loss of Varus and his legions; it was a post that brought Nero the tidings of Galba's insurrection.

Crude as we should deem them, the Roman roads were strongly built, safe, and permanent, and even their ruins are among the greatest remaining wonders of that remarkable people.

Prof. W. McK. Cattell, writing of anthropology at Columbia University, finds it natural that that branch of research should be relatively late in coming to the front, because science must first cover the fields where the material is most stable and most accessible to experiment. "Thus, during the first half of the present century the most important advances were made by the physical sciences; then biology made the greatest progress; now, at the end of the century, it seems likely that the sciences concerned with man will become leading." This science has not been fostered by the universities, but has developed till it has compelled recognition. It is cultivated in the German universities, is recognized by a considerable school in Paris, and in chairs of criminal anthropology in Italy, and courses in it have been established in the Universities of Chicago and Pennsylvania and at Columbia.

SKETCH OF ANDREW CROMBIE RAMSAY.

SIR ARCHIBALD GEIKIE, from whose Memoir the material for our sketch is derived, speaks of Sir Andrew Ramsay as having stood in the forefront of the geology of his time, and as having "by the charm of his genial nature, as well as by the enthusiasm of his devotion to science, exercised a wide influence among his contemporaries." Having joined the British Geological Survey when it was still in its infancy, and having remained on its staff during the whole of his active scientific career—"so entirely did he identify himself with the aims and work of the survey, and so largely was he instrumental in their development, that the chronicle of his life is in great measure the record also of the progress of that branch of the public service."

ANDREW CROMBIE RAMSAY was born in Glasgow, Scotland, January 31, 1814, and died at Beaumaris, island of Anglesey, Wales, December 9, 1891. His father, William Ramsay, was a manufacturer of commercial chemicals, and invented processes that might have made his fortune if patented, but gave them to the world. He was a child of remarkable determination. Being in delicate health, he was sent to the parish school in the seacoast village of Salcoats, where in the natural and physical features and scenery of the region there was much that might have contributed to rouse the observing faculties. In time he was enrolled in the grammar school at Glasgow. After the death of his father, in 1827, he was placed in a counting-house, with the expectation that he would follow a mercantile career, and afterward in the warehouse of a firm of linen merchants, where he seems to have been unhappy. He had acquired a taste for literary pursuits, was "an omnivorous reader," and from the very outset "kept his interests broad." One of the developments of this side of his life was seen in the production of a manuscript periodical, Ramsay's Miscellaneous Journal, by himself and a few other young men, of which he was the editor during 1835 and 1836. About 1837 he formed a partnership with a Mr. Anderson as dealers in cloth and calico, the failure of which after three years left him poorer and disgusted with an occupation that had never had any great attraction for him.

His attention was gradually drawn to geology by the remarkable features presented in the island of Arran, where he was accustomed to spend his summer vacations. Having become acquainted with some of the professors and students of the University of Glasgow, he used to meet Prof. J. P. Nichol there, and enjoy long walks with him, and was introduced to Lyell by Lyon Playfair, who as a student in Glasgow boarded in his mother's house, and accompanied the "father of modern geology" in some of his excursions. In the successive tours and excursions he took he went over ground which had been partly explored by the earlier geologists and of the structure of which they had published accounts that could not, however, "be regarded as more than outlines of a whole subject, which would require years of patient research before its details could be mastered." He had not intended to criticise their work or to publish his observations, which he made for his own gratification, but "gradually he found that various facts met with by him in the course of his rambles had not been noticed by others before him." He spoke of them to Professor Nichol, who, looking forward to the meeting of the British Association in Glasgow in 1840, was preparing a geological model of the island of Arran. He made Ramsay secretary of the local subcommittee of which he was convener, and in reporting the success of his work gave his young friend the whole credit for it. Before this meeting Ramsay read his first scientific paper, which was a description of the work he had been drawn into, at the session held on the eve of an excursion which the geologists of the association took to Arran. Toward the end of this year he published a small book, with a map and illustrations—The Geology of the Island of Arran from Original Survey—which "has long since taken its place among the classics of Scottish geology."

Murchison, having met Ramsay at the British Association, had formed a high opinion of his geological capacity, and now, while the young man was preparing his book for the printer, invited him to accompany him on a geological excursion to Russia. The invitation was a welcome surprise to Ramsay, and he proceeded at once to take advantage of it. When he reached London, in March, 1841, he was informed that Murchison had given up taking him to Russia, but had procured him a place as assistant geologist to De la Beche, who was making the Ordnance Geological Survey for the Government. He was appointed on a salary of nine shillings a day, excluding Sundays, and, proceeding to his post, arrived at Tenby, Wales, April 2d, "there to begin a career in the Geological Survey which was to last until he had risen to be the head of the service, and one of the foremost geologists of his day." The field work of the survey had been a year or two in progress in South Wales when Ramsay joined it, and there were then four assistants on the staff besides him; with, in addition, Prof. John Phillips as paleontologist.

The geological structure of the region in which he labored proved to be excessively complicated. "It had been only cursorily examined by previous observers," and "its real difficulties remained to be discovered and grappled with." Two years later Murchison spoke to the Geological Society of the results that had been obtained among strata so obscured by change, as "among the very highest triumphs of geological field work," and mentioned Mr. Ramsay as particularly cited by the director among the laborers who had obtained them. When in 1845 the survey was transferred to another department, and enlarged by the inclusion of Ireland, Mr. Ramsay was made local director for Great Britain, with a salary of £300. He was to have immediate supervision of the field work of the staff, to see that the mapping was all conducted on uniform methods, to confer with the officers on their difficulties, to bring the experience gained in one district to bear upon the elucidation of another, so as to insure harmony and steady progress in the field work, and the supervision of certain matters of indoor work. To a book of memoirs prepared by the members of the survey at this time, Ramsay contributed a paper on the Denudation of South Wales and the Adjacent Counties of England, which is characterized by his biographer as having been the first attempt to reduce the phenomena of denudation to actual measurement by constructing horizontal sections on a true scale, and showing what thickness of rock had actually been stripped off the face of the country. Some expressions in it led to a correspondence with Darwin and Lyell respecting the relative force of disturbance in geological and recent times. In March, 1847, he delivered his first lecture before the Royal Institution, on The Causes and Amount of Geological Denudations. In June of the same year he accepted the professorship of geology in University College, London, on terms by which it was arranged that his duties there should not conflict with those on the Geological Survey.

Two papers read before the Geological Society in April, 1848, one of which was by Professor Ramsay and W. T. Aveling, are interesting in the history of British geology, inasmuch as they gave the first published outline of the results up to that time obtained by the Geological Survey in North Wales. Although they were mere sketches and printed only in abstract, the director general, Sir Henry de la Beche, was apprehensive as to the consequences of their appearance before they came out through an official channel. He held that the results described were obtained by public servants at the cost of the state, and were the property of the country, and not of the individuals who made them. Some of the staff chafed under the restraint, and it was Professor Ramsay's privilege to effect an arrangement with the director general under which papers might be read at the society after having been submitted to and approved by him. Professor Ramsay thought this was a great point gained, for the survey was "not half enough before the public."

Professor Ramsay had held a very poor opinion of the glacial theory, and for many years during his surveys paid no attention to it. His first recorded mention of it was a diary entry in March, 1845, recording a "jolly night at the Geological; Buckland's glaciers smashed"—the reference being to a paper read by A. F. Mackintosh on the supposed evidences of the former existence of glaciers in North Wales, controverting conclusions previously published by Buckland.

It was during the survey of the Snowdon region, where "he achieved his chief geological triumph" in unfolding the complicated history of former volcanic activity contained therein, that he began to regard the subject of glacial action seriously, and this not till he had been at work there several months. His first reference to the subject occurs in the record of a visit by Robert Chambers to him at Llanberis, in August, 1848, when Chambers and he are mentioned as having gone "out on a glacial excursion up the Pass." A walk across the hills the next day revealed "splendid examples of glacial action." The search for such examples was the special object of Chambers's visit. By the 15th of November, however, he seems to have recognized everywhere the peculiar smoothing and polishing produced by moving ice, and he described the summit of a certain precipice as being, "as usual, well grooved with glacial undulations." His first public profession of belief in the former existence of glaciers in Wales was on the occasion of an address to the Geological Society in December, 1849, on the Geological Phenomena that have produced or modified the Scenery of North Wales, in which glacial action was presented prominently. The lecturer at the same time gave new and original proofs of the former presence of glaciers, "particularly instancing cases where mountain lakes were still held back by ridges of terminal moraine, and where large blocks of rock were perched on ice-worn crags." After this his notebooks contain frequent references to glaciers. Thus he went on, meeting frequent new illustrations of the history of the Glacial period, with his eyes now opened to the existence and significance of the facts whereby he was "led to perceive the meaning of many scattered surface features in South Wales to which, at the time he was surveying in that region, he had paid little heed." On the 26th of March, 1851, he communicated his first paper on glacial phenomena to the Geological Society, On the Sequence of Events during the Pleistocene Period as evinced by the Superficial Accumulations and Surface-markings of North Wales. Having withheld this paper from publication a year for more mature study, he issued it in 1852 under the title of On the Superficial Accumulations and Surface-markings of North Wales." The chief point insisted upon in it was the prevalence of two glaciations—one widespread and prior to the deposition of the drift, the other local in the valleys and posterior to it.

After their marriage, Professor Ramsay and his bride, Miss Louisa Williams, a Welsh lady, took a wedding tour through Switzerland, and Professor Ramsay got his first view of a real glacier "far away toward the summit of the Uri Roth Stock," while crossing the Lake of the Four Cantons, and observed the enormous contortions of the rocks of the region. He made also a special excursion to the Upper Aar Glacier. These experiences "quickened his desire to renew the study of the Welsh phenomena, and sent him back with a far more vivid conception of what the conditions must have been in the Ice age among the hills and valleys of this country." He "threw himself more and more into the study of the superficial contours of the land, and among the various agents by which these contours had ben molded and modified he specially devoted himself to the investigation of the work of ice"; and among those who led the way to a more comprehensive investigation of these phenomena, "and who made the Glacial period one of the most absorbingly interesting of all the geological ages, a foremost place must always be assigned to Sir Andrew Ramsay."

The Government School of Mines, and of Science applied to the Arts, having been established on the removal of the Geological Museum to new quarters in 1851, Professor Ramsay was appointed lecturer on geology and its practical applications. This compelled his resignation of the professorship in University College. Besides the course of thirty lectures given twice a week, he delivered his courses in the system of evening lectures to artisans in which all the teachers engaged, giving six lectures each in the season, and which have been up to the present time eminently popular among the class for which they are designed. Professor Ramsay's first course, on the Utility of Geological Maps, was so acceptable that its repetition was called for. Among the results of the impulse given to the recognition of the importance of science in national progress that followed the Great Exhibition of 1851, was the establishment of the Department of Science and Art, under the control of the Board of Trade and afterward of the Privy Council, to which the Geological Survey, the Museum of Practical Geology, and the School of Mines were transferred. It was also decided to extend the Geological Survey to Scotland, and Professor Ramsay was sent there in 1853 to arrange for its operations, which were begun under his immediate direction in the smmer of 1854. The onerous duty, which nobody was so competent as he to perform, of preparing, from his surveys, a connected description of the geology of North Wales, was undertaken, and became his chief indoor labor for twelve years. The chief of the survey, Sir Henry de la Beche, died in April, 1855. Professor Ramsay had been led by Sir Henry to suppose that he would be designated as his successor, but it was found that vigorous efforts were making to put in the office a man who had only a very slender acquaintance with geology. To avert this disaster, Professor Ramsay suggested to his associates that they unite in recommending Sir Roderick Murchison. The recommendation was heeded, and Murchison was appointed.

In the summer of 1857 Professor Ramsay came to America to attend the meeting of the American Association for the Advancement of Science at Montreal. He was warmly received by our leading geologists, and visited the Great Lakes, examined the more remarkable geological features of the State of New York, and was entertained at New Haven and Boston. "The chief geological features of this expedition," Sir Archibald Geikie says, "were given partly in a discourse to the Royal Institution, but more fully in a paper read before the Geological Society. Ramsay had not yet realized the massiveness of the land ice of the Glacial period. Like most of the geologists of the day, he still regarded the 'drift' as the result of transport by icebergs, and to the same agency he attributed the striæ on the sides and summits of the hills. He recognized the remarkably ice-worn character of Canadian topography, but he did not yet associate that character with a former extensive glaciation by land ice. Nevertheless, he now beheld the effects of this glaciation in a far grander scale than he had ever before seen them, and unconsciously he was accumulating material that would enable him to get rid of the paralyzing idea that the land must have been submerged beneath the ocean as far as the highest striations or drift deposits could be traced. He was not, however, able entirely to divest himself of the old error until the summer of 1861." Four summer vacations after this were spent, till 1862, in excursions to the Alps and to points of geological interest in Germany, where "Ramsay could hardly find himself face to face with new scenes without being led to notice and reflect on the features in them which bore on any of the questions in geology and physical geography which had always been with him such favorite subjects." During these tours he was revolving a problem that had never been seriously attacked, and of which no tenable solution had yet been proposed—that of the origin of lake basins. His attention had been directed to the subject in America, although he formed no new opinions here. But the recognition to which he had now (1861) come, that the older and greater glaciation here was the work of stupendous sheets of land ice, "gave a new turn to his thoughts regarding the terrestrial contours of glaciated regions," and he came to the conclusion that "in a vast number of cases, where the lakes lie in rock basins, these basins have actually been scooped out by the grinding power of land ice." He communicated his paper embodying these opinions at the meeting of the Geological Society, in 1862, succeeding that in which he had been elected its president. His views met with strong dissent from the older geologists, while "most of the younger bloods," as he called them, accepted them.

The imperfection of the geological record, to which Darwin had called attention, became more forcibly impressed on his mind. He was struck by the extraordinary gaps in the succession of organic remains, even when there was no marked physical interruption of the continuity of sedimentation, and connected them with geographical changes of which no other trace had survived. He had spoken on the subject at the meeting of the American Association, and now made "Breaks in the Succession of the British Strata" the subject of his presidential addresses in 1863 and 1864.

Another change in the organization of the Geological Survey was made in 1867, when Scotland was constituted a distinct branch, and Professor Ramsay's title became Senior Director for England and Wales. Sir Roderick Murchison died in October, 1871, and after a few months' delay for the consideration of various other questions, Professor Ramsay was appointed Director General of the Geological Survey, being, "after thirty-one years of service, placed officially at the head of the organization of which he had so long been the life and soul." The reward came to him, however, "too late to enable him to profit by it as he would have done had it been conferred ten or fifteen years sooner." One of his excursions abroad resulted in a paper on the Physical History of the Valley of the Rhine, and a discourse to the Royal Institution on the same subject. He resigned his lectureship, "which in these last years of failing power had become an increasing burden," in June, 1876. He was made president of the Swansea meeting of the British Association, in 1880, and presented an address embodying a general summary of all the geological branches in which he had worked. At the jubilee meeting the next year, in York, as the oldest surviving president of Section G, he was made its president again, and delivered the address, principally dealing with the progress of geology for the past fifty years, with much difficulty. Later in the fall he was knighted, and on the last day of 1881 he retired from the public service.

During the last ten years of his official life Sir Andrew Ramsay gave much attention to the physical history of river valleys, concerning which he sought to trace the cause of the flow of the rivers of a district in the ancient topography of the region, and published special papers on the valleys of the Rhine and the Dee. He was a thorough uniformitarian in geology.

It is not by the visible amount of published work—Sir Archibald

Geikie gives a list of eighty-one books and papers published by him, forty-six maps, and twenty sectional drawings embodying results of his surveys—that we can rightly estimate the extent of Sir Andrew Ramsay's influence in promoting the advance of geology. For nearly thirty years he was a teacher of geology, and "year by year," Sir Archibald Geikie says, "a fresh band of young men came to listen to him, and to carry the fruits of his instruction to all parts of the world. Season after season he lectured to workingmen, who flocked in hundreds to hear him. His lectures were not written out, but delivered from notes, and were always kept up to the latest conditions of the science." Much of his work was published only in this way, or in informal remarks to the Geological Society, when in the excitement of discussion "he would pour out from his full stores of information, and, taking his audience into his confidence, would flash out new views that he had never communicated to any one before." Another form of instruction, less palpable, but equally valuable, was the practical training he gave the men of his staff in the Geological Survey. "Never was there a more delightful field instructor than he. Full of enthusiasm for the work, quick of eye to detect fragments of evidence, . . . he carried the beginner on with him, and imbued him with some share of his own ardent and buoyant nature. . . . He would take infinite pains to make any method of procedure clear, and was long-suffering and tender where he saw that the difficulties of the learner arose from no want of earnest effort to comprehend. . . . If a man had any geological faculty in him, it was impossible that it should not be stimulated and educated under such a teacher." He had a singular gift of conversation, "which enabled him to draw out of a man who had any special knowledge to impart such information as served to elucidate geological questions."

Professor Ramsay records in his diary that in 1843 he refused the Geological Survey of India; in 1859 he began to write popular geological articles for the Saturday Review, which he continued to contribute for several years; in 1862 he received from the King of Italy the order of Saints Maurice and Lazarus in recognition of his scientific attainments and of his services to Italian officers sent at various times to England on missions of scientific inquiry; in 1866 he received the Neill prize from the Royal Society of Edinburgh; in 1871 he received the Wollaston medal from the Geological Society; in 1879 he was elected a corresponding member of the Royal Academy of the Lincei, Italy; in 1880 he was awarded a royal medal by the Royal Society "for his long-continued and successful labors in geology and physical geography;" and he received the degree of LL. D. from the University of Edinburgh.

Editor's Table.

COMPETITION AND THE GOLDEN RULE.

THERE are some advocates of socialism who sum up their arguments against the existing social *régime* by affirming that competition is the direct negation of that rule of conduct which enjoins upon us to do unto others as we would that they should do unto us. The issue is a simple one and deserves a brief discussion.

Let us first consider the meaning and scope of the principle of action to which appeal is made. It is apparent, at the first glance, that it is meant to prohibit and exclude acts of wrongdoing and aggression which, if applied to ourselves, we should feel disposed to resent and if possible to resist. Of a large class of such acts the law takes cognizance, making itself the protector and avenger of those who have suffered injury. But if we take a number of typical cases of competition we shall see that they involve no aggression whatever and justify no resentment. Nearly all sports, to begin with, are competitive; but the winning of a game, provided it is done by fair means, is no violation of the golden rule. True, the loser wanted to win, but he did not want his opponent to *let* him win. All that can be demanded or desired of opponents in such a case is that they shall play honorably and according to the rules of the game. If the conquered party cherishes any rancorous feelings against the conqueror for having beaten him in fair play, that simply puts him wrong with the golden rule, because he would not have wished such feelings to be cherished against him had he been successful.

From play we pass to the business of life. Two firms tender for a contract; two architects submit plans for a building; two teachers apply for a situation; two politicians contest the same constituency; two dealers carry on business in the same neighborhood. The successful firm, the successful architect, the successful applicant, the successful candidate, the more successful of the two dealers—none of these have done any wrong by the mere fact of his success, nor can he be said to have gone counter to any demand made upon him openly or tacitly by his competitors, *unless* he has gained his point by underhand or otherwise unfair means. Explore the breast of each competitor and what wish do you find formulated there? A wish to succeed. That of course, but what wish as regards the action of other men? Is it a wish that the contract, situation, etc., should be given to him on his own terms, without competition or without consideration of the wishes or interests of others? Such a wish would itself be too obvious a violation of the golden rule to call for discussion; so we are still compelled to ask, What is that wish in the mind of a given individual which could impose itself as a rule of action on others? The more we think of it the more clearly and irresistibly it appears that the only demand any one can make possessing the least character of moral authority is a demand for justice, for fair dealing. In the cases above supposed every demand which an individual could avow would be met by fair dealing on the part of his competitors and of those upon whom the award depended.

But there should not be any competition at all, the socialist will reply; competition is itself immoral. Again, let us get close to the facts. Competition, if we consider it as a word, is an abstract noun—so the grammarians used to tell us—and abstract nouns can not be accused of immorality. If we consider it as a thing, then it is a form of human action, and we must throw the immorality back on the men who practice it. Now, in what individual action does the immorality begin? Let us, if possible, get at the *fons et origo mali*. A certain household requires a domestic servant. Is it wrong to decide between the applicants according to their merits? Is it wrong to reject an inefficient person in favor of an efficient? A man wants a tutor for his boys. Is it wrong to insist on proofs of scholarship and character? A merchant wants a bookkeeper. May he be allowed to prefer one who comes to him with good recommendations to one who has none, and whose appearance and manner are not in his favor? If such things as these are permissible, we have the outlines of competition clearly traced; yet is there anything immoral in assigning a task, with its accompanying reward, to the person best qualified to perform it? But the world, it will perhaps be contended, should not be arranged in such a way as to allow two persons to want the same thing. Possibly, if some of our socialist friends could "grasp this sorry scheme of things entire," they might do some notable "remolding"; but whether they would really advance human happiness is quite an open question. Zola somewhere says that if they had their way they would make the very dogs howl with despair; but, however that may be, it is evidently difficult to fix the responsibility for competition on any power less general than that which made the world.

The golden rule (to get back to it) bids us do to others as we would be done by. The rule is laid down for all alike, and, strictly speaking, no one is entitled to claim the benefit of it who is disregarding it in his own practice. The man who shuns honest industry is not doing as he would be done by; he wishes *others* to work that *he* may eat. Yet, if we mistake not, the golden rule is often invoked on behalf of those who are systematic violators of it, whose whole lives are an injury to society. No moral rule could ever have been intended to place us at the mercy of one another's *desires*, and in the case of this particular precept we are required to seek within ourselves, and not simply in the desires of others, the law we are to follow. It is what *we* would that men should do to us that we are to do to them. The responsibility is thus thrown upon us of determining the demands which, in given circumstances, we would make —i. e., ought to make—of other men. Which of us, then, would say, "We demand that, whenever we want a thing, we shall get it, no matter what claims others may have, or think they have, to the same thing"; or, "We demand that whatever we ask for we shall get, independently of merit or qualification on our part"? If such demands need only to be formulated in order to be seen to be absurd, the conclusion comes home to us again with force that the only demand we can really make is one for fair play and justice.

There is nothing wrong with competition as such, for it is merely a necessary form of sifting with a view to obtaining a proper adjustment of each man to his place in life. That it works perfectly to that end, no one would care to pretend; but it has that end in view, and accomplishes it to a measurable extent. Without competition in some form there would be no adaptation, and society would relapse into a state of chaos. If there is adaptation to-day throughout the whole range of the organic world, it is because competition has been at work from the very beginning of things. It is not necessary to deny that competition has been and is attended by many evils; but it will be found on examination that these evils are generally of a character to impair the competition and render it more or less illusory. The trouble in these cases is not with the principle of competition, but with the frauds of one kind or another by which it has been vitiated—acts that are in direct violation of the golden rule, because they are such as no man would wish to have perpetrated on himself. As applied to competition, the golden rule demands an honorable observance of the conditions, expressed and implied, of every competition: it requires that every competitor shall do by every other as he would himself be done by.

Apart, however, from fraudulent competition it may be admitted that in some cases parties compete who might well refrain from doing so. There is a passage in Mr. Spencer's Principles of Morality (vol. ii, page 282) which bears directly on this point. "In its application," he says, "to cases of this kind the popular maxim, 'Live and let live,' may be accepted as embodying a truth. Any one who, by command of great capital or superior business capacity, is enabled to beat others who carry on the same business, is enjoined by the principle of negative beneficence to restrain his business activities when his own wants and those of his belongings have been abundantly filled, so that others, occupied as he is, may fulfill their wants also, though in smaller measure." There is something, however, to be said on behalf of those who do not "restrain their business activities" at the point mentioned by Mr. Spencer. In the first place, the capitalist need not waste his money on senseless luxury and ostentation, but may employ it in judicious enterprises for the general good. In the second place, by staying in business he gives the public the benefit of his superior methods, instead of leaving the field to those who, on the whole, would not, it may be assumed, carry on business so satisfactorily—possibly not deal as generously or humanely with the persons whom they employ as he is able to do with those whom he employs. Evidently, it is very difficult to draw a line at the exact point where a given individual should withdraw from competition. The question for the individual concerned is how he can best discharge his obligations to society—how he can do most good to society—and it seems to us that, in some cases at least, this requirement would most fully be met by his continuing to direct the business which he has organized on a sound basis, and is carrying on to the satisfaction and benefit of a large portion of the public. The golden rule—the spirit of it, at least—is not violated so long as, to the best of a man's judgment, what he does is, in the widest sense, for the public good. We fail, therefore, to find any radical contradiction, or indeed any contradiction at all, between the principle of competition and the maxim to which we have so often referred. We have only to think for one moment of what the world would be in the complete absence of competition—in other words, in the absence of all means for selecting the fit and rejecting the unfit or the less fit—in order to see that competition in itself is not and can not be an evil. That evils attach themselves to it signifies nothing more than that human society is as yet imperfect.

THE SCIENTIFIC TEMPER AND THE NEED OF THE TIMES.

A GOOD illustration of the true scientific temper is furnished in some extracts from the correspondence of James Watt given by Prof. T. E. Thorpe in the Watt memorial lecture delivered by him not many weeks ago. Watt and Cavendish, toward the end of the last century, had both been experimenting and theorizing upon the composition of water. A friend writing to Watt gave him an extract from a paper by Cavendish, and hinted, unjustly, that the latter was making unacknowledged use of Watt's work. The latter's reply was worthy of a true man of science: "On the slight glance I have been able to give to your extract of the paper, I think his theory very different from mine; which of the two is the right one I can not say; his is more likely to be so, as he has made many more experiments and consequently has more facts to argue upon." Again the great discoverer refers to his general diffidence of character. "I am diffident," he says, "because I am seldom certain I am in the right, and because I pay respect to the opinions of others where I think they may merit it." If Science was always served in this spirit, she would have no reason to complain of her devotees, nor would there be any justification for the opposition which the latter, it must be allowed, sometimes excite.

What is principally wanted in the domain of scientific inquiry, as everywhere else, is the spirit of justice. That spirit will prevent a man from appropriating without acknowledgment the labors of others, and also from looking with disfavor on the work of others because it does not tend to support some theory to which he is personally wedded. Men worthy of the scientific calling will recognize that truth is above all, that it is a privilege and an honor to be engaged in its service, and that to make self-glorification the chief end of one's labors is to be unfaithful to the cause of truth and to bring reproach on the profession of science. The scientific world is to be congratulated, upon the general freedom from personal aims and views which its representative men display. The example of Darwin in this respect was of inestimable value. Here was a man engaged in working out a theory of the utmost importance, and, after all abatements are made, of the highest originality. If any man could have been pardoned for being insensible to the objections raised to his theory, or to the weight which might properly be claimed for the opposite views of others, it was he. Yet no man was ever more ready to have his work criticised, no man ever tried with more obvious sincerity to place himself at the point of view of his critics so that he might see the full force of what they had to urge. We hardly think we are mistaken in believing that scientific controversy has shown less tendency to be acrimonious, and a stronger tendency to be just and generous, since the publication of Darwin's Life and Letters.

In these troublous times of contending factions and international jealousies, the very highest service to society will be rendered by that body of men, whoever they may be, who shall most signally exhibit in their words and conduct a love for truth and a desire for justice; who shall stand out most resolutely against the shibboleths of party and the clamors of excited multitudes; who shall most effectively represent and uphold the permanent and universal interests of humanity against the narrower views of national self-love or the gratification of ephemeral passions. If the question is asked, Who shall these be? we answer that we know none fitter to render this service to society and the world than the true followers of science everywhere. We hope and trust they will recognize their mission and all its vast possibilities.

A VICTIM OF MILITARISM.

If the Dreyfus incident, coupled with the Zola trial, has made plain the fact that France is a military despotism pure and simple, it has not been without value. Because it has a constitution, a president, a legislature elected by universal suffrage, and other simulations of republican institutions, most people, particularly in the United States, have thought it a republic worthy of their sympathy. How often have they congratulated it upon its resistance to the allurements of the one-man power and its check to the advent of some military hero like MacMahon or Boulanger to the seat of an absolute executive! The spectacle has led some of them, especially gifted with the power of prophecy, to declare that free institutions have become so firmly established in France that the restoration of the monarchy can never occur.

But persons able to look beyond the form of government, and to detect the substance that it really represents, know full well that free institutions, properly speaking, have not existed in France for several hundred years. While the Revolution made sad havoc with some of the most characteristic features of the old *régime*, it did not vouchsafe the French people the personal freedom, the essence of free institutions, with which their ill-informed friends in this country have credited them. During the long peace that preceded that appalling event, a great change, as may be seen in De Tocqueville's masterly study of that period, had come over the pitiless despotism that culminated under the reign of Louis XIV. To be sure, the laws were just as ferocious as ever, but they were not enforced with the old-time vigor. The governing classes were not so cruelly indifferent to the classes governed. Indeed, it seemed as if France might as easily and as directly as England had done after the Revolution of 1688 pass under a constitutional *régime* and its people become as free and prosperous as those of its neighbor across the channel.

But this piece of good fortune was not destined to come to that most unhappy country. The anarchy of the Revolution not only destroyed the work of the beneficent influences that promised a complete social and political regeneration, but riveted upon the French people a despotism even more intolerable in some respects than that from which they had escaped. Called upon to restore order and thus prevent the threatened dissolution of society, Napoleon made use of all those agencies so natural and congenial to despots. Instead of trying to establish those institutions that would enable his countrymen to govern themselves, he established those institutions only that would enable him to govern them. He felt that they had no more capacity for self government than children. He knew that if he could tickle their fancy with the thought that they were again the dominant power in Europe they would not care whether they were governed from Paris, as under the old *régime*, or by their own local assemblies, as had been the case before the growth of the monarchy had deprived them of every semblance of liberty. The justification of his contemptuous opinion of them is to be found in the maintenance to this day of the administrative and judicial despotism that he created—a despotism that Mr. Bodley, the latest and ablest writer on France, believes to be indispensable to their welfare.

Severe as this judgment is, there is evidence on every hand to warrant it. A people fit for freedom would not endure for a moment the crushing bureaucratic system that regulates almost every activity of the Frenchman from the cradle to the grave and helps to saddle him with a burden of taxation greater even than that of the old monarchy. They would destroy at once a judicial system based upon the atrocious assumption that a man is guilty until his innocence has been established. The secret proceedings by which Dreyfus was convicted would be repugnant beyond their endurance. Were they not animated by the spirit that characterizes the victims of despotism they would never maintain a great standing army for the sole purpose of *revanche* nor permit it to dictate to them what the interests of the state require. The punishment of a man like Zola, whose sole offense is that he has dared to beard the dragon of militarism, and lift up his voice in behalf of a man that he believes to be most cruelly wronged, would appeal to their chivalrous sentiments, and instead of trying to mob him they would side with him against the despotism that is demoralizing and crushing them. Finally, an alliance with a power so hostile to every form of freedom as Russia would seem to them an unspeakable disgrace if not a crime against civilization.

In the face of such evidence as this of the unfitness of Frenchmen for freedom, evidence that has extorted from Jules Lemaître the confession that he is almost ashamed to belong to France, it is impossible to doubt the justice of Mr. Bodley's verdict. It is impossible also to believe that anything better is in store for France as long as it is possessed of the militant spirit and insists upon the maintenance of a great standing army to avenge itself upon Germany. Both are absolutely incompatible with freedom and civilized sentiments, and are certain to lead sooner or later to the appearance of another Napoleon to repress the discontent and despair bred of the hard conditions that invariably flow from despotism and onorous taxation. We believe that the only hope for France lies in the complete disbandment of its army, the discontinuance of its efforts to establish a colonial empire, to which few Frenchmen ever go except to get office, the gradual diminution of its bureaucratic despotism, and the growth of personal liberty and private initiative. A continuance of its present policy will exhaust its resources, demoralize its people, and finally make them as easy a prey to a vigorous invader as the unhappy inhabitants of the Celestial Empire.

Scientific Literature.

SPECIAL BOOKS.

In the brief biography with which she prefaces the journals of her grandfather,* Miss *Audubon* believes that she has given the only correct account of his life that has been written. She complains of the manner in which the editor of a previous biography has treated the material furnished by Audubon's widow, and particularly of ascriptions in his notes of vanity and selfishness to the great naturalist, of which she finds no trace; but that in the nine journals "and in the one hundred or so of letters—written under many skies, and in many conditions of life, by a man whose education was wholly French, one of the journals dating as far back as 1822, and some of the letters even earlier—there is not one sentence, one expression, that is other than that of a refined and cultivated gentleman. More than that, there is not one utterance of 'anger, hatred, or malice.'" She has tried only to put Audubon *the man* before her readers, and in his own words so far as possible, "that they may know what he was, not what others thought he was." Since the journals of the Missouri and Labrador journeys came into the author's hands, about twelve years ago, others have been added which had been virtually lost for years. These documents, which furnish her chief sources of information, have been verified and supplemented by every means—by researches in Santo Domingo, New Orleans, and France, and by comparison. The biography of seventy-two pages which precedes the journals includes the sketch of his life to the time of his flatboat journey from Cincinnati to New Orleans in 1820, which Audubon wrote for his sons, and was printed in Scribner's Magazine in 1893, from a manuscript found in a barn on Staten Island. The first of the journals to be printed is the European, recording the story of his journey in 1826 and his visits to Edinburgh, London, and Paris in the interests of his book—a story full of incident and notices of the men distinguished in literature and science whom he met, and shrewd comment. The modest simplicity of his nature is revealed in this journal in a remark that he found his situation in Edinburgh bordering "almost on the miraculous. With scarce one of those qualities necessary to render a man able to pass through the throng of the learned people here, I am positively looked upon by all the professors and many of the principal persons here as a very extraordinary man. I can not comprehend this in the least." The journal of the Labrador journey follows. This trip was made in 1833 for the purpose of procuring birds and making drawings of them for the continuation of the Birds of America. Its interest is that of science and of adventure in regions not even yet familiar. The narrative of the Missouri River journeys in 1843 is now for the first time published in full, the manuscript of the latter part of it, from September 16th to November 6th, having been lost and supposed to be no longer in existence till it was found in August, 1896, in the back of an old secretary where Audubon had put it on his return. This narrative is perhaps the most interesting of all, and is valuable from the point of view of the naturalist,

* Audubon and his Journals. By Maria R. Audubon, with Zoölogical and other Notes by Elliott Coues. Two volumes. New York: Charles Scribner's Sons. Price, $7.50.

and because it describes in their primitive condition and wildness regions and scenes which are being fast invaded and spoiled by civilization. The book is completed by sixty "episodes" or essays and sketches on subjects that came under Audubon's observation or were suggested to him by his adventures, all but one of which were published in the first three volumes of the Ornithological Biographies, but were omitted from the octavo edition of the Birds of America. One—My Style of Drawing Birds—has been added, and two have been omitted as not being of general interest. Of the forty-five pictures and plates, eleven are portraits of Audubon, and nine are facsimiles of diplomas.

Bird Craft—craft about birds; knowledge of them, of their ways, appearance, and song, when and where to look for them, how to approach them, acquaintance with them—these are what Mrs. Mabel Osgood Wright undertakes to convey in the book of that name;* and the undertaking will be found to be crowned with a large degree of success by those who go out into the field intelligently, with sharp sight and the book in hand. A "pocket full of patience" is also prescribed by the author in lieu of the salt of the legend. For naming the birds she gives the scientific terms containing their own definition, which lose force when translated, and the common English names, also recognized by science, which remain practically unchanged. Then there are local names, which are confusing and changing, and need not be treasured up. One does not have to give up the pleasures of acquaintance with birds, even if he lives in the city. Seventy species have been seen in Boston Common, and one hundred and thirty in Central Park. Further, the specimens in the museums are accessible, where they are now usually placed in the attitudes of life. The dweller in the suburbs or in the real country has still greater advantages with living birds. The study of the "*living* bird, in his love songs, his house-building, his haunts, and his migrations," is particularly insisted upon. "The gun that silences the bird voice, and the looting of nests, should be left to the practiced hand of science; you have no excuse for taking life, whether actual or embryonic, as your very ignorance will cause useless slaughter, and the egg-collecting fever of the average boy savors more of the greed of passion than of ornithological ardor." The study of birds is best begun in the spring, when the untrained eye can become gradually accustomed to its new vocation before it is overtaxed, and the birds can be taken in all their moods from the opening of the season on. So Mrs. Wright takes us, and accompanies us in our wanderings in birdland, like a conversing companion, while she does not neglect to give us the technical information we need. It would be hard to speak too well of the almost vitalized bird portraits which Mr. Louis Agassiz Fuertes has furnished in the eighty full-page plates with which the book is adorned.

GENERAL NOTICES.

Inequality and Progress is the title of a rather disappointing volume,† at any rate to the scientist, by *George Harris*, a professor in the Andover Theological Seminary. The position which the author takes—namely, that inequality is an essential to progress,

* Bird Craft: A Field Book of Two Hundred Song, Game, and Water Birds. By Mabel Osgood Wright. New York: The Macmillan Company. Pp. 317. Price, $2.50.

† Inequality and Progress. By George Harris. Boston and New York: Houghton, Mifflin & Co. Pp. 164.

and that, instead of attempting to equalize things, we should rather strive in an opposite direction—is a thoroughly rational one; but the many facts derivable from psychology, from history, and kindred sciences, and the application of these to a system of society and education, the two sciences on which this question of equality chiefly bears, have been but indifferently handled by Mr. Harris. In fact, to be just, the author announces in his preface that the volume is not intended as a philosophical or scientific exposition, but is rather "a series of observations and reflections which from various points of view exhibit the variety and the unity of men." Notwithstanding these faults there is much good thought in the volume and many well-taken points. The question is one of great importance, bearing as it does directly on the socialistic theories of society, and, as Mr. Harris says, that charmed word "equality" seems to have blinded our people to the absurdity of the doctrine of which it is the watchword. The first few chapters of the volume are devoted to showing the essential inequality of the natural arrangement of things and the impotency of human efforts to bring about an artificial equality. For instance, equality of opportunity in education is shown to be a chimera, not only because of the great variation in individual ability, so that with equal opportunities any two students will graduate with widely differing content of knowledge, but also because what is the most stimulating and appropriate education for one student may have an entirely opposite effect on the next. Inequality or, as the author prefers, variety is next shown to be an essential to progress, and, in fact, one of the results of the latter, and successful social life to depend on the rule of the superior portion of the community, which is again inequality. The chapters ramble on under such titles as Two Kinds of Discontent, Admiration and Inspiration, The Progression of Ideals, until the volume is finally closed by one on Christianity and Inequality. The great importance of a clear understanding of this question, especially in the United States, where we seem to be tending steadily toward socialism, and the slight attention which the inequality side has received during recent years, give Dr. Harris's book a value which perhaps its intrinsic merits do not justify. The reader will gather some new thoughts from its perusal, and may be stimulated to a further study of the question.

Mr. *Edmund Gosse's* principal aim in composing his *Short History of Modern English Literature* * was to show the movement of the subject. He desired above all else to give the reader, whether familiar with the books mentioned or not, "a feeling of the evolution of English literature in the primary sense of the term, the disentanglement of the skein, the slow and regular unwinding, down succeeding generations, of the threads of literary expression." Considering the nature of the subject and the multitude of temptations to stop on the way to expatiate and moralize, his success in giving the idea of a sense of flow is remarkable. A feeling of movement is what the reader experiences in reading the rapid sketches. There are periods, indeed—the Age of Chaucer, the Close of the Middle Ages, the Age of Elizabeth, the Decline, and so on, down to the Age of Tennyson—just as there are stations on the railroad journey, but between the stops the train goes on with power and unslacking speed. Beginning with the Romances of Chivalry, authors and books are called up in succession, with hardly more than a page to each, delineated or characterized in only a few lines or in an epigram, as it were, yet with such vigor and skill as to leave upon the mind the impression of a picture from life. The leaders of scientific thought of the present age, as of past ages, are included in the sketches: Mill, "skeptical and dry, precise and plain," whose works "inspire respect but do not attract new generations of readers"; Darwin, "one of the great artificers of human thought," destined to perform one of the most stirring and inspiring acts ever carried out by a single intelligence"; Spencer, in whose Principles of Psychology, as his friends point out, "the theory of Darwin was foreseen," who has made a deeper impression on foreign thought and is more widely known throughout Europe than any other Englishman of the present age, and whose themes "have exercised a stimu-

* A Short History of Modern English Literature. By Edmund Gosse. New York: D. Appleton and Company. Pp. 416. Price, $1.50.

lating effect over almost every native author of the last twenty years"; Tyndall, who "conciliated critical opinion by the courage with which he insisted on the value of imagination in the pursuit of scientific inquiry"; and Huxley, master of a purer and manlier style, who his whole life through "was attacking the enemies of thought, as he conceived them, and defending the pioneers of evolution."

In Dr. *Francis Warner's Study of Children*,* the practical purpose is very evident, to inform parents and teachers how they should study the idiosyncrasies of children and the relations of their special physical conditions to the psychological symptoms, to the end that they may treat their cases judiciously. If a child is restless, troublesome, even bad, there is most probably a cause in its physical conditions or surroundings for its peculiar disposition. The teacher should seek to ascertain that cause, and so conduct the inquiry that the child shall not be embarrassed or disturbed by knowing his purpose. One of the first principles announced in the book is that "we must remember that children differ greatly in strength and in mental faculty; education should therefore be adapted to the special needs of the individuals. As there are many classes and varieties of children, whose needs must be studied, while bodily strength and mental faculty differ with the age and surrounding, "child study must be a matter of primary interest to the teacher and others engaged in the care of children as affording a basis for the methods of education; giving a source of perpetual interest to work in school, an interest in the individual child, and a means of working out, in practice, the best that can be done with the child in various phases of life. . . . Observation shows the child's strong points which should be cultivated as well as his weak ones which must be combated." The chapters on the physiology and general conditions of the child are followed by others on points and methods of observation—what to look for and how—and then by general instructions on methods of treatment and training. The almost innumerable varieties of cases may be arranged in groups, for which the general principles of treatment and study are suggested. These are illustrated by detailed accounts of typical cases. The author, an eminent writer in this line of study, has had special facilities for preparing for this particular work; having, as one of a committee of the British Medical Association, to study school children as to their physical and mental states, examined one hundred thousand children upon a fixed plan, and taken copious notes of what he found.

* The Study of Children and their School Training. By Francis Warner, M. D. New York: The Macmillan Company. Pp. 264. Price, $1.

Miss *Merriam* seeks in her *Birds of Village and Field** to aid persons who know little or nothing of birds in identifying and studying those they see. The presence among us of larger numbers of them than we usually suspect makes the study of a considerable variety of birds practically possible to any one. We do not have to go away off to seek them. They throng around our very doors; prefer the vicinity of the habitations of men to wild spots; and, shy as they are, reveal themselves to those who look patiently and carefully for them. From seventy to nearly a hundred species a year have been known to resort to private grounds where records are kept. Miss Merriam furnishes an untechnical key, and as simple as may be to the identification of these birds. A "field color key" describes all the various markings that are likely to be seen, in clear, concise terms; and each particular marking is referred to the page in the book where the bird bearing it is described. The descriptions are lively, interesting, bear upon the habits and appearance of the birds, and give many hints as to how we may enjoy them to the best advantage, and even entice them to make their homes among us; and they include a large number of species with the distinctions between them plainly marked, and numerous illustrations, large and small, of special features.

The selection of counties by the Geological Survey of Iowa † for special examina-

* Birds of Village and Field. A Bird Book for Beginners. By Florence Merriam. Boston and New York: Houghton, Mifflin & Co. Pp. 406. Price, $2.

† Iowa Geological Survey, Vol. II. Annual Report, 1896, with accompanying papers. Samuel Calvin, State Geologist; A. G Leonard, assistant. Des Moines, pp. 557, with maps.

tion in 1896 was guided by the consideration of bringing to the attention of the public geological deposits of great importance, and of choosing such locations as would elucidate as large a number of geological problems as possible. Six counties are described and mapped as geologically important in respect to indurated rocks and superficial deposits, and as being, therefore, of great practical interest to the people of the State. The soils are treated as economically the most important formations. Tests of building stones have been completed and are ready for publication. Attention corresponding to their importance was given to the study of the coal beds. It was incidentally demonstrated that the succession of Pleistocene deposits is more complete and more clearly indicated in Iowa than in any other corresponding area of this continent so far studied. The State Geologist is gratified to represent that the publications of the survey are being more and more appreciated, and are received by the people of the State as well as by men of science everywhere with increasing favor. Requests for copies of the reports are very numerous and indicate a widespread interest. High schools in counties already reported upon have introduced the separate county reports as works to be read by the pupils studying geology, and newspapers publish summaries of reports of local interest.

The object of Prof. *L. H. Bailey's Lessons with Plants* * is well indicated by its secondary title; it is to suggest methods of Nature study; not to teach a science, but only to indicate a way in which plants may be studied and the subject taught. The lessons are an extension of the ideas embodied in the Nature Study Leaflets issued for the use of teachers by the College of Agriculture of Cornell University; while these leaflets are, in turn, the direct growth of "observation lessons" which were a part of the instruction given in itinerant schools of horticulture in the State of New York. When the book is used by the teacher, he is supposed to master an observation, collect specimens proving or illustrating it, and teach his pupils from the specimens. If the pupil consults it, he collects specimens and recites from them, not from the book. Pupils will not do this so well by themselves as when under the inspiration of the teacher; for while it is not true that only those things are useful which one finds out for himself—else we could make little progress—"the pupil should find out something for himself, and, more than all, he should enjoy the finding of it." The lessons teach and picture what are to be found in twigs and buds, leaves and foliage, flowers, fruits, the propagation, behavior, and habits, and the kinds of plants; while the appendix contains suggestions on pedagogical methods, books, classification, evolution, the interpretation of Nature, the growing of plants, and a glossary.

Mr. Edward P. Thompson's narrative of the exploration of the *Cave of Loltun*, near Labná, Yucatan, in 1890–'91, is given as No. 2, Volume I, of the Memoirs of the Peabody Museum of American Archæology and Ethnology of Harvard University. The cave was excavated through all the deposits that had been made in it "down to and into the crystalline surface of the ancient floor itself." Numerous interesting remains of man and human life were found, inscriptions and specimens of art, but nothing indicative of primitive savagery. Typical examples of these relics are represented in figures in the text and in large photographic plates.

D. T. Day's twelfth *Report on the Mineral Resources of the United States* (1895) appears in a somewhat different form from the previous reports, the pages being enlarged, and is published in two volumes as Part III of the seventeenth annual report of the Geological Survey. In it the scope has been limited more than in previous reports to the statistics of production of the minerals and statements of the conditions of their occurrence, and less space has been devoted to the technical features of their development.

From the United States Geological Survey we have the monographs from the twenty-fifth to the twenty-eighth volume, inclusive. The twenty-fifth volume comprises the survey of the former bed of the very large *Lake Agassiz*, which occupied the Red River Val-

* Lessons with Plants. Suggestions for Seeing and Interpreting some of the Common Forms of Vegetation. By L. H. Bailey, with Delineations from Nature by W. S. Haldsworth. New York: The Macmillan Company. Pp. 491. Price, $1.10.

ley during the Glacial period, by *Warren Upham*, who prosecuted the work, under the direction of Prof. T. C. Chamberlin, during four years in Minnesota and North Dakota, and by special arrangement with the authorities concerned, in Manitoba. The Canadian part of the lake has also been examined by Dr. G. M. Dawson.

The twenty-sixth volume is an account of the *Amboy Clays*, New Jersey, by Dr. *J. S. Newberry*, completed and revised, after the author became unable to put the finishing touches upon it, by Arthur Hollick, who has also prefixed to the work a brief review of Dr. Newberry's contributions to fossil botany. The Amboy clays are a part of the Cretaceous formation, extending across the State of New Jersey from the Delaware to the southern part of Staten Island, and are the seat of large potteries. Dr. Newberry describes one hundred and fifty-six species of plants found in these clays, mostly from the middle bed in the series, with remains of, perhaps, thirty other species, not clearly identified.

Volume twenty-seven is the *Geology of the Denver Basin, Colorado*, by *S. F. Emmons*, *Whitman Cross*, and *G. H. Eldridge*. The publication of this report has been considerably delayed, as is explained in the preface, by discoveries made while the survey was going on that made further researches desirable. The importance of these discoveries is indicated when it is said that they bear upon the determination of the age of the Rocky Mountain uplift and the line between Cretaceous and Tertiary formations in general, and upon the recognition of coal-bearing horizons throughout the Rocky Mountain region. The area specially treated in the report is regarded as a type of the "foothill belt" of the Great Plains.

The twenty-eighth volume is the final report of the *Marquette Iron-bearing District of Michigan*, by *C. R. Van Hise* and *W. S. Bayley*, with an atlas, including also a chapter on the Republic Trough, by H. L. Smith.

The *Transactions of the Fourteenth Annual Meeting of the American Climatological Association*, Washington, 1897, includes, besides the address of President E. F. Ingalls, on The Antiseptic Treatment and the Limitation of Climatic Treatment of Pulmonary Tuberculosis, twenty-one papers by physicians on subjects related to health, climate, disease, and cure. One hundred and twenty-one members attended the meeting. The meeting for 1898 is to be held in Bethlehem, N. H.

The International American Conference, or Pan-American Congress, as it is more commonly known, in 1890, recommended the adoption by the Governments represented in it, of a common nomenclature designating in alphabetical order in equivalent terms, in English, Portuguese, and Spanish, the commodities on which import duties are levied, to be used in all transactions in which those duties are in question and in business documents. The nomenclature has been prepared, and is now published by the Bureau of American Republics at the Government Printing Office, Washington, as the *Code of International Nomenclature* of that bureau. It consists of three quarto volumes, giving the terms in three orders—English, Spanish, and Portuguese; Spanish, English, and Portuguese; and Portuguese, Spanish, and English, a volume being devoted to each order. The vocabularies embrace more than twenty thousand commercial terms used in the Latin-American trade, in each of the three languages; and are adapted to the counting room, the factory, the shipping office, customs offices, courts, to the use of economists and statisticians, and of all persons directly interested in the business relations of the states of the Western hemisphere. The book will no doubt be of great use and extremely valuable to publicists, business men, and students, and may easily justify its existence; but why the publication of it should be imposed upon the Government rather than left to private enterprise is a matter which one imbued with American notions of the functions of government, and particularly of those of the Government of the United States, will find it hard to comprehend.

In the ninth special report of the Commissioner of Labor a social and economic study of *The Italians in Chicago* is presented. A very minute analysis is given, under twenty headings, of the social and economical conditions, literacy and illiteracy, nativity, conjugal state, families, school attendance and other facts, by sex, nativity, age, etc. It includes data for 6,773 persons in all, 4,493 of whom were born in Italy, grouped into 1,348 families. The average size of these families is 5.02 persons each. As for occupation, 60.68 per cent of all the persons were of the unproductive class; less than one per cent were engaged in agriculture, fisheries, and mining, or professional work; 17.78 per cent in domestic and personal service; 10.14 per cent in trade and transportation; 2.78 per cent in some work in addition to their household duties; and 1.65 in some work besides going to school. Special remark is made upon the small proportion of women working at gainful occupations. The average weekly earnings of persons reporting were $5.93½, the highest $7.64½, and the average number of hours per week was fifty-nine. The number of illiterate persons was 2,752. Questions were asked of the housekeepers whether they had baked bread, spun, sewed, knit stockings, or worked in the fields, in this country and in Italy. In each case a considerable number were found who had done one or more of these things in Italy and ceased to do them here. Three hundred and five persons had sent the aggregate amount of $19,384, or an average of $63.56 each, to bring relatives from Italy; 9 had invested $2,440 in land in Italy and 76 had invested $260,665—or an average of $3,430 each, in land in the United States. Three hundred and ten—271 men and 39 women—had visited Italy since coming here—some of them twice, three, four, and even five times.

We have from George H. Barton, of the Massachusetts Institute of Technology, *Report B on the Scientific Work of the Boston Party of the Sixth Peary Expedition to Greenland*, detailing glacial observations in the Umanak District, Greenland, well illustrated.

In *Crusoe's Island*, of Appletons' Home-Reading Book Series, we have geography, travel, criticism, natural history, adventure, and notes of human traits, all combined in a single small, interesting, and instructive volume. The author, *Frederick A. Ober*, having visited the Antilles to study birds under the auspices of the Smithsonian Institution, became desirous of learning more about those attractive regions. With this desire occurred to him the determination to search out the truth respecting Robinson Crusoe, or rather respecting the spot which Defoe had in view in describing the scene of his great story. In this book he proffers a description of what he believes is "the veritable island in which Robinson Crusoe lived his lonely life, the scene of his wreck, his cave, his bower, his Man Friday; the birds and trees he saw or ought to have seen, together with the author's own experience." Various quotations from Crusoe have been used, which, together with the internal evidence of the book itself, seem to show conclusively that "the island of his exile was not Juan Fernandez in the Pacific Ocean, but Tobago in the Caribbean Sea, not far distant from the north coast of South America"; and Man Friday was a Carib from Trinidad. This, however, is not all the book. The Nature sketches, the tropical pictures, the descriptions of birds, the account of the Caribs, and the adventures, constitute of themselves a story of rare interest.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Reports and Bulletins. Cornell University: No. 144. Notes on Spraying and on the San José Scale. By H. P. Gould. Pp. 16; No. 145. Some Important Pear Diseases. By B. M. Duggar. Pp. 32.—Delaware College: No. 36. Potash. Pp. 24; No. 38. Anthrax. Pp. 16; No. 39. Sorghum. By C. L. Penny. Pp. 23.—Michigan State Agricultural College: Nos. 151-153. Small Fruits and Vegetables. Pp. 96; Nos. 155 and 156. Spraying, and Nurseries and Orchards. Pp. 32; No. 154. Corn Raising. By C. D. Smith, Director. Pp. 24.—Montana: No. 15. Larkspur Poisoning of Sheep. Pp. 16, with plates.—New Hampshire College: No. 48. Ninth Annual Report. By Charles S. Murkland. Pp. 32; No. 49. Inspection of Fertilizers. Pp. 18.—Ohio: No. 84. Sixteenth Annual Report. Pp. 72; No. 90. Sugar-Beet Investigations. Pp. 42; Newspaper Bulletin on Arsenite of Soda. Pp. 2.—Purdue University: No. 68. The Sugar Beet in Indiana; No. 69. Insecticides, Fungicides, and Spraying. Pp. 8.—United States Department of Agriculture: Recent Laws against Injurious Insects, etc. By L. O. Howard, entomologist. Pp. 68; The Cultivated Vetches. Pp. 8; Climate and Crop Service, North Dakota Section. Pp. 8; Miscellaneous Results of the Work of the Division of Entomology. Pp. 100.—University of Illinois: No. 49. The Sugar Beet in Illinois. Pp. 52; No. 50. Cost of Production of Corn and Oats in 1896. Pp. 24.—University of Kansas (Department of Entomology): Scale Insects Injurious to Orchards. Pp. 62.

Bailey, L. H. The Pruning Book, a Monograph of the Pruning and Training of Plants as applied to American Conditions. The Macmillan Company. Pp. 537. $1.50.

Beauchamp, W. M. Polished Stone Weapons used by the New York Aborigines before and during European Occupation. New York State Museum, Albany. Pp. 102.

Blakiston, Son & Co., Philadelphia. Books on Medicine and Allied Sciences published during 1896, 1897, and 1898. Pp. 32.

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Fragments of Science.

An Old-time Naturalist and his Guests.—A pleasing picture is given in Mrs. W. Pitt Byrnes's Social Hours with Celebrities of the person and home of Charles Waterton, a famous English naturalist and traveler of the former part of the century, a picture of whom astride an alligator is one of the early recollections of the writer. He had constructed in his house, for the mystification of his visitors, an odd figure of the missing link; was distinguished by some harmless eccentricities and affectations, and had a wonderfully intimate knowledge of the habits and proclivities of different animals. By the aid of this trait he seemed to be able to entice within his domain any animal he wished. His method was simply to prepare an attractive and convenient lodging for them suited to their taste. It was soon discovered and taken possession of by those it was intended for. For the accommodation of the starlings on his place he had some holes bored in an old tower, when each was at once occupied and made a nesting place by a family of the birds. "Finding his scheme successful, he next created a couple of towers expressly for the accommodation of these interesting birds, securing them immunity from the inroads of vermin by building them on solid stone pedestals, and with excusable pride he used to show to his guests the successful results of his ingenious arrangement." Many other birds were induced in a similar way to make their home on his estate. Having a place for their reception, the owls flocked to it at once, and "he soon had owls of various species by contriving such abodes as each according to its special habits preferred, and, having secured them, each colony added a new pleasure to his life." Among other measures for making Walton Hall pleasant for his animal friends, he prohibited the use of any kind of firearm within the grounds. At last, however, the rooks and rabbits became so numerous that it was necessary to hunt them out with guns and dogs. Yet the waterfowl, "of which there was a beautiful variety, . . . floated leisurely away from the noisy reports and seemed to think themselves perfectly secure on the opposite side of the lake; while the herons—perhaps to get a better view of the sport—perched on the highest branches of the trees till the battue was over. This heronry was one of his most successful achievements, accomplished by the simple mode of attraction I have already described . . . One of his keenest enjoyments was to take his guests up to the telescope room, where the instrument was always set in the direction of the heronry, in order that he might the more completely study the habits of its interesting inhabitants, and observe the strange construction of their nests and the curious positions they would assume."

Hygiene of a Natural Life.—A view of the actual conditions of health under a substantially natural manner of living among the natives of Labrador was given by Lord Strathcona and Mount Royal, chancellor of McGill University, in an address before the Middlesex Hospital Medical School. So long, the author says, as the natives keep to their own food and habits—they live largely on meat and fish, always cooked, and upon wild berries and fruits—they generally retain their teeth. But in the case of the natives from the interior, who adopted the food of the white men, they soon lost their teeth, and their lives were often shortened. Although the climate is severe and the summers are short, the country is healthy, and no doubt the open air conduces to freedom from disease. A form of Turkish or rather vapor bath has been in vogue among them as far back as we have any record. They rig up a small tent, put intensely hot stones inside, and pour water upon them, and then take the bath, which is regarded as very beneficial in many complaints. They have decoctions of herbs, and understand the preparation of nourishing foods, which are given in cases of failing strength and vitality. A decoction made from boiling crushed bones and marrow is largely used in cases of lung disease. Amputations are occasionally performed by the natives themselves, or by the European and Canadian residents, in a primitive way. What may be termed a primitive and somewhat rude form of antiseptic treatment was practiced in the district many years before Lord Lister introduced his great discovery. For the treatment of wounds, ulcerated sores, etc., a pulp was made by boiling the inner bark of the juniper tree. The liquor which resulted was used for washing and treating the wounds, and the bark, beaten into a plastic, pliable mass, was applied, after the thorough cleansing of the wound, so as to form a soft cushion, bending itself to every inequality of the sore. Scrupulous cleanliness was observed, and fresh material was used for every application. The incident shows that while discoveries and inventions are being made in centers of the highest civilization, they may yet be practiced in a primitive way in distant localities hard of access, while the world of science is still unaware of them.

Free Traveling Libraries in Wisconsin.—The institution of Free Traveling Libraries in Wisconsin was suggested to the Hon. J. H. Stout by the observation that the excellent public library at Menomonie was used by only a very small proportion of the country people entitled to draw upon it. Finding that the failure to take out books in larger numbers was due to the difficulty of getting and returning them and not to lack of appreciation of them, he procured five hundred books well chosen for popular reading, divided them into sixteen small libraries each containing thirty volumes, and distributed them, with rules and directions concerning the use of them, at suitable places in the country, to be sent, when that constituency had done with them, to some other, when one of the other libraries should take their place—and so on. The libraries went into operation in May, 1896. The demand that arose for the books encouraged the founder to make additions, and now there are thirty-seven traveling libraries in Dunn County, thirty-four of which are in active service, two are kept for reserves, and one has been exhibited in many parts of the State as a sample. Mr. Frank A. Hutchins, in his account of the libraries, says that the eagerness of the public for them "is touching, and as evident among people who read little as among the more intelligent." Illiterate parents seemed to know, almost by instinct, that if their children could read good books freely, they would be likely to be better men and women, and to hold better stations in life. Even rough men acknowledged the value of good literature. One place that had been described as a "hell hole" took the books notwithstanding its bad reputation, and in a few weeks showed double the circulation of its "scoffing neighbor." A storekeeper took in a library, hoping it would help get the loafing boys out of his store. "They are good boys," he said, "except for their habit of loafing, but they haven't anything to do and I can't turn them out." Of the thirty-four stations in Dunn County, twenty-two are in farmhouses, nine in post offices, two in country stores, and one in a railway station. The success of the libraries in all parts of the county was immediate and the interest has continued to grow, an increase in the circulation being mentioned in each succeeding report. Other places have taken up the idea, and there are now one hundred traveling libraries at work in Wisconsin.

A Tornado's Work on Trees.—After the tornado that swept a part of the city of St. Louis, May 27, 1896, a study was made of the injury done to the trees, the general results of which, with some of the technical details, were communicated to the Academy of Sciences by Mr. Hermann von Schrenck. Hardly a tree escaped injury of some kind, except possibly a few cypresses, which with their conical forms yielded to the force of the wind. Some of the uprooted maples and elms were simply turned over, and when straightened up a few days afterward resumed their former growth. Most of them, however, lost all their principal branches, and some were reduced to the trunk with perhaps two forks. These were trimmed up to look like very heavily pollarded trees. The new leaves were in their most active growth, and the destruction of them was very marked. The leaves were wet, and the injuries were evidently largely due to rubbing against branches. Flying missiles of various kinds aided in the destruction. "Grains of sand and small bits of wood and stone, flying through the air at velocities ranging from fifty to eighty miles per hour, were well able to shred the tender leaves." Many trees were left with hardly a sound leaf on their remaining branches. Other injuries were inflicted, not so evident as those to branches and leaves. "Numerous trees had trunks of sufficient elasticity to bend before the force of the wind without breaking. In swaying to and fro, the bark was considerably stretched on one side and compressed on the opposite side, and in the next instant the conditions were reversed. When this took place repeatedly, the bark was torn horizontally for several feet, sometimes on but one side, more often on both. The violent wrenching of a tree with a large top, like the maple, produced considerable strain upon the bark, especially when the force applied was a twisting one. When the strain was too great, the bark came off in sheets, or split longitudinally. . . . In many trees there was no outward sign of this injury for several months; not until the loosened bark died did any shrinkage take place, but then it split and curled up." Wounds made by flying pieces of wood and slate cutting away bark or imbedding themselves in the wood healed rapidly. In the course of June the axillary buds for 1897 on such twigs as were left began to unfold, and produced new leaves; and by September a growth of six inches or more had been made from these buds. In trees that had no such buds to fall back upon, numerous adventitious buds broke out from all parts of the trunk and remaining larger branches. In many of the most injured trees this growth was very small, and they failed to revive the next spring.

Archæology a True Science.—Following Sir John Evans's presidential address in the British Association on the Antiquity of Man, Lord Kelvin spoke for the claims of archæology to be placed among the strict sciences. There is too much tendency among scientific men, he said, to include under the term true science nothing but dead physical facts and certain definite branches of biological knowledge. To himself it had never seemed at all intelligible how geology could cease to be scientific when it touched upon human history. The fact that there was a poet or historian to narrate the history of a period did not take away this scientific character. We must never forget that geology, going to the earliest period of time when life first appeared upon the earth, brought us down to the present day. Volcanic changes of the earth such as are taking place now, remains of ancient action such as the marvelous lake of lava in Hawaii, are just as much subjects of geological research as if no reporter or narrator existed to record their history. The archæologist of mediæval history and the archæologist who has gone before human history and has helped the geologist to bring into definite connection the epochs of the world's existence, must all be welcomed as scientific geologists.

Adulteration with Antiseptics.—Special attention is given in the second report on Food Products of the Connecticut Agricultural Experiment Station to adulteration by antiseptics. These substances are for the most part, when taken in sufficient quantities and degrees of concentration, poisonous; and whether any one of them shall operate as a harmless preventive or remedy, or as an unhealthful or even fatal poison, to the consumer of food and drink containing it, depends upon the quantity and frequency of the dose. A number of successful food preservatives—such as sugar, alcohol, vinegar, lactic acid, salt, smoke, spices, and "sweet herbs"—are at once recognizable and known by their taste or odor. They are all commonly reckoned harmless to sound digestion and good health when taken in moderation, and are reputed to be unhealthful to certain classes of invalids, or when taken in excess. Within about twenty years several powerful antiseptics have come into very extensive and more or less surreptitious use, that are not recognizable in food or drinks by either taste or odor. These are salicylic acid, benzoic acid, and borax or boric acid. Salicylic acid, the essential ingredient of wintergreen and oil of birch, and benzoic acid, which exists in various balsams and gum resins, in the oils of marjoram, cassia, cinnamon, and cloves, in vanilla, sweet flag, plums, and cranberries, are efficacious only in the free state. Borax and boric acid are effective, cheap, odorless, and tasteless when mixed with food, and are much used. The testimony is conflicting as to the effect of the continued and frequent use of these preservatives upon the health of consumers. There are some falsifications which the public have long tolerated and people are careless of, as those of mustard, which is now sometimes hard to find strong enough to make a plaster of. "This kind of adulteration and the lying statements by which it is forced on the public have so habituated people to poor articles and low prices that purchasers of the recent generations probably do not know, in many cases, what genuine goods are, and do not realize what waste of money as well as loss of satisfaction there is in buying so-called 'cheap' wares, for which, considering the real value of the articles, they actually pay an exorbitant price."

Variety in Tobacco Pipes.—The pipe is treated by the Baron de Watteville as on the point of vanishing from use, being about to be superseded by the cigarette; even the Dutch, our author says, are abandoning their pipes and smoking paper-wrapped stems instead. There is evidently great exaggeration in this assertion, for we meet evidence daily in groups of fashionable smokers that the pipe has not disappeared, and is in no danger of going out of use. M. de Watteville's study of pipes nevertheless presents many features of interest. Consider the materials of which they are made, and the variety in their shapes. White clay is the predominant material for the bowls in England and the adjacent continental countries, red clay in the Mediterranean basin, black clay in Africa, porcelain and elm root in the Germanic countries, stone among some savage tribes, and wood almost everywhere; but where wood is not to be obtained, as in the arctic regions, fossil ivory, whales' bones, or walrus tusks are used. The stems are of wood or horn, of more or less artistic shapes among Europeans; rough ox horn in South Africa, antelope horn along the sources of the Nile, cherry in Hungary and Armenia, jasmine in Persia, bamboo in hot countries, gold, silver, or wood or leather trimmed with precious materials for the lips of wealthy Orientals, and reeds for the poor; and all draw and puff their smoke with equal pleasure. The form and size of the bowls depend more or less on what is smoked, and the fashion of smoking. And what is smoked? Tobacco by the Europeans of Europe and America—when it is not something else under that name. And these are as nothing in comparison with the hundreds of millions of Asiatics and other hundreds of millions of Africans who use opium, hemp, toadstools, rose leaves, tea leaves, cabbage leaves, and what not. We might say that everything is smoked, except tobacco. While tobacco pipes are generally of moderate capacity, some German and Danish smokers use pipe bowls nine or ten inches long and wide in proportion, and there are pipes in Africa and Damascus that will hold nearly a pound. There are pipes of two and more bowls, some Dutch seventeenth-century pipes with six and seven bowls, each having an elaborately shaped stem, being mentioned by M. de Watteville; and other pipes having several stems. The stems vary in length from the stubby pipe that the workman can smoke as he works, to the elongated six- or eight-foot coiled tubes of the Oriental nargilehs. The length of the stem is partly a matter of climate: short stems for cold countries, long for hot ones. The decorations of pipes are subject to the caprices of fancy and the prevailing fashion. Some Oriental pipes are fairly worth their weight in gold by virtue of the jewels with which they are adorned. They often bear coats of arms or a political device, like a cigar holder of the German Kulturkampf period, on which Bismarck was represented as a shoemaker. At every inhalation the figure raised its right arm and brought its hammer heavily down upon the back of a priest.

History in Minerals.—Palæomineralogy is the name which M. J. Thoulet has given to the study of the traces that events have left upon minerals, by means of which we may learn facts in the past history of the rock, whether it be a few days or months or thousands of years old. It aims to reconstitute the geography of the earth in its most remote epochs, in attempting which we have to take cognizance of the most minute details, as we would do in exploring a hitherto unknown island. The methods of this branch of investigation are illustrated by the studies of Sorby on the formation of liquid inclusions in crystals; by those of Des Cloiseaux and Maillard on the optical deformation of minerals, as a result of which we are able to ascertain whether the feldspar in the rocks has or has not been subjected to a red heat. Other experiments, physical and mechanical, permit us to read similar lessons in the history of minerals. Thus Daubrée, after studying the effects of wearing upon pebbles, remarked that "every grain of sand bears its history inscribed upon it." In this way M. Redgers traced the origin of the dunes of Holland to the Scandinavian rocks. Relations have been discovered between the shapes of grains of sand and the velocity of the currents in which they have been carried and the distance. The length of time the grain has been exposed to the action of water is a subject for further study; and it is hoped that it will be possible some time, by the examination of the fossils contained in a specimen, to determine the probable depth of the water adjacent to the deposits; and from the lessons furnished by a piece of limestone, for instance, to reconstitute the geological ocean in which it originated, estimating the dimensions of the sea, the force and direction of the currents and waves and of the winds that blow over it, and the depth of the water, its temperature, salinity, and density—all, in short, that we are only beginning to learn concerning our present seas.

Customs of Demerara Negroes.—The Demerara boatman, Mr. J. Rodway says, "has great powers of endurance. He can paddle for hour after hour, often against the stream, until you wonder how he bears such a strain. But when his work is done he falls asleep in almost any position. Under the burning rays of a cloudless sun which would blister your face he sprawls down in the *bateau* and sleeps like a dog." With his inclination to sleep during the day the negro will spend the night in gossip, dancing, or singing, and often in such a way as to be a nuisance to his neighbors. Such he is in his wakes, when fifty or a hundred people will gather in the yard, there being no room in the house, and, beginning with hymns and going on after midnight to songs and games, may wind up toward morning with a free fight. "Then there is the Cumfoo dance, one of the finest institutions in the world for producing nightmare. Two men beat drums with their hands, the one instrument producing a tum-tum and the other a rattle-rattle, almost without intermission during the whole night. At intervals of about a minute the party utters a weird cry in some African language, which startles you as you lie in bed vainly trying to sleep. As hour after hour passes your house appears to vibrate, the bed shakes, and your spine feels as if made up of loose segments." This and other dances are connected with the Obeah, the witch cult of the African. All the negroes and most of the "colored people" have an innate fear of the Obeah man, however much they may deny it to the whites; and Mr. Rodway tells of a captain of a creole cricket club who was sure his side would win a match game because a notable Obeah man had oiled their bats.

Causes of Sudden Death.—Cases of sudden death from natural causes are classified by Dr. J. Dixon Mann under the three heads of deaths which are due to the presence of a disease universally recegnized as one liable to terminate with sudden fatality—when satisfactory post-mortem evidence can usually be obtained of the cause of death; those due to the presence of a disease which when fatal does not usually end life abruptly—when the post-mortem evidences are usually inferential rather than conclusive; and deaths which do not result from any ascertainable disease—when no evidence is afforded by post-mortem examination. Heart disease is responsible for about half the whole number of sudden deaths of adults. Apoplexy and other cognate brain diseases rank second to it. Some of the diseases liable to terminate thus may exist without giving rise to any symptoms. Especially is this the case with certain diseases that have a prolonged course. The diseases of the second class are quite numerous, and, though several of them are usually inhibitive of motion when fully developed, they occasionally occur in a latent form, and terminate suddenly without their presence being even suspected. In some cases, with these diseases, the issue may be determined by an overloaded stomach. In a large number of instances the victim was undergoing some exceptional form of physical exertion at the time. In most of the cases in which death suddenly takes place without any cause being revealed on post-mortem examination, it is determined by some external causal influence either acting directly on the nervous system or mediately on it by means of a very slight and apparently totally inadequate physical impact. Therefore, in relation to this group, the term "death from natural causes" includes death arising from external and possibly abnormal influences, which, however, can not be regarded as being essentially lethal. Young children are especially liable to sudden death in a number of ways that do not obtain with adults. Infants die very readily from suffocation. Convulsions due to reflex irritation are a common cause of infantile death; and, finally, sudden death may occur to young children without any ascertainable cause.

Work of the Smithsonian Institution.—Among the publications of the Smithsonian Institution mentioned by Secretary Langley in his annual report is the memoir of Lord Rayleigh and Professor Ramsay on the discovery of argon, for which achievements the authors were awarded the first Hodgkins prize of ten thousand dollars. A memoir by Prof. E. Duclaux, of Paris, describes the methods and results of numerous experiments on the chemical rays of the sun by the exposure of oxalic acid to their action, from which it appears that the chemical activity and hygienic power of the sun's rays are not related to the apparent fineness of the day. The library has grown to contain 35,912 numbers. Special mention is made of the gift of Mr. S. Paleanof, of St. Petersburg, of more than three hundred volumes, mostly of Oriental works, with some Arabic manuscripts and many rare Armenian publications. The collection of Chinese coins, etc., bequeathed by the late George B. Glover, includes 2,025 specimens of Chinese, Annamese, Siamese, Japanese, and Korean coins; amulets and bamboo tally sticks used as money; Chinese paper money; foreign coins in circulation in China; and molds for casting coins—the series dating back to B. C. 770, and being continuous in the coinage of each dynasty. The work of the Bureau of American Ethnology has been prosecuted in the study of social organizations, linguistics, and decoration, as illustrated in the Indian tribes. The International Exchange Service, instituted in 1852, is still carried on, with 28,008 correspondents on its records, of which 21,427 are foreign. The operations of the Astrophysical Observatory have consisted chiefly in experiments in the bolographic analysis of the infra-red solar spectrum and the preparation of a report thereon. Information has been sought from the institution on all sorts of subjects, and has been furnished, or else the way to get it has been pointed out.

Dinner in the "Zoo."—The appetites of the twenty-five hundred animals, more or less, kept in the London Zoölogical Gardens furnish a curious field for study; and the matter of dealing with them is in some cases one of great difficulty. Only one animal—the hog—seems wholly indifferent as to the nature and quality of its food, and some species are extremely fastidious. Even the ostrich manifests a choice, and shows no relish for the nails and old iron with which it is credited with regaling itself on the African farms; and one species, the Somali ostrich, accepts only green food, refusing to touch the meat and biscuits of which the South African ostrich is very fond. The giraffe is one of the daintiest of beasts, living in nature on the leaves which it strips from trees, and in the gardens on the best clover hay, crushed oats, bran, and chaff, with fresh green tares and an occasional onion as relishes; and while it is very fond of fresh, whole apples, rejects one that has been bitten. Some animals are able to change their native tastes and acquire others, vegetarians becoming flesh eaters, and insect eaters turning to fruit and grain—as the kea, of New Zealand, which, once a strict vegetarian, has become very fond of mutton. Animals in the Zoo have to submit to more or less of this, for their native food is often unattainable. Nothing has been found on which the Australian koala will thrive, but the kangaroos and wallabies take kindly to grass and maize, and breed frequently. Unfortunately, the kangaroos are very subject to gout and corns. The polar bear is happy with horse blubber and plaice, and the crocodiles and alligators are satisfied with raw meat. The apteryx, which at home lives on worms and larvæ, feeds and prospers on imitations carved out of fillet steak.

MINOR PARAGRAPHS.

The debate concerning the presence or absence of considerable bodies of water on Mars has taken a new direction, and observers are now looking for optical evidence. If there is any large body of water on the planet, the image of the sun should be seen, when the proper conditions for the phenomenon exist, reflected from its surface as a fine point of light. No such image has been observed by the astronomers who have busied themselves most with Mars; and the conclusion is drawn that the planet's store of water is derived from the melting of the polar snows. Mr. Taylor, of York, believes that there is enough of this to affect the hue of the vegetation, the existence of which is indicated by dark lines and spots. There does not appear to be anything in this theory to preclude the possibility of Mars having a copious supply of rain.

While admitting that water may be an effective agent in making deposits like loess, M. J. A. Udden adduces reasons in the Bulletin of the Geological Society of America for believing that the loess in the Mississippi Valley was chiefly deposited from the air. It is often found in situations where the agency of water can hardly be predicated, and contains land shells. The universal presence of mineral dust in the atmosphere and its constant settling necessitate its accumulation in places where erosion is at a standstill or does not exceed the rate of atmospheric sedimentation; and the conditions now nearly correspond with this. In mechanical composition fine wind sediments and loess are largely identical. The loess beds are more uniform in structure than deposits from water can well be; and other features of the loess appear easier to explain if it be regarded as a land deposit.

The law of wills and inheritance is cited by Isaac F. Russell, in a paper on the Vendetta, as perhaps exhibiting more than any other body of justice doctrine the influence of kinship in legal evolution. "In point of historical development intestate inheritance precedes testamentary succession. The conception of a will as a means of disinheriting children and devolving an estate in accordance with the excessive partiality, fleeting caprice, or malignant temper of the testator, is a conception of our modern times, and was not familiar to the jurisprudence of primitive antiquity. In fact, ancient law regarded a will as a means of perpetuating the family in a succeeding generation by nominating a new chief on whom the headship was to be devolved. Little power of free testamentary alienation was recognized. The patriarch was more like a trustee or steward of common possessions belonging to the family than an original proprietor. He could not do as he saw fit with what seemed to be his. Often a son, on coming of age, could compel his father to make a partition of the family holdings, as suggested by Jesus's parable of the prodigal son.

The ninth of the series of annual abstracts of the Linnæan Society of New York contains a paper on the Fishes of the Fresh and Brackish Waters in the Vicinity of New York City, by Eugene Smith. Mr. Smith has found fifty native, eleven introduced, and twelve probably occurring native species, belonging to fifty-four genera and twenty-four families, showing that while the number of species is not large, the families are well represented. None of the species are limited to a small area of near-by country. "The fresh-water species of New England and of the Maritime Provinces as far as the Gulf of St. Lawrence are nearly all found with us, the exceptions being mostly the absence here of the more northern salmonids. Our vicinity represents a sort of border land between the very restricted fish fauna of the New England 'Zoölogical Island,' as Agassiz called it, and the far richer fauna encountered in the Delaware basin immediately to the west of us," with a few fishes that properly belong to the eastern Carolina basin.

A singular lithological formation is described by Prof. Persifor Frazer as exhibited by the ore in the Coletta mines of the Northern Black Hills of South Dakota. Uneven lenticular masses of ore have been deposited on the upper surface of the quartzite, suggesting a resemblance to sausages strung together by slender strings. The masses lie approximately in the same plane at intervals of thirty or forty feet, parallel with each other, and are intersected by other similar masses at right angles, the richness and quantity of the ore being increased at the junction. These corrugations, as they are called, are broad and shallow masses from five to twelve feet wide and from eight inches to three feet thick. Where they are united end to end, or at the parts analogous to the connecting string of the sausages, the rock becomes sandy and free gold is found. The strange formation is supposed to be caused by the existence of furrows or troughs in the surface of the quartzite in which the contents of the metalliferous solutions were deposited, but what caused the depressions is not clear.

NOTES.

A two-weeks' Summer School of Sociology, Economics, and Politics will be held at Syracuse University, Syracuse, N. Y., June 27th to July 9th, when seven hours of classroom work each day—five lectures and a conference of two hours—for eleven days, will be given; with a sermon by an eminent minister on the Sunday, both dealing with the religious bearings of present-day social movements. The lecture courses will be given by John R. Commons, professor of sociology, on Social Philosophy; Charities, Inebriety, Crime, and Child Serving, and City Government; and by Dr. J. H. Hamilton, professor of political economy, on Industrial Problems and Money and Banking. A Coöperative Boarding Club will be organized, by the aid of which and other means of reducing expenses the whole cost of sojourn at the school, including tuition charges will not be more than $14. Inquiries may be addressed to J. H. Hamilton, 306 Waverly Place, Syracuse, N. Y.

At the summer quarter of the West Virginia University, Morgantown, beginning July 1st and continuing twelve weeks, the teaching of sociology and allied subjects will be a prominent feature. The quarter will be divided into two terms of six weeks each, of which students may enter either or for any part of the quarter. Dr. Lester F. Ward will give two courses of class lectures on Pure and on Applied Sociology, and four public lectures. Prof. J. H. Hamilton, of Syracuse University, will deliver two courses on Money and Banking, and on Industrial Problems (July 11th to August 13th). Prof. J. H. Raymond will deliver two full courses through the quarter on the Principles of Economics and A Historical Survey of Sociological Thought, and also a series of public lectures on A Group of Social Philosophers. The summer quarter is not a "summer school," but an integral part of the university year, with all the departments in operation.

In a bulletin of the New Hampshire College Agricultural Experiment Station on dehorning cattle, the horns of cattle are described as consisting of two parts of different origin; the outer horny shell, derived from the skin, and the bony inner part or pith, derived from the skull. These parts are undeveloped in the infant calf, but begin at once to grow. If removed after some development, they must be cut away, the cut being made deep enough to remove the matrix. In calves the as yet soft and growing points of the horns are of small extent and can be destroyed with little trouble by the simple application of caustic potash or caustic soda. When properly applied, either substance destroys the matrix or growing point of the horny tissue and the underlying periosteum. In calves a few days old a surface half an inch or a little more in diameter will destroy these parts.

The announcement for the third year's work of the "Marienfeld summer camp for boys" is just received. The camp opens on the last day of June and closes on the 1st of September. It is meant to offer a thoroughly wholesome outdoor life for boys during the summer months, and to provide enough of the intellectual element to keep a sound balance of character. Professor Hendersen's ability as an instructor and the care with which the moral and social training of the members of the camp is carried on should make a summer's residence at Marienfeld an extremely valuable experience for the growing "youngster."

A rather unique cold pack is described by an English practitioner of Constanta, Roumania. He was called in to visit a Roumanian boy suffering from typhoid fever. He found the child's head wrapped in a white sheet, which he shortly observed to be moving; presently a small frog crept out on the pillow, and further examination revealed two or three dozen more, which the mother said she had been told to apply by some other doctor.

Some interesting revelations are made by correspondents of Nature concerning the refractoriness of insects to poisons. The caterpillar of the spurge hawk moth feeds on sea spurge, a plant that secretes an acid juice "so painfully poisonous that it is difficult to imagine a digestive apparatus competent to deal with it"; a druggist of Sydney, New South Wales, found weevils feeding and thriving on wheat soaked in strychnine; a certain caterpillar feeds on the virulent poison contained in the kernel of the seed of *Physostigma venenosum* and is not affected by it, while it is killed by hydrocyanic acid; and a weevil feeds with impunity the in last-named poison. The subject is an interesting one for investigation.

Two oceanic meteorological observatories have recently been established on the Azores, one on the island of San Miguel and the other on the island of Flores. The San Miguel observatory has regular cable connection with some of the European observatories, and that of Flores, although not yet in cable connection, promises to be very important. By the aid of these stations the European meteorologists hope to be warned of the approach of storms fifty hours in advance.

The French Journal *Le Veto* has counted 852 pieces in a bicycle, and adds that by closer searching we might find more.

An effort is making in Utrecht, Holland, to erect a monument by international subscription of Buys Ballot, the famous Dutch meteorologist, whose name has been given to one of the fundamental laws of the modern science.

The list of recent deaths among men of science includes the names of Bradney B. Griffin, author of papers on the fauna of the northwest coast of America, and of important papers on subjects of cellular biology, March 26th; M. Aimé Girard, professor of industrial chemistry in the *Conservatoire des Arts et Métiers*, in Paris, who was distinguished for his researches in the chemistry of vegetable fibers, wheat, meal, sugars, and drinks; T. Kirk, a New Zealand botanist, chief conservator of state forests, and author of Forest Flora of New Zealand; Dr. George Dragendorff, professor of astronomy at Rostock; Dr. F Sandberger, professor of mineralogy at Würzburg, aged seventy-two years; Jules Marcou, a distinguished French and American geologist, at one time professor of geology at Zurich, author of geological maps of the United States and of the world, and of numerous scientific papers, at Cambridge, Mass., April 18th, aged seventy-four years; Alfred U. Allen, originator and secretary of the Postal Microscopical Society and formerly editor of the Journal of Microscopy and Natural Science and of the Scientific Enquirer, at Bath, England, March 24th; Colonel Sir Vivian D. Majendie, inspector of explosives, London, April 24th; Dr. J. S. Hyland, a young mineralogist and petrologist of much promise, who was author of papers on petrological subjects, and at one time connected with the office of mineral resources of the United States, on the west coast of Africa, April 19th, aged thirty-two years; and Melville Atwood, geologist and metallurgist, who devised improvements in the working of zinc ore and introduced the blanket system of amalgamation, at Berkeley, Cal., April 25th, aged eighty-six years.

MARIA AGNESI

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THE EVOLUTION OF COLONIES.

By JAMES COLLIER.

I.—THE GENESIS OF COLONIES.

NOWHERE is the analogy between the individual and the society more applicable than at the beginnings of both. Though, as research advances, it will probably be found instructive at the very summit of the scale,* it is most illuminative at the base, where the individual and social organisms are often indistinguishable. It is then perceived to be an identity which binds together two widely separated provinces of knowledge. So close is the parallelism in the lower ranges that biological statements have only to be translated into sociological terms. The genesis of individuals is the key to the genesis of societies, and of those special societies named colonies. The biology of reproduction is the foundation of what may be styled coloniology.

Reproduction in its earliest or sexless form is discontinuous growth. Species can be arranged in an ascending series so as to exhibit an insensible transition from mere expansion of the parent mass to the budding off of new individuals. In certain species, like the sponge, the two processes are identical, and no true line of division can be drawn.

Colonization is the national mode of self-reproduction, and here again extension and multiplication are inseparable. Continuous population, remarks Grote, was not the law of the ancient world. A Greek city-state did not grow by expansion, as a modern state does; it grew only by multiplication. It did not annex adjacent

* See a recent treatise: Conscience et volonté sociales. By J. Novicow. Paris, 1896.

territory; it planted a colony. The coast of Asia Minor was colonized from the Greek mainland and the islands of the archipelago; the whole country would nowadays be annexed by a conquering power as the spoil of a single battle and permanently occupied; but it was successively settled by twelve Ionic and twelve Æolic colonies, each of them independent, with conterminous territories. A Greek colony grew in the same way. Naxos or Syracuse, on the Sicilian coast, might, either of them, have annexed the strip of territory between them; they colonized it. A Greek city, like a hydra, was incapable of expanding beyond a certain point; when that point was reached the mass broke and gave birth to a new city. Greece seems never to have got beyond the city stage of national development. Roman colonies were at first of the same character. They were planted in conquered territory, to hold it for Rome, and had a certain independence; as the intervening space between Rome and the colony was occupied by Roman citizens, the colony became continuous with the city and formed part of an undivided empire. So does every nation advance over its own territory. Each new clearing in the surrounding forest is the seat of a colony. The trapper and fur trader of the early days in North America were continually founding stations ever farther in the interior, which proved the nuclei of fresh settlement. The pioneer squatter of Australia is still moving into untrodden regions. Such colonies are like grasses, which are sown by the wind in a myriad separate plants, but become contiguous and form the carpeted turf. As reproduction is discontinuous growth, colonization is discontinuous expansion.

Growth is everywhere limited by the constitution of the organism; beyond a certain size the mass of cells can not be governed from a common center. The limit attained, the augmentation takes on the form and structure of the parent, and, thinning away at the point of junction, a new individual is launched into space. This is the form of reproduction proper to the lower half of organic creation—to invertebrate animals and the more lowly forms of plants. It is nonsexual, for it is produced neither by sexual individuals nor by separate sexual organs in the same individual, nor by the union of differentiated cells. It takes place in unicellular organisms, like the protozoa, by the rupture of the unit mass of protoplasm. Higher species, like sponges or hydras, protrude buds at any point or all round, which often remain connected with the parent. Or there may be an outflow at a single point successively repeated. The bud may be of all sizes, but is usually less than the parent; in rare cases it is equally large.

The earliest forms of colonization answer in all respects to asexual reproduction. The Phœnician and Greek cities were units;

they were social protozoa. When colonization took place, the city split "by natural fracture" (the words are Grote's) into two or more cities, each an autonomous and separate unit, as Phocæa sent nearly one half of its citizens to Sardinia. Or a city gave birth to a number of cities, as Andros (itself a colony of Eretria) to Samê, Akanthus, Stageira, and Argilus. Sometimes even Greek and Phœnician colonies (celebrated for their independence) remained connected with the mother city, as when Sybaris ruled over twenty-five dependent towns, and Carthage welded three hundred communities into her wide commercial empire. Often the reproduction was concentrated into a single extrusion or overflow, as when Thera colonized Cyrene. Most of the colonies were smaller than the metropolis, but Sybaris and Carthage must have greatly exceeded the parent states.

The Roman colonies were of higher structure. They may be described as midway between the city type of colony and the national type. The earliest were hived off from the mother city and acquired some of the civic character that she retained all through her history till she was nationalized in 1870. They may be compared, like certain of the Greek colonial groups, to the progeny that surrounds a zoöphyte and remains in asexual continuity with it; but, though they long retained a certain independence, they showed that they belonged to a higher type by being ultimately incorporated with the Roman Empire.

The earliest modern colonies, with a still higher potentiality of future development, had the same asexual character as the earliest Phœnician, Greek, and Roman colonies. They were the spontaneous offshoots of the mother country, and they were of low organization. The whole asexual or unorganized division may be classified in five or six groups.

The pioneers of colonization were pirates and marauders, fishermen and navigators, hunters and traders, explorers and discoverers, missionaries, runaways, adventurers, and convicts. It would be impossible to make a tripos of these very miscellaneous groups, or arrange them in the order of time or importance. As the exterior cells of a floating organism push outward at one or more points in search of food, many, perhaps most, colonies have their beginnings in the spontaneous efforts of independent sections of a community, situated on or near its boundaries, which extend to ever more distant parts their exertions in search of a livelihood. It is easier to rob others than to procure spoil or food where they found or reared it, and so privateers and marauding adventurers may have preceded fishermen and hunters. The earliest Greek and Roman colonies seem to have been founded by just such bands. The Spanish and

Portuguese colonies of South America were hardly more exalted in their origin. The Dutch East Indies were colonized by a band of landless resolutes from the Texel—disorderly youths (says the old chronicler), "whose absence was more desired" there "than their presence." The gentlemen adventurers who founded Acadia, like the two La Tours, the renegade Frenchmen (like De Castin and his half-breed son) and the forest rangers who "blazed the track" in Canada for future settlers, Kipling's "gentlemen rovers" and "lost legion," Mr. Cecil Rhodes himself, when he seized Matabeleland, are types of this class. The Jamieson raid was only the last of the daring burglaries by which ancient and modern colonial empires have been built up.*

The toilers who reap the harvest of the sea, half savage as they have always been and often still are, have at least more honest ways. It was mariners from Biscay, and Guipuzcoa, in the beginning of the fourteenth century, who sailed down the African coast as far as the Canaries and led the modern colonizing movement. Basque, Breton, and Norman fishermen were the first authentic visitors to the New World, and they were soon followed by fishermen from the west of England. They did not at first settle. Like the whalers and the Labrador fishermen of to-day, they went home as soon as they had filled their barks, returning each successive season. Their next step was to establish headquarters, as the Newfoundland fishermen at St. John's. Finally, they came for good, as did the English fishermen who settled on the Plymouth coast. Newfoundland may be described as the fishing colony *par excellence*. Few of the ancient colonies had a similar origin, but the five Greek colonies in the Gulf of Tarentum, together with Cumæ and famous Byzantium, may partly have so begun.

The establishment of commercial relations with indigenous peoples has been at the foundation of a much larger number of colonies. Commerce possibly arose out of fishing. As may still be observed on any seacoast, fishing vessels were converted into merchant ships and fishermen differentiated into seamen, some of whom were specialized into merchants. The first ships were also shops. The poet of the Odyssey describes a Phœnician ship as lying for a whole year off a port in the Grecian archipelago, engaged in constant traffic with the natives, and only departing when she had sold her entire cargo and taken a fresh one on board. Cutters laden with cheap drapery still coast along thinly populated countries, running up rivers and creeks and disposing of their merchandise to visitors conveyed to

* It is no longer the last. The Power that most vigorously protested against the raid—Carlyle's "pious Germany"—has herself, with a mixture of sanctimony and effrontery, laid violent hands on the territory of an unoffending people.

them in boats. The next step was to establish a warehouse on shore. In the early days of Australia sea captains brought out adventure cargoes, and on the second or third trip they landed their merchandise and sold it in shops which they built or hired. Just in this way we imagine the bold navigators of Phœnicia and Carthage to have traversed the Mediterranean, and, carrying their own wares to distant parts, received in exchange the products of foreign countries. As the trade grew, they left agents in charge of their warehouses who became the nucleus of a colony, as to-day Greeks or Germans settle in Liverpool or Adelaide and form a quasi-colony. The coasts of Sicily, Italy, and Greece, Africa and Spain, Gaul and Britain were thus dotted with commercial establishments, The Tyrian settlements are said not to have advanced beyond the stage of factories; yet Cadiz, the oldest city in western Europe, is of Tyrian foundation. The Carthaginians aimed at conquest as well as trade, welded some three hundred communities into an empire, maintained an army in Iberia, and fought for supremacy with the future mistress of the world. Yet neither were their settlements always colonies, and when the Greeks threatened to supplant them in Sicily they abandoned their outposts and concentrated themselves in a few principal points. The colonies of the most intellectual nation in the world were, nine tenths of them, commercial in their origin; the ancient Greeks were "a nation of shopkeepers." They unscrupulously seized an island adjoining the mainland, an isthmus or headland that could be easily fortified and defended, and there established a seaport, commanding a monopoly of trade with the natives. The Ionian settlements on the coast of Asia Minor answered to this description, and most of them had this origin. The coasts of Thrace, the Propontis, and the Black Sea were dotted with such merchant colonies. Calabria and Sicily were almost Hellenized. In far-away Marseilles and at the mouth of the Rhône were laid the foundations of two great mercantile cities. After the conquest of Britain a stream of Roman merchants and artisans poured themselves over the new field, and a number of towns—London, Bath, St. Albans—were formed as "the new result of freedom of traffic and immigration." The whole ancient world, which we think of as devoted to war and conquest, addicted to religious rites, absorbed in political struggles, or producing and enjoying immortal works of literature and art, had its existence based on industry and commerce, as the existence of the individual is based on hunger.

The modern world has been built up on the same foundation: The Venetians continued the eastern trade of the Roman Empire, and everywhere in the Levant left colonies. Portugal and Spain, with their ports opening on the Atlantic and inviting to discovery, were the first to take the colonial field. The invention of the astrolabe and the discovery of the magnet made distant voyages practicable. All through the fourteenth and fifteenth centuries they stretched ever farther the scope of their trade till they had annexed the Atlantic islands, begun settlement at the southern cape, and laid the foundations of those colonies their shadowy claims to which (in Mashonaland) for some time resisted, a few years ago, the more invincible assertion of British armed occupation. Columbus's great voyage of discovery was but an extension of shorter trading voyages, and one of his three ships was equipped by merchants. Dutch colonies were still more an extension of Dutch commerce; they were planted mainly under the auspices of chartered companies, and while Spanish and French colonizers threw a glamour of religion over their undertakings, and Swedish and English colonies were often largely philanthropical, trade has ever been the chief, almost the sole, object of Dutch colonization. The West India Company founded New York, which was for years no more than a place of meeting where fur traders exchanged European commodities for skins, and the commercial agent of the company was its first governor. Canada was won for civilization by the same agency. Cartier's second expedition, which gave Canada to France, De Monts's and Champlain's were fitted out, in whole or part, by Breton merchants of St. Malo. Even the French Company of the Hundred Associates, which set the seal on the colonization of Canada and had Richelieu and princes of the blood for figureheads, was financed by merchants. Companies of the East Indies and the West, of the North, the Levant, and Senegal were formed in France in rivalry of those in England and Holland. The commercial conquest of Algeria and Madagascar was attempted by such companies two centuries before it was finally accomplished. But the tale of the foundation of colonies by commerce would be too long to tell. Not only the origin but the extension of colonial possessions are the work of commercial enterprise. Africa is at this day being colonized by chartered companies. Governments are deliberately colonizing and annexing to create markets. "Trade follows the flag," says Lord Salisbury. The French admit that no Platonic views but the need of openings for trade lies behind their late-born colonizing ambition; and Señor Canovas del Castillo avowed that Spain is making desperate efforts to keep Cuba and the Philippines not only for historical and sentimental reasons, but as Spain's last markets. What needs to be noted here is that the commercial colony, like the adventurers' and the fisheries colonies, is at first mainly asexual. The merchants who engineer them do not themselves go out to them; the traders do not at first permanently settle; there are few women, and few children are born. Not out of such beginnings will a sound colony grow; not out of such materials can a normal society be built up. Commerce alone can not generate a true colony.

The traders desert the coast, and the more daring become hunters and trappers like the natives. This pioneer form of colonization is best seen in the *coureurs de bois* of old Canada—bold, adventurous men who had broken away from the restraints of civilization and plunged into the free life of the forest. They intermarried with Indian women, and their half-breed sons formed the *personnel* of the companies which controlled the fur trade for two centuries. Their meeting places with the Indian trappers were scenes of drunkenness and debauchery which threw the missionaries into despair. They jealously guarded their game preserves against the approaches of settlement. It was a degraded type of civilization, and, though it was the base, it was never the root of Canadian society. Not out of it could a true colony spring.

The big-game hunters of old days were men of a similar type, and were at least the beginners of the French colony of Louisiana. The big-game hunter of to-day is an Englishman or a Frenchman in whom the instincts of the savage periodically break out under a polished surface. One of the best specimens of the race, Mr Selous, claims that such men rank with missionaries as pioneers. The big-game hunters, he contends, opened up Rhodesia. The hunters of gorillas in the south and of lions in the north of Africa have been the precursors of settlement. But they have seldom themselves settled in the country they roamed over, and left few descendants to inherit their strength and courage.

Often associating with the hunters and trappers and merchants, and sometimes (like Joliet, the discoverer of the Mississippi) differentiating from them, are the explorers. An adventurous race, who traverse continents while the hunters scour kingdoms, the Ibervilles and La Salles, the Stanleys and the host of African and other travelers are the indispensable forerunners of annexation. Baker and Speke and Grant almost compelled the English occupation of Egypt. European travelers of many nationalities led inevitably to the wholesale partition of the Dark Continent. Missionaries sometimes accompany them, as Marquette did Joliet, or they sacrifice, like Livingstone, their own high calling to the broader vocation of the explorer; or they follow in his track, as three hundred missionaries arrived in the wake of Stanley's explorations; or, themselves the first explorers, they found villages, as the Jesuits did all over Canada and in Illinois and Michigan, some of them to become centers of colonization or great cities like Montreal; or they occupy and administer wide territories like Paraguay; or they pioneer civilized settlement, as in Algeria and Madagascar, throughout the south seas and the far East. Sometimes, it must be sadly confessed, they make settlement practicable by emasculating the natives, as the Jesuits the Hurons and English missionaries the Maoris. But none of these classes are by themselves colonizers. They do not permanently settle, and the missionaries are as jealous as the fur traders of the advance of European occupation. Many of them, in North America and New Zealand, have advocated and encouraged the most fatal of all measures to a true colony—the formation of a race of half-breeds.

Hunting passes into pastoral pursuits by the domestication of the animals captured, as slavery arises out of war. The Greek colony of Cyrênê and its offshoots, Barka and Hesperides, were stock colonies; but the first settlers being exclusively men, they intermarried with the natives, and the true colonization dates from a later settlement of both sexes. The drovers of reindeer and the pastoralists of the Alps are in like manner male groups. Cattle-breeding northern Australia is still in the polyandrous condition of having ten men to one woman, and that was probably near the ratio of the sexes in the early days of the country. It is apparently the same on the *estancias* of Brazil, and Darwin states that "these Spanish colonies do not carry within themselves the elements of growth." Yet they lay the foundations for normal societies. What Bancroft says of the herdsmen of Carolina is true of all countries: they are "the pioneers of colonization in the wilderness." Sheep colonies, like New South Wales, are a stage nearer complete self-propagating societies than cattle colonies like Queensland. Shepherds and shearers are long semi-nomadic, and the squatter is sometimes the only family man; but villages grow up at the confluence of grazing runs to supply necessaries, shoe horses, build and repair, bait and accommodate. The "station" and its lord may be the true social nucleus, but expansion arises from the village with its families and rudimentary industrial organization.

The most advanced and most potent of all the pioneer types of colony alone remains to be mentioned. The mining colony is not a modern invention. Phœnician Cadiz and Græco-Italian Cumæ were, the one commercial and the other agricultural as well. But Athenian Amphipolis, with its auriferous and argentiferous mountains, must have been settled for its mines, and barren Thasos, like the adjacent Thracian mainland, must have been colonized by the Phœnicians, as afterward by the Greeks, for its gold mines alone. Gold discoveries on a great scale are nevertheless modern and characterize two of the three great epochs of colonization. The South American exodus of the sixteenth century and the Australian and African rushes of the nineteenth have this feature in common that they had in themselves no principle of expansion. The mining settlement is a mechanical formation and not an organic growth. Its rise has been too often observed to need description. A lucky prospector finds a gold- or silver-bearing reef, possibly in a district indicated by a geologist, who is thus also a pioneer. The news spreads like the cry of fire. From the adjacent colonies and distant countries a mob of adventurers and old gold diggers crowd in and clamor for concessions. The field is soon white with tents, huts spring up as by magic, a "store" is set up, a hotel follows or precedes, and in a few weeks a wild-cat township comes into existence. It grows with the growth of the "diggings," and declines with them. When they are exhausted, the fortuitous concourse of its inhabitants scatter as swiftly as they came, and the township leads a death-in-life existence on the tailings; or, if the country is favorable, the solider portion of the miners take to agriculture or industry, and the town becomes a manufacturing or distributing center. Denver, Ballarat, and Johannisburg are types of the miner's camp turned into flourishing cities. South America was founded as a series of gold and silver colonies, and saltpeter has lately established an English colony in Bolivia. The gold discoveries of 1851 "precipitated Australia into a nation." In still more recent days silver has generated several of the Western States and built up a great political party. Within the last decade gold has transformed a scattered population of farmers and big-game hunters in South Africa into a warlike republic. The precious metals thus start colonies, or give them an impulse when founded. They may even change their base. A pastoral and agricultural country, like Victoria, may be converted into a commercial and industrial country. Other results are more questionable. Population is attracted, but it is disorderly and without cohesion, and state industries have to be created for the support of the multitudes whom the exhaustion of the mines has thrown out of employment. Hence arise huge loans and oppressive debts, protective duties, overgrown cities and plethoric communities, where the brain is overfed and the extremities are starved.

These are, roughly outlined, the pioneer types of settlement that constitute the first chapter in the history of all colonies and countries. They have been assimilated to the asexual method of reproduction because they belong to a low grade of organization. They are initiated mainly by men; they do not, taken singly or all together, form a perfect social organism or a self-subsisting society; and they are incapable of a prolonged existence.

Asexual passes into sexual reproduction by a series of gradual transitions that are no longer a mystery; they have been well discriminated by Professor Le Conte. The mechanical rupture of simple organisms is followed by budding on any part, that by budding on a special part, that by the formation of an internal organ, which in a still more advanced stage generates at once male and female cells; differentiated sexual elements are next produced by independent sexual organs, which are ultimately assigned to separate individuals. Asexuality passes through bisexuality into unisexuality.

If the analogy between the individual and the society is much more than an analogy; if it is an identity; if social processes are but a continuation and expansion of animal processes, every one of these transitions should find its counterpart in the genesis of colonies. Coloniology, however, is itself still in the pioneer stage and must be content with hinting at resemblances that future Le Contes will demonstrate. The fission of unicellular organisms is paralleled by the "natural fracture" of Greek and Phœnician urban states. Gemmation at any point finds its analogue in the way by which continental countries plant colonies, or colonies plant fresh colonies, in contiguous territory. Specialized gemmation may have its parallel in the limitation of emigration from maritime countries to certain ports. Internal gemmation may take place in societies when emigration is engineered from within, and the internal bud becomes a sexual organ when emigration agencies are formed. The dominating races—the last conquering immigrants—in any country are the male elements; the subjugated races are the female; emigrants at first are chiefly of the former, but the latter ultimately join the stream. Lastly, when England sends to the United States its enterprising and Germany its revolutionary citizens, while Celtic Ireland sends, doubtless with many of a different sort, its pick-and-shovel man and its serving woman, there is an approach to the marriage of nations. State union, indeed, for the purpose of propagation took place in very early times. Three Phœnician cities jointly founded a third, where, however, the three colonies led a semi-independent existence side by side. Many Greek colonies were established by two mother cities; but all of these were of the same stock, and their association rather resembled the conjugation of infusorians. Had Corinth (of the masculine Doric race) joined Ionian Miletus in colonizing Sicily, it would have been a true sexual union.

The acquisition of the secondary sexual attributes by peoples will, no doubt, be yet shown to follow a parallel course to their acquisition by the individual. The lowest races seem to be everywhere sexless. The Australians and Fuegians and Veddahs exhibit no masculine qualities; they are not conquering, inventive, progressive. Among the Red Indians we may observe the beginnings of differentiation: the Iroquois and the Hurons subjugated other tribes, and one such defeated tribe was condemned to be called "women." Both of these peoples, again, voluntarily or not, became females to the invading English and French. The French are still males to the Arabs and Malagasy; they were lately males to the Alsacians and Lorrainers, whom they so impregnated with their civilization that the Germans can only re-Germanize their own countrymen by recolonizing the two provinces. Can a nation lose its sex? Prince Bismarck, who is a noumenalist among statesmen and goes to the root of the matter, as another retired statesman is content with exploring a wide surface, describes the Celts and Slavonians as feminine, while the Germans and English are masculine. Were the French conquering and creative while they were still led by a Teutonic aristocracy; and is it because they deposed their rulers in 1789 and 1830, and allowed the Celtic substratum to come to the surface, that they have lost the leadership of Europe in war, science, and philosophy? Did Spain cut her spermatic nerve, so to speak, when she killed off her Protestants and freethinkers? If it was so, we might describe national sex as being produced by the emergence, commonly the immigration, of a conquering class or race. The effects are very different in different cases. The Hindus imposed their government, language, and religion on the races of India; the Hellenes on the Pelasgians. The Goths and Germans imposed their government and laws on the Iberians and Celts, accepting the language and religion of the indigenes, which, however, were those of Rome. A race may thus be at once male and female, as France receives her militarism and her music from Germany, while she communicates her plastic and literary art. All existing and extinct civilized peoples are or have been bisexual. By the adventurous male elements in them they found pioneer colonies (those of our first or asexual division, which might perhaps have been called male colonies, like certain low organisms). By male and female elements together they build up and organize the higher colonial groups belonging to the second or quasi-sexual division, in which each colony is a more or less complete reproduction of the mother country, and is therefore capable of self-subsistence. Here, again, as in the first, the arrangement is a compromise between the logical and chronological order.

1. It may seem an abuse of language or an error in classification to place *convict colonies* in this division. The foundation of such settlements might rather be considered the expulsion of feculent matter from the social organism than the planting of the healthy germs of a new national life. Yet low as it is—far lower than the higher groups of the pioneer division—the convict colony bears within it the potentiality of complete development. Crime, unhappily, is

confined to no class. A convict ship, therefore, carries out to new lands representatives of most of the ranks, professions, and occupations that go to make up a complete society. Time being given—and a long time, for its growth is abnormally slow—it will develop, if only into the apelike caricature of the country that gave it birth. Colonies that have a convict origin, or have at different stages been inoculated with convictism, are numerous. A number of Greek and Eastern communities seem to have had no better beginnings. The depopulated town of Dymê, in Achaia, was settled by Pompey with pirates. A robber chief reconstructed on the Galatian frontier the decayed town afterward named Juliopolis. Five of the Ægean islands were Greek penal settlements. A portion of the bands that invaded England were pirates; the aristocratic and hygienic Isle of Wight was made by the Jutes a voluntary convict settlement. After the failure of Hispaniola, Columbus had partly to content himself on his third voyage, as on his first, with prisoners respited from the gallows. Brazil was at first a penal settlement, and it was afterward re-enforced by a very superior kind of "convicts"—the victims of the Inquisition. The equipment of the early expeditions to Canada was of like kidney. Roberval was granted permission to ransack the prisons and take thence thieves, homicides, and fradulent debtors. "Banished men and the usual complement of villains" made up De Monts's expedition. "Scoundrels of the deepest dye" crowded to Laudonnière's standard. Captain John Smith's company consisted in part of felons and vagabonds. Eighty convicts were among the first French colonists of Louisiana. All through the seventeenth century "Newgate birds" were shipped to North America, especially to Maryland and Virginia. North Carolina, like ancient Rome, was "the sanctuary of runaways." It somewhat moderates our admiration of the nobly conceived project of Gustavus Adolphus to find that the Swedish settlement on the Delaware was designed in part as a penal colony. But it was toward the end of the last century and in the first half of this that penal colonies were established on a colossal scale. For the long period of fifty-two years (1788–1840) New South Wales was the recipient of every variety of convicted felon—some fifty thousand being dispatched to it from first to last. In 1803 some of the more incorrigible specimens were selected and sent to Van Diemen's Land, which continued to receive them for half a century. Twenty-one years later the same abandoned classes were shipped to the colony afterward named Queensland, but only for eighteen years. A more appalling origin for a colony can not be imagined, and the tragic page of history is blackened by no more sickening horrors than deface the early annals of Australia. Yet so little were the consequences of the transportation system dreaded that West Australia, where golden Coolgardie had not yet been discovered, petitioned to share in the indirect benefits of it, and was a convict settlement from 1850 to 1868. A sanguine speculator only ten years ago proposed to colonize the Bay of Plenty in New Zealand with the sweepings of English jails and workhouses. It must be admitted that the apparent results go far to confound the criminologist; more law-abiding communities than these do not exist. What miracle has been wrought to bring wheat from tares and grapes from thistles? It is not enough to say that the flood of immigration to the gold fields has swamped the penal elements. Tasmania has had little gold and but few immigrants, yet Tasmania is as respectable as New South Wales. The self-destroying power of evil will account for the disappearance of much: there were always more men than women, and many of the women were barren, as is usual when both sexes are profligate; there were usually few children, and the convicts were not long-lived. On those that survived, and on their offspring, social influences were immensely powerful. As the chemistry of the earth (in Whitman's poem) absorbs the products of putrefaction and decay, and gives them back as luxuriant vegetation, the higher chemistry of an orderly and moralized society assimilates all that is good in disease and crime by utilizing the criminal and repressing and ultimately extirpating his antisocial impulses. These admissions being made, an irreducible residuum remains. The "white trash" of the Southern States has long been affiliated on the transported English prisoners of the seventeenth and eighteenth centuries. Mr. Eggleston finds further traces of them in the "hereditarily pauper and criminal classes" of the North. Professor Fiske has come upon the tracks of the "mean white" in "little isolated groups of wretched hovels" among the mountain villages of New England. And other observers, forgetting the corruption of human nature and its perpetual downward tendency, have been tempted to discover in Australian towns and villages unmistakable evidence of convict ancestry.

2. Often almost as low in actual working, but unquestionably higher in theory and result, are the many *military* colonies through which rather the imperial than the properly colonizing nations have built up their empire. Their objects are everywhere the same: to hold in permanent subjection a country that has been conquered by arms, not won by commerce or industry, and to repress the incursions of hostile peoples. They are what Cicero called them, *propugnacula imperii*—"outworks of empire." The Assyrian colonies seem to have been of this type. The settlements differ somewhat in character, according to the quality of the troops employed. The lowest of them may have been the Nubian people whom Diocletian

transplanted from the Libyan Desert to Syene in order to guard the frontier, and the next lowest the strange colony of Saracens whom the freethinking Frederick II planted in Apulia. Much higher were the colonies of vanquished Goths and Ostrogoths, Franks, Gepidæ, and Vandals whom the Roman emperors settled on the frontiers—in Spain and Britain, Africa and Illyria and Asia Minor, Greece and Palestine. Whether as legionaries or veterans, these soldiers seem to have been accompanied by their families, and where they did not drive away the indigenes (as they did at Camolodunum, in Britain) they were granted lands and supplied with the instruments of tillage. Some of these military settlements, like two of the Numidian colonies, became centers of Roman civilization; others, like Chester, Gloucester, and Colchester, grew into prosperous towns; still others—and these perhaps the majority—like the colony of veterans planted by Hadrian on the desolate site of Jerusalem, did not thrive. Higher yet than these were the towns settled with Greek soldiers by Alexander and the Alexandrids. Of the Macedonian, Thessalian, and Thracian, Thessalonica was alone important; some of those in Asia Minor were in later times flourishing. Military colonies are not unknown in mediæval and modern Europe. The Frank kingdoms of Jerusalem and Cyprus, the principalities into which the Eastern Empire was partitioned, and Constantinople itself, where in the beginning of the thirteenth century there was a Frank colony of fifteen thousand souls, were all military colonies, though of brief existence. Under the Swabian emperors, small colonies of noble and peasant Germans were established in Davos and other Alpine districts in German interests. Spain conquered South America by planting a series of military colonies. France, always more conquering than colonizing, is but slowly converting Algeria from a military into an industrial colony. Even colonizing England has planted military colonies in Ireland, Nova Scotia, and Ohio, besides having temporary camps on her frontiers where towns grow up, as at Raglan and Otahuhu, in New Zealand; and the pensioner settlement of Onehunga may be taken as an image of an ancient Roman colony of veterans.

3. We seem to rise considerably in the scale as we leave behind us colonies founded on the lust of conquest, and arrive at colonies whose formation was governed by *political* motives. They are always more or less collective; they sometimes take place *en masse;* they are often directed and organized; and they are homogeneous. Involuntary migrations are among the earliest of them, as when the Achaians and Œnotrians, driven out of the Peloponnesus and Italy by the Dorians and wild tribes from the Apennines, emigrated to Sicily. The best known, and more voluntary, are those of the

Ionian cities of Asia Minor, after their subjugation by the Lydians and Persians. A collective Pan-Ionian emigration to Sardinia was proposed, but a series of sovereign states was too disunited for such heroic action, and it took place piecemeal. The whole of the Phocæans, taking with them their wives and children, their furniture, and the decorations of the temples, sailed for Sardinia, but more than half of them lost heart and returned to the subject city which they had sworn never to behold again. The inhabitants of Teos emigrated to Thrace and founded Abdera, to the Bosporus and settled Phanagoria. Many of the Samians fled to the promised land of Cyrene and some to Sicily. Other cities were almost depopulated. After the captivity, and still more after the conquest of Jerusalem, Jewish colonies were similarly dispersed over the greater part of the Greek and Roman world. The Albanians of Scanderbeg, who so bravely resisted the Ottomans, took refuge in Apulia. The Salzburgers described in *Hermann und Dorothea*, and the noble *émigrés* of the Revolution, with their headquarters at Coblenz, are recent examples of the collective migration of political colonies. Many Greek colonies were the offspring of internal dissensions in the parent state: Theræan Cyrene is doubtfully said to be one; Syracusan Himera is another. Roman colonies of the same origin were often organized by popular leaders as a safety valve, like those of Carthage and Narbonne by Caius Gracchus. The loyalists, who to the number of forty thousand emigrated to Canada and there settled Ontario after the Declaration of Independence, are a striking example of purely political colonization. But it is rebellion oftener than loyalty that founds colonies. The discontented New-Zealanders who, some fifty years ago, projected an independent republic somewhere in Oceania, anticipated (in imagination only) the Queensland journalist who, to escape from the tyranny of British ideas, emigrated a few years ago with a band of sympathizers to the wilds of Paraguay, there to found, amid impossible surroundings, the Utopia that is now struggling for existence.

4. It may seem a mere refinement to distinguish *imperial* from political colonies. Yet there comes a time in the history of great nations when a spirit of proselytism takes possession of them, and they are irresistibly moved to stamp their institutions and ideas on only half-reluctant peoples. The Athenian colonies planted by Cimon and Pericles, when the queenly city was at the height of her power, were to some extent of this description. More truly propagandist were the five hundred urban communities, with the imperial cities of Alexandria, Antioch, and Thessalonica at their head, founded by conquering Alexander and his victorious generals. Nothing less than the Hellenization of the known world was their

aim. Their immediate success was wonderful; their ultimate success has been in a manner complete. With the same systematic activity, continuous, homogeneous, and conscious of its aim, the earlier emperors pursued the Romanization of the world. Cities like Nicopolis and Marcianopolis were founded; Corinth and Patras and Jerusalem were raised from the dust; old provinces were colonized afresh, and newly discovered countries thrown open to settlement. Yet the panegyrist of the empire has to admit that the results attained were in part illusory. The flourishing industry and commerce, literature and art were no products of despotism, but of the earlier free institutions; and the new foundations were artificial and without true life. In modern France, not commerce only, but far-reaching schemes of dominion, dictated to Colbert the annexation of Newfoundland, the purchase of the West Indies, the conquest of Senegal, and the systematic colonization of Canada and Cayenne; not gold, but visions of empire, dazzled the imagination of La Salle when he colonized Louisiana. A school of French publicists optimistically ascribes the present colonizing fever in their country to "an impulse of patriotic idealism." England seems only lately to have become fully conscious of the vocation assigned to her by Hegel seventy years ago as "the missionary of civilization"; and Lord Rosebery's description of the British Empire as "the greatest secular agency for good existing among mankind" is no longer a hyperbole. Germany and Italy, with doubtful success or total failure, follow in her footsteps. Even the United States, once a self-contained commonwealth, now exercises an effective suzerainty over the South American republics, and, finding a continent too narrow for her ambition, annexes the Sandwich Islands. We are at the dawn of a new era of colonization.

5. Early in the century a group of French writers, of whom the most famous was Chateaubriand, reacting from the materialism of the French Revolution, proclaimed Christianity the source of European civilization. A generation later another idealist, Edgar Quinet, generalized the conception, and eloquently exhibited religion as the generating principle of every society: the source of its political institutions, art, literature, and philosophy, the secret of its life and the key to its history. In due time comes the scholar, and the late Fustel de Coulanges applied the view to the civilizations of India, Greece, and Rome. The other day Mr. B. Kidd placed the doctrine on a physiological foundation. But if this theory is true of society in general, it must be true of those special societies named colonies and (what is here in question) of *their* genesis. As has been seen, colonies have many origins. Yet religion is one of them: there are *religious* colonies. The religious sentiment has at all times played a

large part in colonization. Phœnician Melkarth was the companion and protector of Tyrian colonies. The Hebrew colonization of Palestine was God-guided. Apollo, through the Delphic oracle, was the instigator and director of not a few Greek colonial settlements. Sometimes he nominated a founder; of two cities the god himself was "œkist." Perhaps we may say that all the later Greek and Roman colonies were placed under divine guardianship, but religion was too closely bound up with government to be of itself the basis of a colony. It is in modern times that the maturity of the religious sentiment has given rise to independent social formations. The great Puritan settlements of New England are unapproachable examples of the strength, cohesion, durableness, and power of generating new communities which that sentiment can give. Its complexion may vary. There are many degrees between the ecclestiastical theocracy of Massachusetts and the secular theocracy of Pennsylvania and west New Jersey, with the transcendental theocracy of Rhode Island as a middle term. In east New Jersey three distinct types were blended. Where religious enthusiasm does not generate colonies, it endows them with a principle of life. Commercial New York might have remained an inorganic community of traders but for the influx of exiles from all Protestant Europe, who gave it the energy of a world-city. If Canada was founded by fishermen and adventurers, it was built up by religious zealots. The sturdy communities of French farmers and Dutch Boers in South Africa had religious dissent as their *raison d'être*, and still have a strong religious faith as their chief social bond. In our own time two remarkable colonies have been established in the south seas on religious or at least ecclesiastical principles. The Otago Association and the Canterbury Association, which settled the southern parts of New Zealand about the middle of the century, were respectively the outcome of the disruption of the Kirk in 1843 and of the Tractarian movement in the same decade. Both societies had all the characteristics of church settlements: the emigration was homogeneous and of an excellent class; the clerical element had a large share in the government; and many of the institutions had an ecclesiastical tinge. But neither of them was a theocracy even of the mitigated seventeenth-century type, and the lapse of thirty years sufficed to show how ill-adapted were both of them, as originally designed, to the new surroundings. Yet the large and elevated part played by these communities in the history of New Zealand, the importance of similar smaller nuclei in other Australasian colonies, the immense influence of the Puritan, Presbyterian, and Quaker States in North America lend no small countenance to those who believe, with Quinet, that religion is "the substance of humanity."

6. Even in *philanthropic* colonies religion is an auxiliary. Georgia was projected partly in the interests of "the persecuted Protestants of Europe," and was promoted by the Society for Propagating the Gospel. Whitefield and the two Wesleys were among its first evangelists, and a body of German Moravians formed a settlement in its territory. These religionists even sought to turn it into a religious society, but found their heterogeneous materials refractory. It was the flame of philanthropy, burning strong and clear in the breast of James Oglethorpe, that gave the colony its distinctive character. The relief of the poor and the oppressed is a motive that places it higher than any ecclesiastical foundation. Baron Hirsch's Jewish colonies may be equally religious and humanitarian. Miss Rye's and other Canadian settlements are the offspring of pure philanthropy, still subsidized mainly by the orthodox and the devout.

7. Lastly, there is a type of colony peculiar to our own time and impossible earlier, which we may call (for want of a better name) *sociological*. It was the invention of one who to the reflective faculty of a De Tocqueville joined the executive capacity of a Turgot, and who had the good fortune, denied to both, of seeing his conceptions realized. We shrink from the Darwinian ascription of so much to "accident," but accident plays as large a part in history as in nature, and it was accident which constrained Edward Gibbon Wakefield to throw his energies into the work of colonization. Having examined minutely and considered profoundly the origin and circumstances of existing colonies, he came to the conclusion that a colony, to be successful, must faithfully reproduce the essential members of the mother country—a conclusion in strict conformity with the biological analogy. The superior classes had been lacking to previous emigrations; to induce them to emigrate, and to keep the whole administration in their hands, he proposed to abolish the wholesale granting of lands, or the selling of them at a cheap rate, and to dispose of them at a price which would reserve them for the rich; with the proceeds of the fund so raised the poor were to be sent out as laborers and artisans. State churches and an aristocratic form of government were necessary corollaries. Five colonies were (1837–1851) actually founded on this basis in South Australia and New Zealand. They were administered by men the most capable who have ever governed these countries; the settlers were of the best kind; and they were powerfully aided in England. But the circumstances were unfavorable. The natives in New Zealand were hostile, and the local government was implacably opposed to the growth of an *imperium in imperio*. The attempt to reproduce in a new country a moribund artistocratic society was foredoomed to

failure; the company surrendered its charter, and the settlements were absorbed by the New Zealand Government. They nevertheless contributed greatly to the colonization of a country then covered with forests and occupied by cannibals. Together with the two ecclesiastical provinces of Otago and Canterbury, they have communicated the energy and self-reliance that distinguish the "Britain of the South."

If the foregoing classification of colonial origins be correct, two conclusions necessarily follow: First, colonial societies in their mature state have not been developed out of the primitive loose aggregations of various kinds which everywhere sprang up in favorable circumstances, but are rather founded upon them, as the Pliocene on the Miocene strata. Next, the part which intention and design, conscious and organized action, have played in social evolution is greater than sociologists have hitherto been willing to admit. And as, in virtue of the law that the development of an individual is a recapitulation of the development of its ancestral species, the genesis of colonies is a rehearsal of the genesis of all societies, social origins will have to be studied a little less from imagination and a good deal more from history than has yet been attempted.

WEATHER FORECASTS: THE MANNER OF MAKING THEM AND THEIR PRACTICAL VALUE.

By E. J. PRINDLE.

WE are not always conscious of the great influence which the weather exerts on our affairs. Fair weather gives zest and interest to everything, while dark clouds depress us and take the life and sparkle from that which was before most attractive. In cases of severe illness the weather sometimes makes all the difference between life and death. Our emotions are largely under its control. The farmer's first thought in the morning and his last consciousness at night relate to the weather. The sailor, the pleasure seeker, the shopper, and the builder are all deeply concerned with the weather, to say nothing of the children, whose lives are quickly limited to the four walls of the house on the approach of bad weather.

It is a matter of so much concern that our Government spends annually about nine hundred thousand dollars for the maintenance of its Weather Bureau, in order that we may know a few hours beforehand what to expect of the elements.

The first attempt at scientific forecasting of the weather was the result of a storm which, during the Crimean War, November 14, 1854, almost destroyed the fleets of France and England. As a storm had raged several days earlier in France, Vaillant, the French Minister of War, directed that investigations be made to see if the

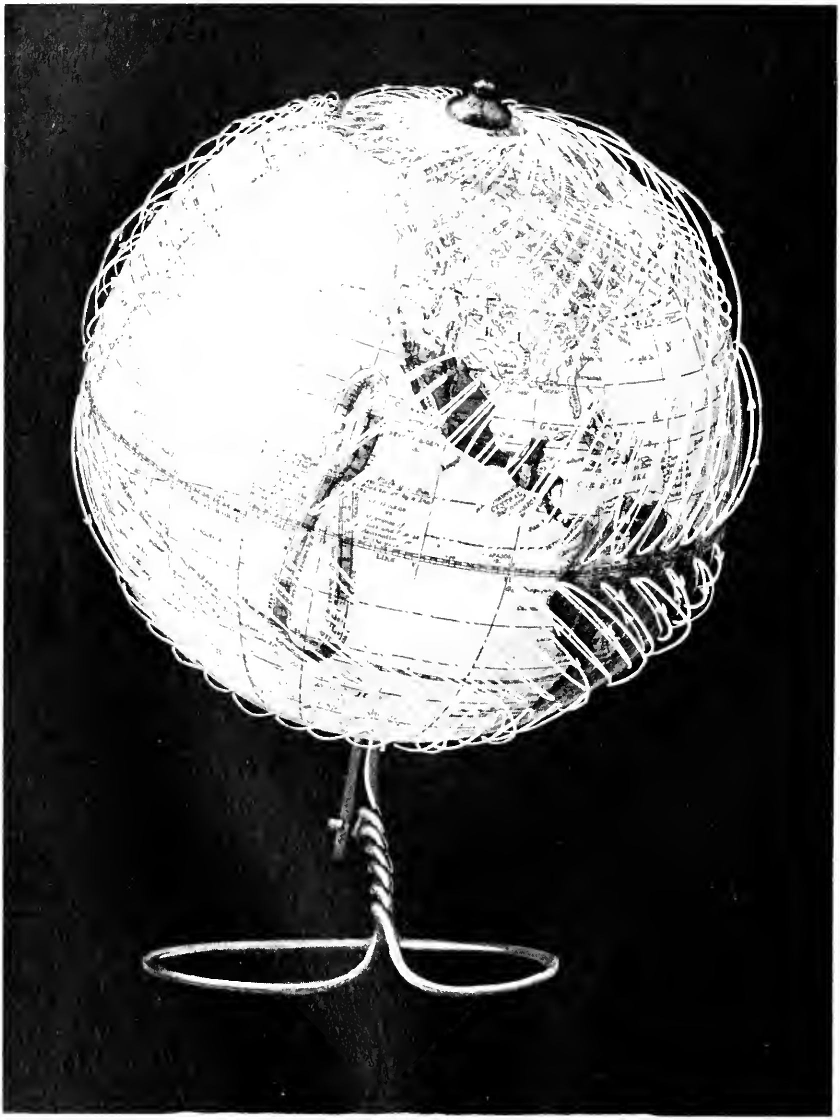


FIG. 1.—GENERAL CIRCULATION OF THE ATMOSPHERE.

two storms were the same, and if the progress of the disturbance could have been foretold. It was demonstrated that the two were in reality one storm, and that its path could have been ascertained and the fleet forewarned in ample time to reach safety.

In order to intelligently predict the weather for even a small section of the country it is necessary to know the conditions that exist over the whole United States, and over as much of the rest of the world as possible. The Weather Bureau receives observations from one hundred and fifty-four stations. There are four hundred and eight-five miles of telegraph lines and submarine cables operated by the Weather Bureau for connecting with such points as Cape Hatteras, Nantucket, and islands in the Great Lakes and on the Pacific coast.

To understand the plan of work of the Weather Bureau it will be necessary to enter to some extent into the laws of the weather; but it will not be found difficult to see how the forecasters of the bureau, with their greater knowledge in the same directions, are able

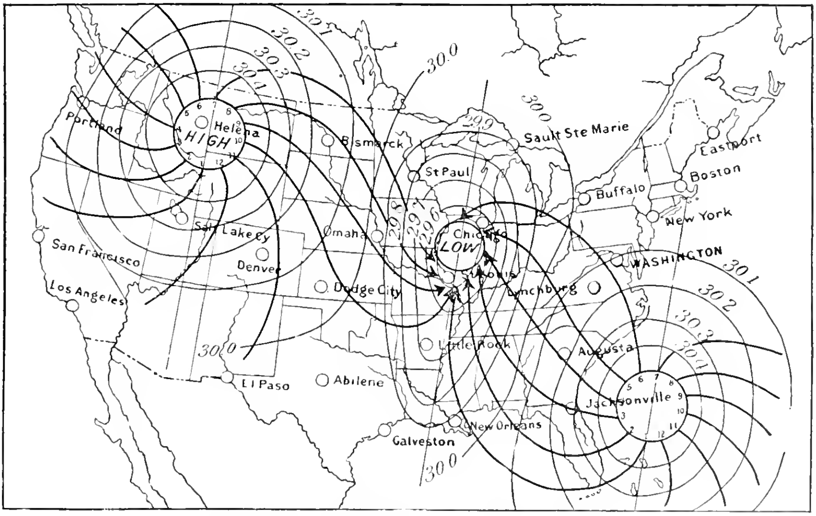


Fig. 2.—Showing Isobars and Wind Lines.

to foretell the weather correctly, as they do, in over eighty-two per cent of the predictions. Strange as it may seem, the weather does have laws, laws that are inflexible, so that, if the conditions are correctly understood, the changes in the near future can be confidently predicted. All of these laws have not, however, been discovered, and some that are well known have yet to be satisfactorily explained.

Primarily, the winds result from the sun heating the tropics to a much greater extent than it does the polar regoins, causing the air to rise in the tropics and flow toward the poles at a high altitude; from which regions it returns toward the equator along the surface of the earth. Owing to the rapidly lessening circumferences of the parallels of latitude toward the poles and other causes, there is an ascending belt of air near the parallel 64, toward which the surface wind blows from each side, and a descending current of air near parallel 32 of each hemisphere, from which the air flows north and south.

Friction between the surface of the earth and the atmosphere tends to carry the air with the earth in its rotation. As the velocity of the earth's surface is nothing at the poles and increases toward the

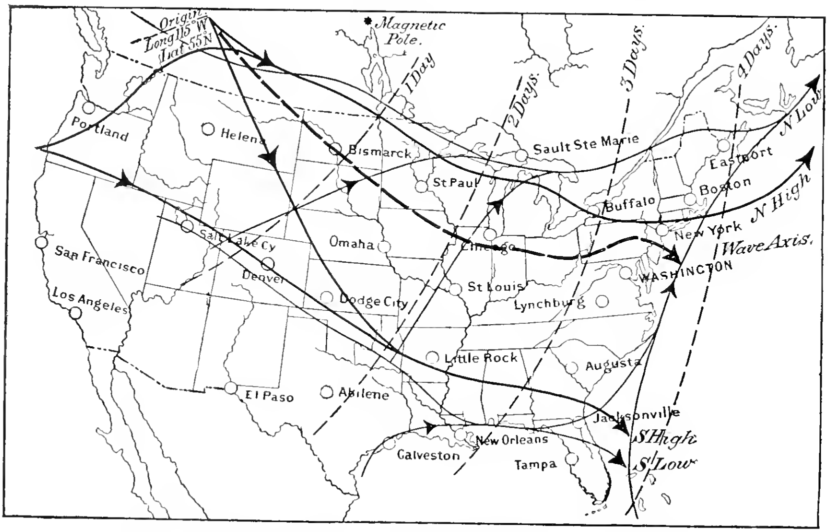


FIG. 3.—SHOWING THE ORIGINS OF THE HIGHS AND THEIR PATHS.

equator, those winds which blow toward the equator will lag behind and have a westerly direction, and those that blow toward the poles will retain their greater velocity of the lower latitudes and travel faster than the more northern parallels, resulting in an eastward direction over the earth's surface.

In the temperate zone of the northern hemisphere there is a general northeasterly drift of the surface atmosphere at a fairly regular rate of motion, and this causes our storms almost without exception to travel from west to east. This eastward tendency of all atmospheric disturbances is the basis of all predictions.

In the great ocean of air, as in the ocean of water, there are constantly occurring waves and hollows, or areas where the air is piled to an unusual height, showing increased pressure on the barometer, and areas where the height and pressure are less than the normal. These high and low areas, or "highs" and "lows," as they are technically known, travel in a general northeasterly direction. In Fig. 2 is shown an actual case of a low between two highs in the United States, and it is extremely interesting to notice the laws of the winds around them. The finer, oval lines are used to connect all points having equal barometric pressure. They are known as "isobars." The heavy, arrow-tipped lines show the actual direction of the wind as it was observed on this occasion. It will be seen that the winds flow spirally outward from the highs in the direction of motion of the hands of a watch, while they blow from the high spirally inward toward the center of the low in the opposite direction to that of the watch's hands. These same directions will always be found about a well-defined high or a low. A severe storm and a low will always be found together, and the law of the winds about a low enables navigators to judge of the direction of the center of the storm and to steer away from it in time to avoid disaster. The lows are called cyclones, because of the inward direction of their winds; and the highs are known as anticyclones, because the winds resulting from them flow outward.

The highs are caused by descending currents from the upper air due to increased density which results from cooling by radiation of heat from the upper air. The lows are caused by the air absorbing heat from large areas of the earth's surface where the sun has acted strongly. The heated air ascends and flows outward at the upper levels, reducing the barometric pressure. If the air is moist,

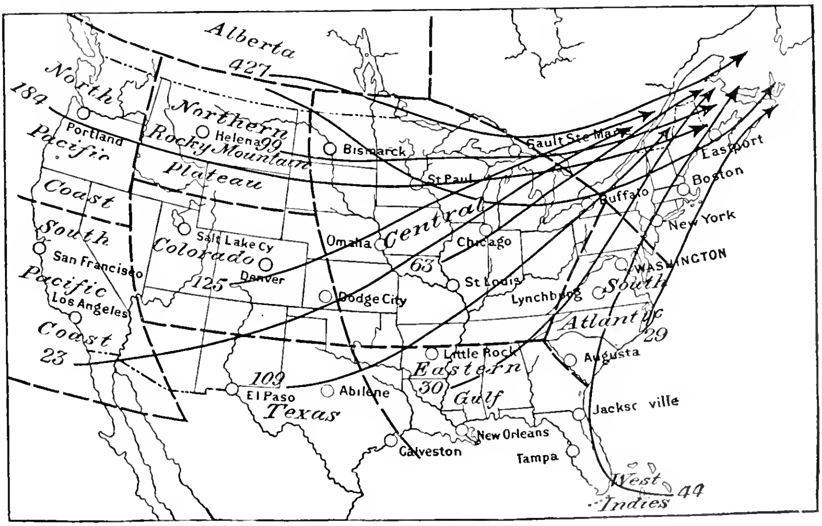


Fig. 4.—Showing the Origins and Paths of Storms.

when it rises under the action of heat, its pressure lessens until the moisture is condensed; and the liberated latent heat serves further to heat the air and increase the upward flow. The condensed moisture usually appears as clouds or rain.

The highs are found to enter the United States from only two points. In the winter they usually originate in Alberta to the north of Montana, and they follow either of two well-defined paths in their eastern course. One path leads southeasterly to the Georgia coast, from which locality the high follows the warm, moist air over the Gulf Stream to the Gulf of St. Lawrence, there to pass beyond our observation (Fig. 3). The other path extends across the Great

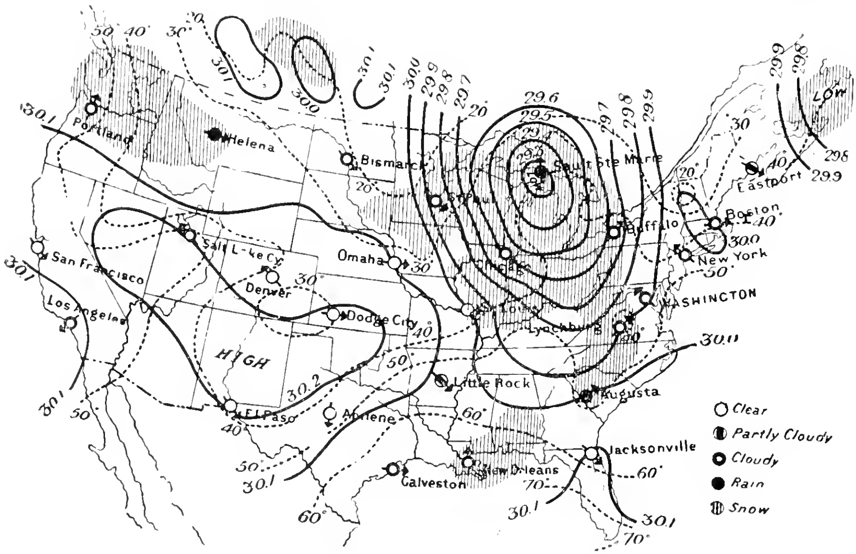


FIG. 5.—A NEWSPAPER WEATHER MAP.

Lakes and New England to the same destination. In summer the larger number of highs enter our country from the Pacific Ocean about the latitude of Oregon, and either pass northward along the Pacific slope, whence a crossing is made over the Rockies to the northern circuit from Alberta, or through the Salt Lake region to the southern circuit from Alberta. Having determined the circuit which a high will follow, and having found its rate of travel from observation, it becomes largely a matter of calculation to foretell its progress across the continent.

While the highs have only two points of entrance to the United States, the lows or storms originate in nine different districts throughout the country. In Fig. 3 the heavy full lines represent the paths of the highs. The lighter full lines indicate the origins and paths of the lows, and the heavy dotted line is the axis or path of the middle of the cold waves. It will be seen that the lows follow the two circuits, northern and southern, of the highs, and that they occasionally cross over from the southern to the northern circuit. Some of them originate in the West Indies and travel up the Atlantic coast.

Fig. 4 shows the nine districts into which the United States has been divided with reference to the origins of storms and also the paths of the storms. All the paths cross New England, and the chart shows what a harsh, changeable climate this section has. There is no other region on the face of the earth, not even excepting Siberia, where there are such sudden and violent changes of weather as in New England. All storms that visit the United States cross New England and pass off toward the St. Lawrence Gulf, if they do not die out on the way. Lows move on an average at the rate of twenty-five miles per hour.

We have now seen that highs and lows have definite points of origin or entrance into the country, and that they follow well-established tracks. It is clear, therefore, how their location a few hours in advance may be estimated.

Highs are not usually accompanied by rain, but the temperature falls in advance of them as they pass over the country. The lows, on the contrary, are the storms, and usually carry rain with them. The greatest rainfall is usually to the northeast of the center of the low, and the low tends to move toward the point where there is the heaviest rain. The temperature of the air rises in the regions to the east of the low, and falls to the west of it.

Having located the highs and lows that exist and determined what paths they are likely to follow, from the laws that have been

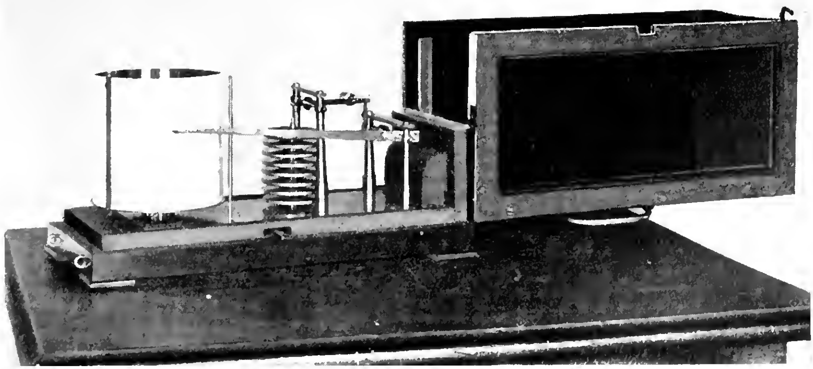


Fig. 6.—The Barograph.

explained, it may be seen how the direction of the wind, the occurrence of rain, and the changes in temperature can be predicted (Fig. 5). Fig. 5 is a reproduction of a newspaper weather map. The dotted lines connect all points having the same temperature, temperatures ten degrees apart being chosen. The full lines are lines of equal barometric pressure, there being a line for each one tenth of an inch difference in pressure. The arrows fly with the wind. Rain is indicated by the shaded areas. It can be observed how the winds blow with the hands of a watch around the high, which is central over New Mexico, and in the opposite direction about the low, which is central over Sault Ste. Marie. The temperature is higher to the east of the low, and falls behind the low and before the high in their eastward progress. The rain is seen accompanying the low and to the east of it.

For the purposes of forecasting it is necessary to know the barometric pressure, direction of the wind, and state of the skies. All this information is telegraphed to the Weather Bureau twice daily from

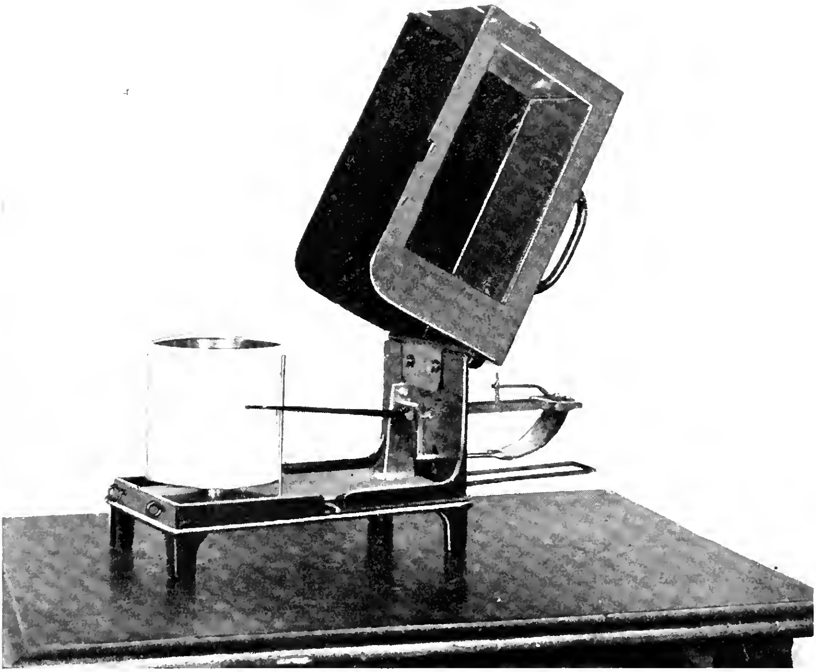


Fig. 7.—The Thermograph.

each of the stations of observation, and all other telegraphic business must give way to this for the time being. Each message is, by means of a cipher, usually expressed in ten words or less. The observations are taken at 8 A. M. and 8 P. M., Eastern time. The results are exchanged with the Canadian Weather Bureau. The principal stations are provided with recording instruments, so that a continual record is kept of all these features of the weather. While the instruments appear complicated, they are based on principles that are easy of comprehension.

The barograph consists of a series of corrugated sheet-metal cells placed one upon the other and connected at the upper end of the series to a system of magnifying levers that operate a pen. The pen point rests upon a sheet of paper which is held on a cylinder

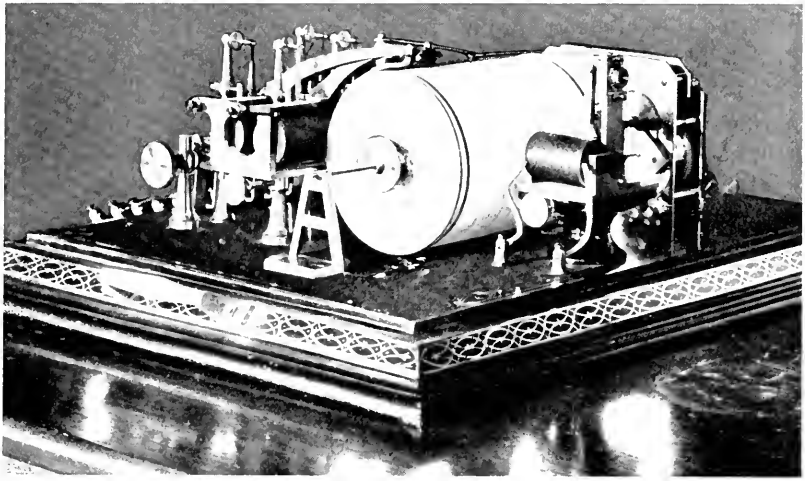


FIG. 8.—THE TRIPLE REGISTER. Front view.

having clockwork within it to give it a slow rotation. The varying pressure of the atmosphere causes the cells to contract and expand, and this motion, transmitted through the levers, causes the pen to trace a line on the graduated paper whose co-ordinates represent the pressure of the atmosphere at any given time.

The thermograph is somewhat like the barograph in principle. The element that is affected by the temperature is a metal cell that has the form of a curved and flattened tube, one end of which is secured to the framework and the other end connected by a link to a lever carrying a pen point. It has also a clock-driven cylinder with its graduated sheet of paper. The tube is filled with alcohol, and, as the liquid expands, it straightens the tube and moves the pen over the paper, making an irregular line that represents the ever-changing temperature.

The maximum and minimum thermometers record the highest and lowest temperatures respectively in the twenty-four hours. The former is an ordinary mercurial thermometer with the addition of a contraction in the tube just above the bulb. The heat forces the column of mercury past the contraction, but it can not return to the bulb when the temperature lowers. The minimum thermometer is an alcohol thermometer that has a colored glass float in the liquid. When the alcohol contracts, the skin of the liquid carries the float down with it; but, when the temperature rises, the float remains to mark the lowest temperature.

The amount of moisture present, or the humidity of the air, is determined by a comparison of dry and wet bulb thermometers. They are both ordinary thermometers; but the bulb of the latter is covered with muslin that is wet. In the latest form of instrument the thermometers are mounted on arms carried by a shaft that is rotated by a crank which is geared to the shaft. The motion of the shaft rotates the thermometers in vertical planes and causes the water in the muslin to evaporate more or less rapidly according to the amount of moisture in the air. This evaporation lowers the temperature of the thermometer; and, from tables constructed after long experiments, the degree of moisture can be determined by the difference in temperature between the two thermometers.

The direction and speed of the wind, the hours of sunshine and cloud, and the amount of rainfall are recorded by the "triple register." The instrument has a cylinder on which is carried a graduated sheet of paper for the record. The cylinder is supported by a horizontal shaft that is turned by clockwork. On the shaft is secured a spiral wire that engages grooves in a bearing of the shaft; so that, as the shaft turns, it and the cylinder are moved along. This would cause a stationary pencil to trace a spiral on the cylinder. The shaft carries two arms parallel to itself that pass

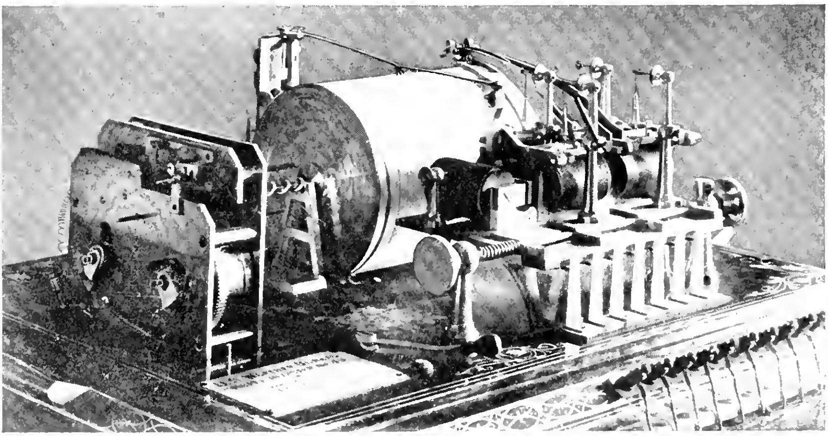


Fig. 9.—The Triple Register. Rear view.

through a yoke which is turned by the clock, this arrangement permitting the shaft to recede from the clock under the action of the spiral. The cylinder revolves four times in twenty-four hours, so that each record passes across the paper four times.

The wind vane is an arrow-shaped vane mounted on a vertical shaft. The tail of the arrow is gradually broadened laterally to give it greater steadiness. A sleeve is fastened on the shaft of the wind vane and is provided with four cams, each of which extends over three eighths of the circumference and the central points of which are a quarter of a circle apart. Four contact levers, having rollers in their ends, bear on these cams; and, when raised

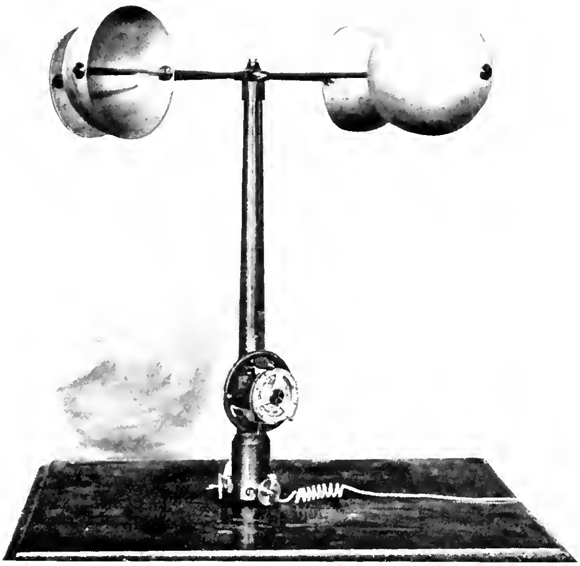


FIG. 10.—THE ANEMOMETER.

by the cams, the levers touch contact springs having a wire from each that runs to one of four magnets beside the "triple register." The levers and magnets are all connected with batteries. The magnets act on armatures that are carried by levers, one for each magnet, which have pens that make a dot on the paper of the cylinder every time the magnet acts. One or two contact levers are always elevated by the cams to make a contact. The cams are so arranged that only one cam acts when the vane is directed to a cardinal point of the compass; but, when it is between two such points, two of the cams are acting. Thus the eight principal directions of the wind are indicated by the four pens. The clock breaks the circuit of the vane except for an instant each minute, so that the pen in action makes a dot each minute.

The velocity of the wind is registered by an instrument consisting of a vertical shaft which carries four horizontal arms having sheet-metal cups on their ends. The wind acts more strongly on the open faces than on the backs of these cups, and causes them to revolve the shaft. Through gearing connected with the shaft, pins on an index close an electric circuit for every mile the wind travels, and the current through a magnet of the triple register causes a sidewise motion of a pen acting on the paper. The number of jogs in an hour thus made in the line traced by the pen gives the velocity of the wind. The ninth and tenth pins are connected, so that one long jog occurs in the record for every ten miles, making it easy to count the total.

FIG. 11.—THE SUNSHINE RECORDER.

The sunshine recorder is constructed on the principle of the differential thermometer. Inside of a vacuum tube is a tube having a bulb formed on each end, and the inner tube extends into the lower bulb nearly to its bottom. Both bulbs contain air; and the lower one, which is coated with lampblack, has a quantity of mercury in its lower part. The mercury also extends up into the tube. Two wires enter the opposite sides of the inner tube between the bulbs, and these wires form part of the electrical circuit of the one of the magnets of the triple register which magnet occupies a side of the triple register by itself. The armature of the magnet, through a pawl-and-ratchet mechanism, gives the pen lever of this magnet a step-by-step motion, first to one side and then to the other. This action takes place when the sun, shining on the heat-absorbing lampblack, causes the air and mercury in the lower bulb to expand and force the mercury up the inner tube until it completes the electrical circuit between the wires in the inner tube. The clock breaks the circuit except for an instant each minute. When it is cloudy the pen simply traces a straight line.

The recording rain gauge consists of a cylindrical casing supporting an open funnel above and a reservoir below. Beneath the mouth of the funnel is a pivoted tray or "bucket" divided into two compartments and pivoted so that it can be tipped to bring one compartment under the funnel mouth; and, when that is filled with rain water, it will be overbalanced and tip down, thus pouring its water into the reservoir and bringing the empty compartment under the mouth of the funnel. This tipping of the bucket momentarily closes an electrical circuit including the sunshine-recording magnet of the triple register, and causes the pen to follow a motion in general like the sunshine record, but so irregular as to time, and having either more or less steps in a given time according to the rapidity of the rainfall, that it is easily distinguished from the sunshine record. The clock does not interfere with the circuit of the rain gauge.

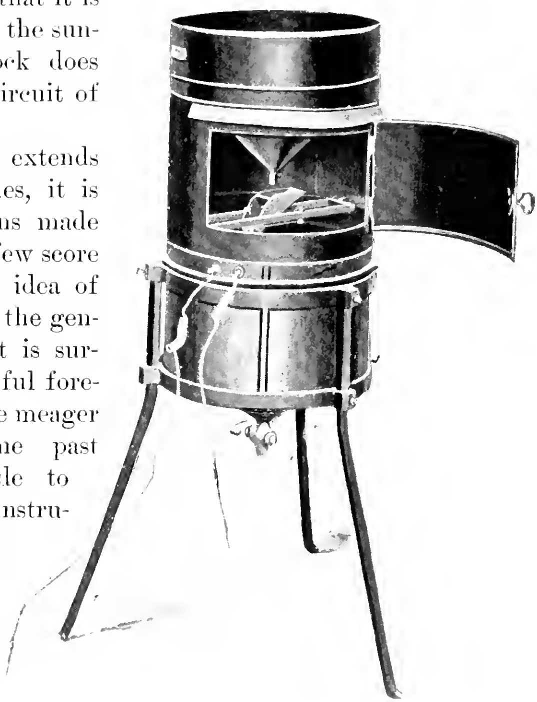


FIG. 12.—THE RECORDING RAIN GAUGE.

As the atmosphere extends upward some forty miles, it is evident that observations made at the usual height of a few score feet can not give much idea of the condition existing in the general mass of air, and it is surprising that such successful forecasts are made from these meager data. For some time past efforts have been made to carry up recording instruments by means of kites or trains of kites. The kite shown in Fig. 14 is a typical Weather Bureau kite. Its weight is but six pounds, and yet it presents to the wind an area of fifty square feet, and has lifted a weight of one hundred pounds in a wind of twenty-five miles an hour. An altitude of seven thousand feet has been reached with the kites. A special instrument is made for attachment to the kites that electrically records the temperature, pressure, and humidity of the air and the direction of the wind. The combined weight of the instrument and battery is but two pounds and a half. When it is considered that, owing to the weight of the air above, the bulk of the air is comparatively near the surface of the earth, it will be seen how very valuable are observations made at the heights reached by these kites.

It may well be asked: Of what practical value are the Weather Bureau reports and prophecies? As a matter of dollars and cents, does the expenditure of the money necessary to support the Weather Bureau pay? Upon investigation it will be found that it is an immensely profitable investment.

Reports are received weekly from eight thousand special correspondents concerning the effects of the weather on the crops, and these reports serve to set a value on the products which is in just proportion to the supply, and to enable plans and contracts for the future to be made with reasonable certainty.

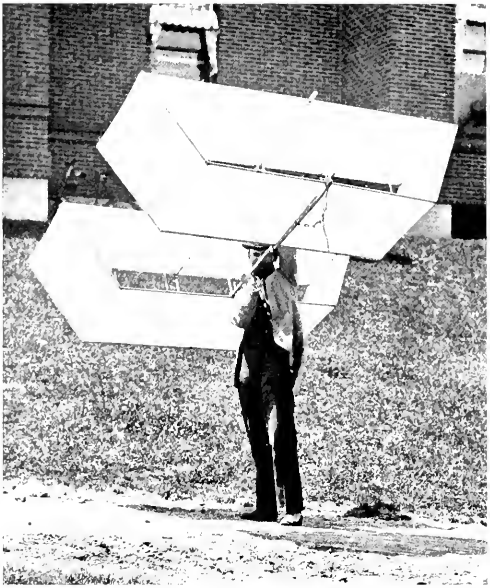


Fig. 13.—A Weather-Bureau Kite.

The records, running back as they do for many years, enable invalids, manufacturers, and agriculturists to find with certainty the locality that is best suited to their needs. The investigations of the Weather Bureau have been directed toward determining the parts of the Unites States where the most constantly humid atmosphere may be found in order that cotton manufacturers may know where their spinning can be most successfully done. Forewarnings of frost enable the truck farmers to protect their produce with a mantle of smoke from a smoldering fire.

The terrible cyclones of the West are frequently foreshadowed by the Weather Bureau long enough in advance to enable people to place themselves and their property in the most protected conditions; and, during the floods of the Mississippi and Missouri Valleys, incalculable savings of life and property result from their warnings. Before the days of the bureau the West Indian hurricanes came unannounced, and sometimes two thousand lives were lost in a single storm. Under the warnings of the Weather Bureau, three such storms have passed in succession without the loss of a single life, and the property saved from one storm in the form of vessels detained

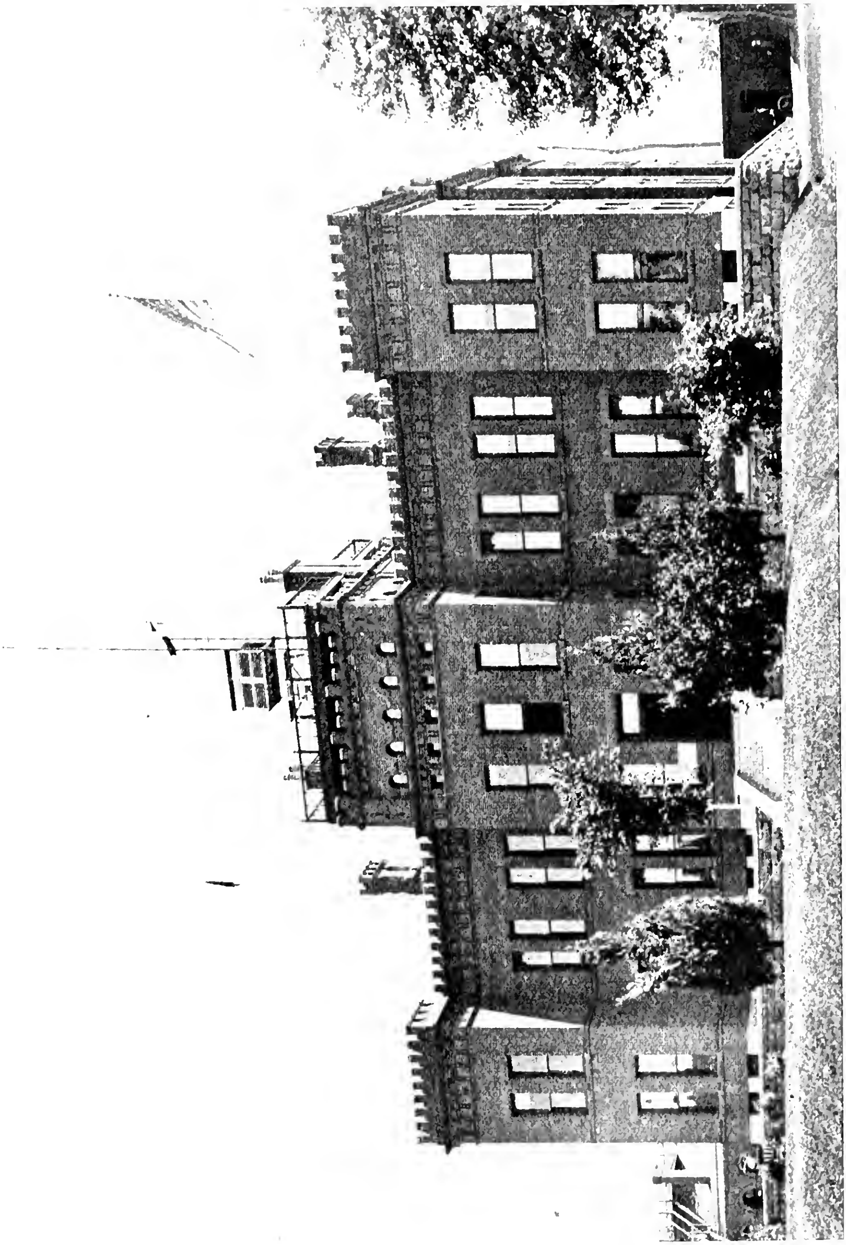


FIG. 14.—THE OFFICES OF THE UNITED STATES WEATHER BUREAU.

in port would support the service for two years. At Buffalo, in the winter of 1895–'96, by forecasting six very severe storms, one hundred and fifty vessels, valued at seventeen million dollars and carrying eighteen hundred persons, were held in port by the warnings. Every one remembers how the American liner St. Paul went ashore near Long Branch, February 2, 1896. A dispatch from the forecaster informed the captain that at such an hour the wind and tide would present the most favorable opportunity for getting the steamer off. At that time everything was in readiness, and a successful attempt was made. A ship and cargo valued at several millions of dollars were thus saved largely through the effort of the Weather Bureau.

By predictions of the heavy snows, many railroads are saved from complete and lasting blockade, and the immense cattle herds of Kansas, Nebraska, Indian Territory, and Texas are enabled to reach places of safety.

The Weather Bureau not only justifies its existence by its services, but it deserves sympathy rather than ridicule when in the face of such difficulties its forcasts are wrong. The investigations of its scientists are constantly improving its methods, and the error in its predictions is being reduced to very satisfactory proportions.

THE PHILOSOPHY OF MANUAL TRAINING.

By C. HANFORD HENDERSON,
LECTURER IN HARVARD UNIVERSITY.

II.—THE METHODS OF MANUAL TRAINING

THE general project of manual training depends for its motive upon our scheme of ethics, and for its underlying principle and justification upon our philosophy of life. The methods of manual training depend no less completely upon our current psychology. But in this there are two distinct elements to be considered. One element, which I think we do not make enough of, is the psychology of the teacher; and the other element, which we are only coming slowly to make enough of, is the psychology of the child. By the psychology of the teacher I mean something extremely definite. I do not mean the general laws of mind as applied to the men and women who teach manual training. Their minds operate on much the same principle as do the children's, except that, being older, they are naturally less flexible and less open to outer influence. But I mean especially the hold which these teachers have upon the philosophy of manual training; the view which they entertain in regard to its function and its relative place in the general scheme of education; and, finally, their own intellectual and emotional and bodily culture.

Some one, I believe, has been pleased to calculate that the efficiency of school work depends upon the equipment to the extent of only fifteen per cent, and upon the *personnel* of the teaching force to the extent of eighty-five per cent. You remember, perhaps, what was said of Mark Hopkins: Put Mark Hopkins on one end of a plank, and a boy on the other end, and you have a university. I do not think these estimates are exaggerated. It is the human element that counts.

The bulk of our secondary education in America is carried on in the public schools, and there is much to be said in favor of this arrangement, and somewhat to be said against it. The fortunes of these schools are for the most part in the hands of boards of education, which are composed mainly of prominent and successful business men—men with a large turn for affairs, and scant patience with the theorizing of philosophers. It is noteworthy that the class of problems with which these men have principally to deal in their private affairs are concerned with material ends, and it is only natural that, when they come to turn their hands to public affairs, the material aspect of things should most claim their attention and energy. I say that it is only natural. It is none the less unfortunate.

Now, the *personnel* of the teaching force is just one of those immaterial problems with which these popular committees are both by training and disposition least prepared to deal. It constitutes, I think, a particular weakness in public education, and one that we can only overcome by taking the practical conduct of education more and more out of the hands of those admirable citizens whom we may call the friends of education, and putting the matter more and more into the hands of men and women specially trained for this most important service.

When you come to the carrying out of a special scheme of education, such as manual training, you will readily see that its methods necessarily depend very largely upon teacher psychology, and I propose to devote the first part of this paper, which has to do with the methods of manual training, to an examination of the attitude of mind which the teacher of manual training brings to his work.

There are, of course, as many views of manual training as there are people thinking about it, but in a broad way there are two very distinct and I may say somewhat antagonistic views. These are not, however, views which men and women have looked upon and deliberately elected. They are much more organic than that. They are views which have grown out of their daily living, and represent their unconscious attitude toward life itself. This genesis gives them both the respectability that is inherent in all honest opinion, and also the fixity that is the most hopeless quality in prejudice. I may, for the sake of a handle, name the two views the educational and the artisan view.

Manual training as a scheme of education occupies a curious middle ground. It has not been evolved in the schools themselves. Like most of our educational innovations, it has been forced upon the schools from without. But the lack of harmony in our conception of manual training does not grow out of this circumstance. Indeed, were it a brand-new thought, offered us from any one of the world's intellectual or industrial camps, we might expect it to present a unit conception, to be accepted, or declined, as the case might be. But such has not been the genesis of the manual training idea. It has not been introduced into education as the embodiment of the educational creed of any one party. It has come into the schools from two different directions, and in its outer form is the incarnation of two distinct and radically different modes of thought. You can hardly understand manual training as a system of education unless you understand its history; and you will readily see that the methods used by the teachers of manual training, while conforming in a general way to one pattern, depend for their essential spirit upon the path by which these teachers have approached the subject. While manual training in some form is a part of all education and appears in all grades, it began its career as a distinct scheme of education in schools of high-school grade. All the early manual training schools were high schools. Even now, when manual training has grown and spread beyond our most sanguine expectations, the typical manual training school is still a high school. Now, the high school occupies a middle ground. It has, on the one side, the elementary school and kindergarten, and, on the other, the college and technical institute. The curriculum of the high school is consequently a composite, and contains elements borrowed from the lower schools and from the universities, or thrust upon it from one of these sources. But as a rule each element in this composite has come into it from one direction, either up or down, and has not assailed it from both sides. Manual training occupies the exceptional position of having come from both directions, from above, from the technical schools, and from below, from the kindergarten and from sloyd, and to have brought from both of these sources fundamental ideas much at variance with each other. In the technical schools manual training is pursued purely as an end in itself and absolutely without thought of its culture value. It is wanted simply as a help to engineering studies. The formal manual training had such an origin. It sprang up in Russia in the technical schools of Moscow, and first attracted any general attention in America at the time of the Centennial Exhibition in 1876. The thought back of it was purely utilitarian. It was, I believe, quite devoid of any idea of physiological or mental reactions of definite and independent educational value.

This system was seized upon in America by men of the industrial type of mind, and was valued for what I may call its bread-and-butter reaction. While I do not sympathize with their main thought, I do not wish in any way to discredit that part of it which was undoubtedly admirable. These men looked upon the high schools of America and saw that many of them were not educational. They saw that they were commercial, that they were teaching commercial geography, commercial arithmetic, commercial penmanship, commercial bookkeeping, and the like, and that as a result they were turning out a race of clerks with ideas little above those of trade and bargains, who could be had by the thousand in any of our great cities for from five to ten dollars a week—perhaps I ought to say from three dollars a week upward. Meager as is the ideal of life presented by industrialism, it was a great step forward as compared with the commercialism which it is meant to supplant. Viewed from the human standpoint, it is a step forward just in proportion as the thoroughgoing artisan, with his strong, lithe body, his quick eye, his skillful hand, his somewhat independent habit of mind, is better than the thoroughgoing clerk, with his endowment of all that is commonplace and subservient. But the men who introduced manual training into America saw that these commercial young people from the high schools had not deliberately chosen so mean a plan of life, but had rather been forced into it by the absence of any better plan. I do not mean to go into the vexed question of free will and necessity, but I think as students of education that we can not shut our eyes to the fact that the young person we are considering, now midway in his teens, is still the victim of his own inexperience, and is very far from free, and that the older half of society has very obvious duties to this same young person, not only in creating generous ideals of life, but not less in inaugurating a social *régime* which will open the way to their realization. It is quite useless to allow, or perhaps I ought to say force, boys and girls to grow up in the atmosphere of a low social ideal, and then blame them for it. It is quite useless to consent to a social order which presses sadly upon the majority of men, and then despise humanity for not making way against the inevitable.

And the Centennial Exhibition opened the eyes of the nation to another fact. It showed us that despite our boasted Yankee ingenuity, American workmen were far less skillful than their European and particularly their Continental brethren, and the fact had to be accounted for. It was seen that in America manual labor was looked down upon, that the social as well as the educational pressure was all in the direction of commercialism and away from handicraft, and finally that the boy who braved social opinion and went in for hand work had to do it almost by stealth. The old institution of apprenticeship had died, and the present order of artisan had been so far tainted with the commercial spirit as to be jealous of his skill. He hoarded it like a miser, unwilling to pass it on from generation to generation. The ranks of skilled workmen in America were and are renewed from the more fertile soil of Europe. Furthermore, in 1876, education in America was even more a mechanical process than it is to-day. All these forces conspired to give manual training a distinctly industrial trend. And this trend was manifestly strengthened by the fact that manual training had been originally apprehended as a form of industrial education. It had indeed appeared in the literature under that name, and under that name was being advocated in Switzerland, in France, and in parts of Germany. I do not think that in 1876 manual training was anywhere being put forward as a culture branch. The movement in America began largely as an artisan movement. The schools that were started in the decade following the Centennial Exhibition were all conceived in this spirit. Some of them have experienced no change of heart since then, but others, I am happy to say, have been transformed and transfigured. Like Saul, the son of Kish, we unexpectedly found a kingdom. Later schools have had much the same history. In some the leaven of the new idea has worked; in others not.

But even within the bounds of the artisan spirit, a restraining grace came into play, which illustrates very well, I think, the tendency of education to continue its search for underlying principles, however unfavorable the conditions, and so to substitute the general for the specific. Manual training, even in the hands of these industrialists, never developed into the teaching of specific trades—the manual training schools were always distinct from the trade schools. Whether the industrialists were appalled by the diversity of trades to be taught, or were restrained by some vague notion that the state ought not to foster one craft rather than another, or were frightened by the prospective antagonism of the trades unions, I do not know, but certain it is that the movement gained educationally with each repetition of the assertion that no trades were taught, but only the principles underlying all trades. The growth of this universalizing spirit has made possible a far broader conception of the true function of manual training.

But meanwhile the manual training idea had been making its way into the curriculum from the other direction, from the lower schools, and from them it came purely as an educational idea. The educational conception has come from the kindergarten, from sloyd, and last of all from a more abstract source, from philosophy. Let us glance at these three elements.

Manual training permeates the whole Froebelian philosophy. Arnold has said that religion is morality touched with emotion. One might characterize the kindergarten as activity touched with sentiment. As far as may be, the activity is all self-directed, for that is the only sort that has any educational value. The hand comes in as the instrument of much of this activity. It is particularly to be noted, however, that the training is quite without industrial import. It has no ulterior purpose, but is simply and solely directed to the development of the child as an organism—an organism whose function is thinking and feeling and acting. The activities of the kindergarten are manifold, but the *motif* is always the same. It is constantly educational. Between the kindergarten and the manual training high school there is a gap of between seven and eight years, the dreary desert of the elementary school, where I sometimes think that children are taught with infinite patience things that they would have found out for themselves next year. But the spirit of the kindergarten has crossed this gap, and has made itself felt in the high school as the educational advocate of manual training. Froebel built true and firm in resting the foundations of the kindergarten upon the self-activity of children, and its *motif*, development, carried into the work of older children, must take some form of manual training. And so manual training came knocking at the doors of the high school, not alone from above, from the technical schools, but from below, from the kindergarten as well, but from this side it was a triple knock.

In the far north, in Sweden, there had been growing up a system of manual training for elementary schools based entirely upon the educational idea. It was not called manual training, but was known as "sloyd," which signifies handy or dexterous. It involves the idea both of planning and executing—that is to say, the idea of creative work—and is a direct and beautiful application of that principle of self-activity which Froebel made the corner stone of the kindergarten. It is permeated with the true Froebelian spirit, and is quite worthy to follow the kindergarten in a rational scheme of education. As the basis of sloyd we have the old peasant hand work, rich both in beauty and in sentiment. This has been systematized into a scheme of regular school work, and has been made purely educational. But it has not lost, I am happy to say, the sincerity and reality that characterized the old peasant handicraft, and I value it so highly, not alone for its true educational spirit, but quite as much for the warm human sentiment that is an essential part of it. Sloyd is very thoroughgoing in its methods. It strives to develop the body by a series of physical movements physiologically arranged, to develop the mind by means of the rich mental reactions which accompany all motor activities; and not less to develop the heart by enlisting in all the work the child's good will and unselfishness. Sloyd has been well defined by Mr. Gustaf Larsson, the head master of the Sloyd Training School in Boston, as "tool work so arranged and employed as to stimulate and promote vigorous, intelligent self-activity *for a purpose* which the worker recognizes as good." It is a capital definition and a noble aim.

Sloyd constituted the second party in that triple alliance of which I have spoken. But there is still a third element involved, one too recent to have had any history, but destined, I am bound to believe, to do great things and to win the day against the combined forces of industrialism itself. The third element comes from the universities, but approaches the high school along the path of the lower schools, and so allies itself with the kindergarten and sloyd in forcing manual training into secondary education on purely educational grounds. It is nothing less powerful and modern than experimental psychology itself. The study of human physiology, and especially the study of brain action, is showing us each day more and more conclusively that if you want good work you must have a good tool—that is to say, a good organism—and that is precisely the educational basis of all manual training. It is the search for organic power.

These two conflicting ideals of manual training meet and do battle in the manual training schools. If you take a school built up on the educational ideal, and another built up on the industrial ideal, you will find them both doing apparently the same thing, but you can not, I think, get very far beyond the threshold without observing a tremendous difference—a difference that you will remark in many quarters, but nowhere so distinctly as in the faces and persons of the boys themselves. The difference is not due to any variation in the material equipment, perhaps to no great change in the curriculum, but to a very subtle, intangible thing, to the point of view of the head master. It all depends upon him and upon which view of manual training he entertains and would have prevail. I can not too much emphasize this point. Back of all action there is an idea, a motive. If you would change the action, you must first change the idea. It makes a tremendous difference what people are thinking about as they carry on their work. This principle is the basis of all scientific pedagogical effort, of all scientific reform, indeed, of all well-directed work of any kind which has to do with human elements. It is the fault of the old education and of the old schemes of reform, and, for that matter, of too much of current education and current schemes of reform, that they address themselves solely to the outer event, and leave the motive, the idea back of it all, quite undisturbed. The real pivot upon which the manual training movement swings is in the idea. In presenting manual training to you as a scheme in which two opposite and antagonistic ideals are now contending for the mastery, I do but state the fact. But I have large faith that the educational ideal will ultimately prevail, and this in spite of the fact that the schools themselves—that is, the manual training schools proper—are largely in the hands of the industrialists, and avowedly represent the artisan point of view. I have tried to do full justice to that point of view, and I want to say again that as a substitute for the commercial training of the average high school, with its bookkeeping, and commercial arithmetic and commercial geography, and commercial ideas of life generally, even the artisan training is a marked advance. It is to be welcomed by all who value a more sturdy living and who esteem power. As a man, the decent artisan is infinitely ahead of the smug shopkeeper. Furthermore, the same artisan point of view, by cultivating self-reliance, by spreading self-supporting ideas of life, by imparting useful skill, by encouraging self-activity, does render a large social service, and does, quite unconsciously, possess a large educational power. I should be unwilling in any way to belittle this service. It is something to be socially grateful for, and to be appreciated at its full value. But the criticism remains true that what is not the best is bad, and the artisan point of view, not being the best, I must maintain is relatively bad.

Many of the training schools represent this artisan view, and one need never go far afield to find striking examples. In my own city of Philadelphia, which I believe is chiefly known in New England for the excellence of her butter and the whiteness of her doorsteps, there are two manual training schools, in which from the very start the educational purpose has been bravely upheld. The two ideals have been in conflict there as elsewhere, for we are a thrifty city with some talent for turning an honest penny, in spite of our love of comfort and grandfathers, but the fight has been a good one, and in the main a successful one.

It is always more effective to paint in black and white than it is in neutral tones, but in presenting these two views of manual training as so sharply distinct, I have not been bent, I think, by artistic motives. I believe the two views to be as sharply distinct as I have painted them.

Assuming, then, the educational point of view on the part of the teacher, we may turn to the second element, the psychology of the child, as our monistic philosophy sees it, and may inquire into the methods which that psychology suggests.

First and last and always, the problem is human. Manual training has but the one purpose, the development of the child, and it can only carry out this purpose by learning how the child develops. Every organism—and manual training, as we have seen, considers the child to be a unit organism—is in contact with an outer world, with something which is not self. This contact produces sensations. We can not know the outer world, can not know whether indeed there be an outer world. We can only know our sensations and the stream of thought into which they merge. As soon as we begin to think, we are forced into some stage of idealism, but whether we take the moderate, in a sense realistic, ground, that there is an outer world, but that we have no knowledge of it except as a mental experience; or the middle ground, that there may or may not be an outer world, that we have no warrant for either affirming or denying its existence, but that the one undeniable reality is consciousness; or the extreme ground, that there is no outer world at all, but that the drama of life is a drama carried out simply and solely in consciousness, it makes, happily, little difference in the practical methods of education, provided we do not vivisect the child, and get something out of him other than a unit. What we have to deal with in any case is human consciousness, and our work is to unfold and perfect that.

These sensations, whatever their origin and precise nature, are certainly the primary material of thought. Knowledge is a perception of relations. The process of thinking is a process by which we bring our sensations into relation with one another, or bring a sensation into relation with some concept, which is the abstract of a previous group of related sensations, or bring one concept into relation with another. Knowledge, then, is the result of thinking, and it is only by thinking that we can grow wise. Experience being the best teacher, it is commonly stated that knowledge is the result of experience. But this is not strictly true. It is only true when you specify what sort of experience you mean. If the experience has resulted in an embarrassing wealth of sensations, and has created little disposition to bring these sensations into relation with one another, the product is not knowledge. Globe trotters are not proverbially wise people. But if the experience has taken an inner turn, and has consisted in a careful and luminous working up of the crude materials of consciousness, the product is knowledge of the highest sort. This accounts, I think, for the fact that some of our most profound philosophers have been men of somewhat limited experience. But there are cautions in both directions. If the omnivorous reader and globe trotter stand at one extreme, no less does the closet philosopher, building tremendous structures out of insufficient material, stand at the other. Health is found in the golden mean—to meet life and to reflect upon it. I take education and evolution to be one, the reaction of the environment upon the organism. The process consists in arousing in consciousness a group of sensations of the right sort, and in the right amount, and in inducing a habit of working up this material into thought. The process requires a wholesome organism, and one operating in obedience to some inner impulse—that is to say, it requires self-activity and not vicarious activity. It is a very subtle process, work for angels rather than for men, and all the while it must be carried out with utter unconsciousness on the part of the child as the result of his own spontaneity. The teacher may stimulate this self-activity, must supply materials for it to spend itself upon, but never—and this is the particular temptation in the path of the teacher—never must he substitute his own activity or his own impulse. It was a great day for me when I woke to the fact that one can only do what one wants to do. It was a great day for me, both because it taught me the source of my own actions, and because it taught me that to influence other people's actions you must first influence their desires. A given environment is not the same environment to two different children. Their power to respond is different. Their will to respond is unequal. If the environment is to react helpfully on both of them, either a change must be brought about in the children themselves, by means of a secondary or preliminary environment designed especially for that purpose, or else the given environment must present alternative elements calculated to appeal to different natures. Both methods are legitimate and both are often necessary. The first is brought about by the personal *tête-à-tête* work of the teacher, work wholly individual, work requiring the characteristics of both the serpent and the dove; and the second, by giving the school life that flexibility and many-sided interest which will allow some choice on the part of the child. The sensations that we want are only brought about by action, by direct physical contact with the environment, and this can only come as the result of desire. We live in a world rich in possible activities and sensations, embarrassingly rich, but possible only to those who want them. One can only do what one wants to do. The source of power and the limitation of power are one. It is found in the emotional life, in desire. Where this is manifold and rich, life is manifold and rich; where this is stunted and poor, life itself is stunted and poor. There is here a direct causal chain which can not be broken, and which must be taken into account in any rational educational method. It is desire, action, sensation, thought. I do not know whether psychological analysis will some time show us what desire is, or separate it into more primal elements, but, however composite it may turn out to be, it will always continue the mainspring of human action, and the primary element with which education will have to deal. Everything centers in the emotional life. To stunt and cripple and repress that is to make impossible a full life in other directions. Kill it, and you have the dead souls of our social world. In childhood, the emotional life is strong. And here, I think, and not in Florida, is to be found the fountain of perpetual youth. We should never grow old if in our hearts we could keep always the full flood of feeling. It is the drying up of this part of our natures that makes possible the dreadful indifference and paralysis of old age. And we want this prodigality of feeling because it will lead to action, and we want action because it will bring sensation, and we want sensations because they are the material of thought. Manual training builds its methods upon this psychology. It looks first and last and always to the motive power. to the emotions and desires. If these are strong, if the child is alert and full-blooded and interested, at once may be undertaken the more specific work of supplying a rich and suitable environment, to keep alive this emotional life, to strengthen it and to direct it to helpful and noble ends. Well-born children possess this full emotional life, but with apathetic children it must be aroused. The little childish heart must be set on fire with new desires and longings, and these made so strong that they simply must be satisfied. This is a difficult task, and one with which the older schemes of education do not pretend to cope, for they do not realize that it is an essential part of their work. Indeed, for the most part they address themselves to the very contrary proceeding, the repression of such childish desires as already exist and are found not to be convenient.

The method by which manual training arouses and fosters a many-sided interest and stimulates desire is by giving children something to do, and by allowing such a free play of choice and individuality both in the something and in the doing that at the very first possible moment the activity shall be self-directed. When this point is once gained, the work of education has begun. Where the will is weak, as in the case of poor, anæmic children, the interest may soon flag, may indeed sputter and go quite out. And all this is very discouraging. But the interest must simply be aroused and stimulated afresh. Never, however great the seeming extremity, must the interest and desire of the teacher be made to do duty for that of the child, for, the moment this occurs, the work of education ceases, and a meaningless, unpsychological process takes its place.

It is not much learning that makes us mad, but much interference.

In young children, the great impulse is to play, and it was this form of self-activity that Froebel seized upon. But the desire to make things, the constructive faculty, is also there, and this is utilized in the weaving and other forms of paper work. In older children the play impulse weakens and the constructive impulse strengthens. It is this latter impulse that manual training appeals to. In doing this there is large choice of method. But the essential element is always the motive power, the desire. This bears the same relation to all that follows that the water or steam power does to the mill. It keeps it running.

The formal manual training does not concern itself specifically with the principle of interest. It lays out a series of abstract exercises, involving the primary tool operations in wood and metal. The exercises are as abstract as the propositions of geometry. They are carefully graded so as to be increasingly difficult, and are all dimensioned. Thus in wood, the first year's work may consist in a series of from seventeen to twenty-one exercises, beginning with a simple rectangular parallelopipedon, and ending with a somewhat elaborate dovetailed box. In the second year the joinery course gives place to pattern making, the creation of forms which are to be used as molding patterns in casting in lead and iron. Here, too, the exercises are carefully graded, beginning with simple forms and ending with quite difficult problems. The sequence differs in different schools, and no two schools use precisely the same exercises. But this is a detail which is not essential to the method. There are usually three terms a year—terms of about thirteen weeks each—and as the wood work runs for two years in the typical three-year manual training school, this gives six terms in all for the accomplishment of the instruction in wood. It is customary to devote one term to wood carving, and another term to wood turning. This latter is sometimes introduced during the first year, if there are enough turning lathes for all the boys to work at once, and sometimes it is given as a secondary course, running along with the joinery and pattern making.

The same principles hold in the metal working. It is all carefully graded. During the first two years it includes the primary operations of the machine shop and the blacksmith shop—chipping, filing, and fitting; molding and casting; forging and welding, ornamental ironwork and tinsmithing. During the third year the manual work, exclusive of the science laboratories and the drawing rooms, is usually confined to machine-tool practice, and here the time is divided between abstract exercises and finished projects.

The course is entirely logical. It was originally planned for the one purpose of imparting technical skill, and it does this in a large and surprising manner. It seems incredible that some of the work turned out could have been done by young boys. Nor do the boys have to be urged to this work. Although the object is simply technical skill, and does not concern itself primarily with human motives, still the work is so thoroughly in line with boyish activity that it does quite unconsciously enlist those desires to a very large extent. You can see this if you will watch the little workers. They are for the most part absolutely absorbed, and quite unconscious of your own presence. There is in all of us a strong desire to excel, a delight in overcoming obstacles. We like to do battle, and especially when we are young. A cross-grained piece of wood, a stubborn bit of metal, are so many challenges, and an alert boy is eager to accept the gauntlet. Some of the boys, furthermore, have conceived the idea that they would like to be carpenters, or pattern makers, or wood carvers, or machinists, and work under the spur of an ulterior purpose. At fourteen they have already begun to live in the future, and have accepted the ideals of industrialism. The organic reactions that follow upon this manual activity, though not so good as would follow from a more psychological course, make, nevertheless, for increase of brain power. There is a notable enlargement of judgment, of accuracy, and of self-reliance. There is an actual increase of physical health, there is a usable skill. And all of this is very good. But these results, splendid as they are, can be made still better, and are being made still better by the humanizing of the whole scheme in the hands of educational workers. The spirit of the kindergarten, the spirit of Herbart, the spirit of sloyd—a spirit which finds no scheme of education tolerable which has not for its object the full and complete life, the life of body, of intellect, and of heart—this spirit, I say, has been permeating our thought and making its way into the high school. And this is precisely what the formal, technical manual training most needs. It needs to be humanized. It wants to be touched with morality, with beauty, with sentiment, in order to be the ideal education; for the end of education, as Herbart has well said, is to create in the child a moral and æsthetic revelation of the universe. I have confidence that this humanizing spirit will conquer, and that manual training will ultimately mean in all our schools what it means to-day in a few of them, and is coming to mean in many more—a complete, human, educational process and not simply an artisan training.

The methods of this educational manual training concern themselves very much with the principle of interest. They seek not only to satisfy existing desires, but to create new ones. Theirs, you see, is far from being a doctrine of parsimony. It is rather a doctrine of ungrudgingness. In place, therefore, of abstract exercises, poor in present human interest, finished articles are offered. They are very simple, of course, but they are as carefully arranged and graded as the abstractions they replace. Groups also take the place of single articles, so that the boy may select his work, and so have the advantage of a deeper and more individual interest. In addition, the principle of service is brought in. The articles are useful—some little domestic convenience that may be given to the mother, some well-made trifle that the father will use and value. The sentiment which is thus woven into the work is far from idle. It is more than a pretty nothing. Have you ever reflected that all the great and beautiful things that have been made and done in the world—the great pictures, symphonies, poems, stories, buildings, exploits of all kinds that have needed the human spirit—have been made and done, not as the result of technical skill, but as the result of a sentiment, the sentiment of hope and love? I regret the partial decay of a visible religion in our midst, not because I believe that men need creeds to make them good on earth or to point out the way to heaven, but because it seems to me that an impressive worship, rich in color, in music, and in tradition, does so much to keep alive the sentiment of man, and give him the power of great and noble performance. I can not but envy the old painter who brought to his work the passion of a divine and human love, who painted the Mother of God with that face which embodied his own heaven. It may be that that passion for humanity which is appearing now as a redeeming force in modern society may some time touch afresh the national life with emotion, and open to us again a period of great performance.

The Herbartians are right, I think, in their scheme for the correlation of studies, when they group all the work about some sentiment study and invest all with human interest.

There is, further, an æsthetic objection to the abstract exercises of the Russian manual training. They are not beautiful. The finished projects of the American system—for so I shall in hope call the educational manual training—may be made beautiful. This, again, is a principle in both kindergarten and sloyd work, and one that we can not leave out of the count. It is, I think, an educational crime to have children deliberately make ugly things. Why should they, when there is so much possible beauty in the world, and so much real ugliness already? It is of large importance that children in all their work should regard beauty as a sacred and necessary quality.

The finished projects have a further advantage in better allowing a large proportion of free-hand work. Curved lines and warped surfaces that can only be judged by sight and touch are not only more beautiful but also more educative. A too great reliance upon calipers makes us all mechanical. It is quite possible to have the projects accurate and fully dimensioned, and yet largely free-hand. To fulfill all these requirements—to have the work proceed strictly as a result of the self-activity of the child, to invest it with an emotional interest, to make it sound physiologically and æsthetically—is not easy, and much ingenuity is required and will be required to work out a satisfactory set of models. It is just as important to have them carefully graded. It will never do to discourage the child by too great initial difficulties, nor to waste time by adding difficulties too slowly. There must be constant progress. When a bean stalk gets to be ten inches high, the next thing for it to do is to get to be eleven inches. And not only do the projects vary, but the materials as well. Wood and metal and clay, even leather and fabrics, all lend themselves to the purpose and are all utilized. If this work is to create that many-sided interest in life of which we have been speaking, it must have many sides to it. The projects, then, ought to have diversified social functions. The first interests of the child are all domestic, and it is entirely fitting that the first articles he makes should be borrowed from that aspect of life. But these interests want to broaden. With increased constructive skill, they may well take in more ambitious projects in both arts and science—steam engines, dynamos, cameras, scientific apparatus of all kinds, architectural units, and all the diversified objects of a rich and varied social life. This is in part the practice in the present manual training schools, as far as the third year's work is concerned. The graduating class makes one or more finished projects of a practical kind, sometimes in miniature, often of full size, so that the article may take its place in the equipment of the school. And I am glad to say that more and more the tendency is to substitute these projects for the less fruitful abstractions, and so to realize the educational ideal. Mr. Sayre, the principal of the Central School in Philadelphia, told me the other day that such was the tendency there. It was also the tendency at the Northeast School. Mr. Richards, of the Pratt Institute in Brooklyn, writes me that not only are they substituting simple finished pieces for the abstract exercises, but also that they are giving the preference to small individual projects over larger ones requiring group work, and that they are making these changes because they believe that in this way they develop greater individuality and arouse a keener interest. Dr. Belfield, the director of the Chicago Manual Training School, writes practically the same thing, and adds that they will probably make no more large pieces, except where they are needed in the equipment of the school, work quite justified by the altruism which it fosters. It would be easy to multiply testimony, but I think we should gain nothing by it. The point I want to make is that manual training in America, in spite of our potent industrialism, is becoming each year more educational, and this is most encouraging.

To stimulate this many-sided interest, and to cultivate genuine sentiment and æsthetic appreciation, are large elements in the method of manual training, but it shares this with other schemes of education. The part of its method which is distinctive is physiological. It is the cultivation of the brain through the body, and more especially the cultivation of the brain through the activities of the hand, the setting up of definite mental reactions as the result of definite muscular movements. Experiment shows that the brain does not act as a whole in its reactions with the outer world, but that for the various activities of life there are specialized local brain centers. Furthermore, function is shown to be directly dependent upon organ. If the organ be impaired, the function is crippled. If the brain center be destroyed, the function is annihilated. The reverse is also true—the inhibition of the function, and the organ atrophies. The exercise of the function means the health and growth of the corresponding center. The localization of brain function is one of the most interesting results of modern experimental psychology, and is well worth the attention of all interested in social movements. If these local brain centers could be stimulated and developed by increased contact of their tributary extremities with the outer world, we should have a strengthening of the brain tissue, a more sensitive organism, and, as a final result, a general increase of intellectual power. The most complete power would come from the most perfect development of all the parts. We want no repression, no thwarting, no deadening. We want the expansion of all the parts by the wholesome exercise of all the functions. And this expansion must go on *pari passu*, not the abnormal growth of one center through the undue exercise of its corresponding function, with the starving of surrounding centers and functions, but the normal and wholesome growth of all. As the hand is the chief instrument of touch, its exercise will cultivate the tactile and visual centers. By the skillful framing of these manual activities, and their arrangement in due sequence, we shall bring about a corresponding series of mental reactions of the highest evolutionary and educational value. Manual training means hand training; sloyd means skill; but the hand training is in reality the training of that part of the brain which directs the hand, and skill is in reality a mental quality. One's cleverness in arranging the manual work comes in right here. It is not in securing a series of mental reactions, for they would come willy-nilly, but it is in securing a series of mental reactions of the most desirable sort.

The term manual work is often used very loosely to include all forms of mere bodily work, such as the activities of the day laborer, of the washerwoman, and the domestic servant. But such work is not hand work. It is strictly bodily work, and the hand serves merely as the clutch by which the particular tool, whether shovel or broom, is fastened to the body. The main mental reaction is fatigue. But manual work proper is the sense of touch applied to the carrying out of some definite and intelligent purpose.

We do not yet know enough of these mental reactions to reach any finality in the matter of the manual exercises. It is for the present experimental. In the most progressive schools you will find a large amount of flexibility. The exercises of one year will not be the exercises of the next. There is the constant hope of something that will yield richer returns. But the underlying principle is the same. It is distinctly physiological, a system of brain gymnastics by which an expansion of function brings about the development of the organ. It is founded upon a monistic philosophy of life—a belief that man with all his diversity of need and of power is essentially one, a unit organism.

The mental reactions that manual training brings about are essentially ethical, and, since conduct has to do so largely with one's relations with one's fellows, they are also essentially social. The most evolved conduct, that which displays the most complete adaptation of means to ends, can be the result only of a completely rounded intelligence. Complete morality means the setting up of definite moral ends, and it also means their attainment. We weaken the moral fiber deplorably, it seems to me, in our modern way of looking at things, when we lay such moral and legal stress upon the motive, and so little upon the performance. The emphasis is not justifiable. Since motive and act stand in the direct relation of cause and effect, it may be charitable but it is certainly not scientific to couple a good motive with a bad act. If the moral ends have been clearly seen, if that vision of the complete life has been fairly grasped, the more difficult and it seems to me the essential part of morality, the attainment of the complete life, still remains to be fulfilled. To accomplish this part of its mission, manual training seeks to make very clear the relation between cause and effect, and to eliminate the capricious and grotesque. Every bit of manual work is a practical adjusting of means to ends, an object lesson in causation, and when finished, it stands there before us, and tells us in very plain and unequivocal language whether the thing has been well done or ill. There is no room here for idle excuses.

These are some of the methods of manual training. Not one of them is sacred or fixed or unalterable. They are mere tools, a process, a means to an end, something to be altered, relinquished, supplanted, as a wide knowledge and a deeper love show such changes to be wise. But every detail of method has the one purpose, and this never changes—the unfolding and the perfecting of human nature. It is the search for human power through the perfecting of the human organism.

WOODPECKERS AND THEIR WAYS.

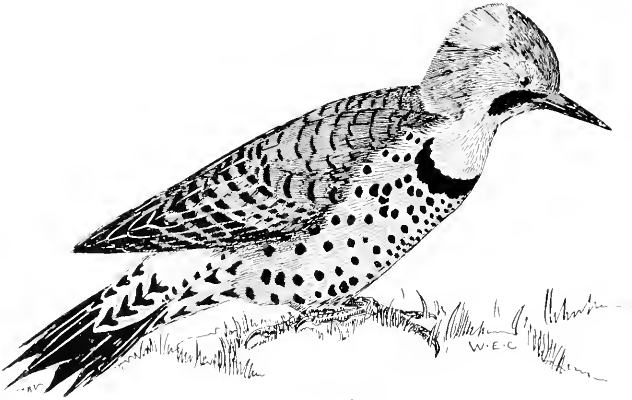
By WILLIAM EVERETT CRAM.

WOODPECKERS as a class form one of the most striking and easily distinguished groups of birds, the entire family conforming to a certain type to a remarkable degree. Probably each of the three hundred species could be safely described as a vigorous, muscular, heavy-bodied bird, with long wings, close-fitting plumage, and a strong, stiletto-shaped beak. Their legs and feet, like those of the parrots, cuckoos, etc., formerly placed in the same order, are short and stout, with the outer toe turned backward parallel with the hind toe as an aid in climbing. In certain species, however, this outer toe is entirely wanting.

Their peculiar method of gaining a livelihood has developed a tongue perfectly adapted to their requirements; it is pointed and barbed at the tip for securing the larger insects, and is kept constantly coated with a mucous substance to which the smaller ones adhere. At the back of the mouth it divides, and passing each side of the neck at the base of the skull is carried up over the top of the head, where the two portions join and are inserted in the right nostril. In the common hairy woodpecker, and possibly some others, it curves downward, and is wound about the bony case which protects the right eye, the latter projecting more than the left for its accommodation. This double bow enables the bird to shoot forward and contract the barbed tip with wonderful velocity, while the mucus is applied each time from two large glands at each side of the throat.

In the autumn, when the last generation of aphides spreads itself over every leaf and twig in the forest, woodpeckers may frequently be seen engaged to all appearances in licking up these diminutive insects from their resting places, their long tongues giving them a decided advantage over other birds in this pursuit, for woodpeckers are not the only birds that find aphides palatable in spite of their small size—not only the warblers, but purple finches and others, generally supposed to be fruit-eaters, apparently depending to a certain extent on this delicate fare.

The family colors are black and white and red in sharply contrasting patterns, though some members of the group that have taken to gathering a portion of their food on the ground appear to have adopted the more inconspicuous browns and greens for protection. The common golden-winged woodpecker is a case in point, a bird which I fancy occupies much the same place in this country that the green woodpecker does in England, though the latter is probably nowhere as abundant or familiar as our species. Both are



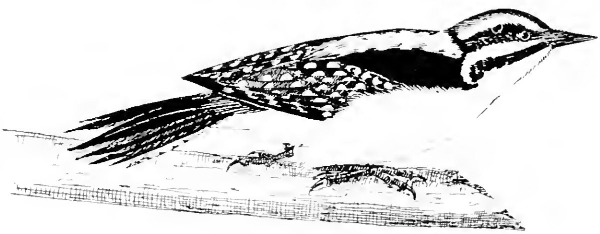
Golden-winged Woodpecker.

genuine enough woodpeckers, but without the conservative habits of the majority of their race. The typical woodpecker, large or small, spends the greater part of its time clinging to the bark of a tree, by preference a dead one, hitching himself along by short stages, usually ascending the tree by a spiral course in order to survey as much of its surface as possible, and whenever he suspects the presence of an insect beneath the bark his sharp bill enables him to dig through bark, sapwood, and everything, until his victim is finally cornered at the extremity of its hole, and is drawn forth impaled on the barbed point of the bird's tongue, or held fast by the sticky substance which covers it. And while so engaged the bird's black-and-white plumage is really not so conspicuous as might be expected, at a distance the colors appearing to blend in such a manner as to give the effect of dark gray or ash color, which matches admirably with the surface of the majority of tree trunks, especially in the shadow. But the flicker gets a comparatively small portion of its food in this manner. Sometimes, it is true, he may be seen pecking away busily enough on a prostrate log or decaying stump in the pastures, and he is said to render valuable assistance to the fruit growers by digging out the borers from the trunks of peach and plum trees at every opportunity, but he prefers the less laborious process of gathering his insect food from the surface of the ground like other birds, probably digging some of it from the turf with his bill. It is said that in some parts of the country they have learned the trick of flattening themselves as traps on top of ant hills with extended tongue which the ants seize upon as something eatable and are drawn in and devoured by the dozen.

Now, it would hardly be safe for a woodpecker of almost any other species with black-and-white plumage to follow any such occupation, but the flicker when at rest only shows a subdued brown banded with black, tiger fashion, in a way that might possibly suggest the shadows of grass stems on dry turf or the fallen branch of a tree, the general effect being not unlike that of the plumage of the meadow lark in a similar position. Many of the concealed feathers, however, exhibit the brilliant black-and-white pattern characteristic of the tribe, and when the bird takes flight, as if aware that concealment was no longer possible, he flashes out the full glory of his wings and tail, that, together with the patch of white on his back, hidden until now by his folded wings, make him conspicuous as long as he is in sight. The scarlet of his crest, although bright enough, would hardly attract attention at any distance.

Now, in Kansas and westward the flickers have wings and tail lined with red instead of yellow, and where the two species come together it is said to be not uncommon to find specimens with one wing lined with red and the other with gold, and the tail feathers divided in a corresponding manner.

The green woodpecker of England, as might be expected in a climate where the leaves and grass are not burned brown at midsummer, wears Lincoln green like the foresters of old, who probably



DOWNY WOODPECKER.

knew him well and respected him as a bird that, like themselves, refused to live in confinement, and was only contented when in the greenwood.

Like the flicker, it has received a dozen or twenty common names by which it is known among the country folk, and among them highhole, yaffle, and woodwall at least are common to both this bird and our own species, which appears to have been confounded with the other by the early settlers. Woodwall I have never known to be applied to our bird outside of a certain limited district in southern

New Hampshire, where it is almost exclusively known by that name. He is evidently a bird of a good deal of intelligence, though undeniably cranky at times. He is quick to know where he is not molested, and, once he has convinced himself that the surroundings are not likely to prove dangerous, will take up his abode perhaps in an apple tree a few yards from the house, and will return summer after summer as long as he is allowed to remain in possession. For the last ten or fifteen years, perhaps longer, a pair have nested in this manner in an apple tree on the farm where I write, and have succeeded in bringing up a promising brood each season without serious mishap. When the tree they formerly occupied was cut down, they merely moved to another still nearer the house, and made their hole in a large branch hardly a dozen feet from the ground. They were obliged to cut through the green sapwood at first, and then through a few inches of dry but extremely hard wood beneath, before reaching the decayed heart of the branch, but their bills were equal to the task, and they soon had a gourd-shaped cavern some eighteen inches in depth, with the doorway opening to the south. They seldom exhibit much impatience about going to housekeeping each spring, and it is usually pretty well along in May before they have done their spring house-cleaning. This consists merely in clearing out the bottom of the hole and perhaps enlarging it slightly. There is nothing that really deserves the name of nest, the eggs being laid on the rotten wood or loose chips at the bottom, after the manner of the woodpeckers.

THREE-TOED WOODPECKER.

The birds are rather quiet, but not at all timid during the nesting season, coming and going at all hours of the day, quite regardless as to whether any one is watching them or not. But soon after the eggs are hatched there may be heard a low murmur issuing from the opening of the nest, which increases in loudness day by day until it is a murmur no longer, but a kind of stifled crying and squalling, which rises to a chorus of shrieks on the arrival of the old birds, or, in fact, at the approach of any one or anything, the youngsters taking it for granted that any sound that reaches them in their seclusion must necessarily mean food, and each endeavors to drown the clamor of all the others.

After a while the parents try to entice them out into the daylight by clinging to the branch and holding some delicate morsel before the entrance, whereupon the most enterprising, or possibly the hungriest, youngster scrambles up the wall of the nursery and, thrusting out his head, seizes the food and falls back aghast at his own boldness. They are apt to be slow about leaving the nest, and are generally fully fledged before they finally gather courage to crawl forth and cling to the branches, shrieking hysterically for their parents to come to their rescue. After a day or two of such behavior they grow braver, and learn to accompany their parents about the orchard, and at last away to the pastures, seldom showing themselves about the house after they have fairly learned to fly. Being a heavy-bodied bird, the flicker is only too often regarded as a game bird, though his flesh is, to say the least, tough, and here is where his intelligence becomes most apparent, for it certainly looks as though these birds learned to know at sight those persons who are in the way of shooting them, for they are almost invariably regarded by these gunners as about the most difficult birds to approach in existence, though others do not regard them in that light, and for my own part I certainly have hundreds of opportunities for shooting them every season if I were so inclined.


Yellow-bellied Woodpecker.

The downy woodpecker perhaps comes next to the flicker in abundance, for, although never to be seen in any great numbers, one or two of them may usually be found wherever there are decaying trees for them to work upon. Nor do they depend entirely upon dying trees for their nesting grounds, as one may frequently be seen working his way up the stem of a young fruit tree or sapling whose smooth bark would hardly be supposed capable of furnishing concealment for the smallest insect. Next to the apple tree, the elm is perhaps his favorite, the rough bark of large ones allowing him to move about between the ridges and dig away beneath the loose scales to his heart's content. He is probably capable of spending more time on a single tree than any of the others of his family. After having finished with the trunk he will carefully go over each branch from tip to base, never hurrying, but acting as if he knew that he had the

Red-headed Woodpecker.

whole of eternity to do it in, and perfectly contented to spend half an hour on a space that he could cover with one of his wings. He is usually accompanied by other birds, for birds are not scattered evenly about the woods at any season of the year, but more in company or flocks of half a dozen or a dozen different species, brought together apparently for society's sake, and following any temporary leader from tree to tree.

Downy, however, seldom quits his work when the others see fit to depart, but keeps pegging away by himself until other birds come up, attracted, I fancy, by his rapping, to linger about in his company for a few minutes, and then off again as the whim seizes them. Like the majority of birds, the downy woodpecker is apt to be more in evidence during the spring and fall migration than at other times, but is never entirely absent, and often appears more than usually numerous immediately after a cold wave in midwinter. At this season he sleeps snugly in a hole cut out of the wood for the occasion, and evidently finds the getting up in the morning the most disagreeable part of it, for he seldom shows himself until long after the sun has begun to melt away the frost from the south side of the trees. He is most active now at midday, frequenting southern hillsides, where the air is warmest and the brown leaves show between the drifts, and where he is sure to have the company of other birds if there are any in the neighborhood. He is not afraid of the cold, however, and may often be seen at sunset hard at work on the exposed side of a tree, while the north wind ruffles up his feathers and the frost makes the wood resound with reports like pistol shots. But just as the last spark of sunlight dies out among the tree tops he hurries off to his bedroom with an occasional shrill chirrup for good night, and stows himself away for a good sixteen hours of sleep. In May the pair construct a nesting hole in a dead branch, usually well up toward the top of the tree they have chosen. They are less given to occupying the same nest for successive seasons than are the flickers, and the abandoned holes, as well as their winter apartments, serve excellently for nesting places for bluebirds and tree swallows, and others of similar habits. During the heat of summer their habits are the same as at other seasons, though they keep more in the shadow of the leaves, and rise earlier in the morning, doing a large part of their sleeping at midday.

IVORY-BILLED WOODPECKER.

The hairy woodpecker is much larger and heavier than the downy, but his color and markings are the same, except that his outer tail feathers are pure white, not barred with black, as in the other species. They are much less abundant than formerly, some years being decidedly rare. Ten years ago, or even less, they were often seen climbing over woodpiles in farmyards on sunny days in the winter. Their habits are much like those of the downy woodpecker, and their cries, though louder, are rather similar. There seems to be no special reason why they should decrease in numbers, for they appear perfectly willing to put up with the conditions of a settled country, and are much less subject to the persecutions of the youthful sportsman than are their larger cousins the flickers.

The arctic three-toed woodpeckers are slightly larger, and are peculiar in having dispensed entirely with the real hind toe, being provided with only three toes on each foot, two before and one behind. The males are easily distinguished by a square patch of yellow on the back of the head.

This species is decidedly uncommon in this latitude, and one may watch patiently for years without so much as getting a glimpse of one, and when at last they do make their appearance it is not by the hundred, as is apt to be the way with northern birds when they see fit to visit us, but scattered singly about the woods and swamps in a manner hardly calculated to attract attention. This is about their southern limit though curiously enough a species almost identical with this one inhabits the forests of Guiana, while the intermediate region can show nothing in the least like it.

The coloring of the yellow-bellied woodpecker is somewhat more complicated, the white being partly replaced by yellow, and the throat and top of the head crimson. Autumn birds are frequently seen without any red whatever, and with the entire plumage so thickly streaked and spotted as to give an effect of dull grayish brown in the distance.


Pileated Woodpecker.

They make their appearance with considerable regularity in the spring, about the middle of April or a little before, singly or in pairs, and seldom in any great numbers. They are decidedly rare throughout the summer, and are seldom very abundant in the fall except in certain seasons, when they outnumber all the other woodpeckers put together, and may be seen in families of half a dozen or more, running about the hickory and oak trees, which appear to be their favorites. Being much more restless and impatient than the downy, they seldom linger long in a place, but keep flying from tree to tree, pecking here and there as suits their fancy, until, finding an especially attractive spot or decayed branch, they settle down for a few moments of hard work, and manage to do considerable execution in a comparatively short time. They are commonly called sapsuckers, and are supposed to injure fruit trees by drilling little cup-shaped holes in the bark in order to drink sap which flows from them. There is no doubt that they make the holes, sometimes thousands of them in a single tree, but there seems to be little evidence that the trees are ever injured by the process, at all events not enough to offset the advantage received from the destruction of borers and other insects.

The red-headed woodpecker is probably the most generally known and widely distributed species in this country, though rare in New England except, perhaps, in the more southwestern portion. I have seen but two specimens in New Hampshire, the first in the southern part of the State within a few miles of the coast. One hot June day he came flying across the fields and, alighting against the trunk of an apple tree, began hammering away at the bark in true woodpecker style, then, descending to the ground, appeared to search for insects in the plowed earth beneath the tree. After a few minutes he took wing once more and steered off toward the south. Half a dozen years later I saw one flying among the mountains near Lake Winnepesaukee, but had no opportunities for observing it. They were said to be quite abundant in southern New England in the autumn of 1881, presumably migrating visitors from the West, where they are much more common. Like the flicker, this species exhibits a decided fondness for fruits and grain of various sorts, and is generally considered a destructive bird on this account.

The ivory-billed woodpecker, now confined to the Gulf States and lower Mississippi Valley, is generally admitted to be the finest representative of his race. He is nearly two feet in length, with a scarlet crest and white stripes down each side of his neck. A considerable portion of his wings is also white. In the Southern swamps he still carries on the woodpecker trade on a scale in keeping with his size. The alacrity with which he can hack to pieces the decaying trunk of a tree is said to be simply incredible to one who has never had the good fortune to see him at work. The pileated woodpecker, or logcock, is somewhat smaller, with less white on the wings. Formerly abundant throughout the country, this species has retreated and diminished in numbers with the clearing off of the old original forest growth, and is now only to be found in the most secluded woods and mountain regions, and is nowhere common. A few pairs are still said to linger in the western parts of Massachusetts, and I have found unmistakable evidence of their presence in the newly chiseled trunks of dead pines on some of the New Hampshire mountains, but as yet have been singularly unfortunate in never having seen a living specimen.

SABER-TOOTHED CATS.

By S. W. WILLISTON.

OF the family of cats, the *Felidæ* of naturalists, there are now in existence upon the earth about fifty distinct species, nearly all of which are so closely allied to each other that they have received the common designation of *Felis*. Our domestic cat, whose wild origin is lost in history, is a good representative of the family and one of its smallest members. The Asiatic tiger, the largest and most powerful of all, rarely reaches a length of eleven feet, while the African lion falls not far behind in size and prowess.

The habits of all these fifty species are much alike. With the exception of a fish-eating Indian species, they all obtain their food, which consists of the flesh of other animals, by stealth. For this reason they are all, with the exception of the African lion, inhabitants of forests and jungles, rarely frequenting the open plains, where concealment is less easy. No other living animals are so perfectly adapted for carnivorous habits as are they: their teeth are sharp and cutting; their claws long and pointed, and ensheathed when at rest; their body is lithe and flexible. Their intelligence, while perhaps not equal to that possessed by the other great carnivorous family, the dogs, is by no means of an inferior order.

These fifty living species, however, comprise but a small proportion of all those that have lived in the past. More than that number of extinct cats are already known to scientific men, and many others must have lived of which we yet have no knowledge, and perhaps never may. Those fossil cats have been discovered in nearly all of the great regions of the world where their descendants now live. In Australia and Madagascar they have apparently never lived, because these regions were separated from the mainlands long before cats came into existence, and they have never found an opportunity to reach them since. The oldest cats are known from Europe and North America, making their appearance in geological history, so far as we now know, at nearly the same time. In South America they appeared much later.

In no continent have the extinct cats been found in greater variety and abundance than in the United States, and it is not improbable that here is the real birthplace of the family. More than twenty-five species have already been discovered in the United States, and doubtless not a few others will yet be added to the list. The oldest are from the Bad Lands of South Dakota and Wyoming, while others, only a little more recent, are from Oregon. Remains of those which lived much later have been discovered in

Florida, the cave deposits of the Eastern States, from the Indian Territory, Texas, Kansas, Nebraska, and elsewhere. It is not at all improbable that within recent geological history more than one hundred species of cats have lived within the boundaries of the United States, some of them not becoming extinct until after the advent of man himself. The largest species yet discovered is from the famous bone beds of Phillips County, Kansas, associated with large dogs, rhinoceroses, horses, camels, etc., in the Loup Fork Tertiary. This species, though yet known from very scanty material, has been rightly named *Felis maxima* by Scott, and it must have measured thirteen or fourteen feet in length.

While collectively all these extinct species are known as cats, only a few are so nearly related to the living species as to be classed

SABER-TOOTHED CAT (*Hoplophoneus occidentalis*, Leidy).

in the same genus *Felis;* and these few are the most recent of all. It will be remembered that at present only four or five species of cats are inhabitants of North America—the lynx or wild cat, ocelot, panther or mountain lion, and cougar; the ocelot and cougar found only within the southern limits. Cats are almost always inhabitants of tropical or warm temperate regions.

The most remarkable of all the extinct feline animals are those known to naturalists as the saber-toothed cats or tigers, a group comprising the greater part of all the fossil forms. They date back to the earliest times of which we know anything about the family in North America and reach down to the time of man himself. A large and powerful species described from the Indian Territory by Cope lived contemporaneously with the hairy mammoth, as evidenced by the commingling of their skeletons. There can be little or no question but that the hairy mammoth was contemporaneous with man in North America as well as in Europe. Their geological range is from the close of the Eocene to the latter part of the Pleistocene.

The accompanying illustration will give a fairly good idea of what some of these saber-toothed cats were like. Of course, one can not say that the animals were colored as the artist has represented them in his drawing. Perhaps there is more reason to believe that their markings, if they had any, were spots rather than bars, since spots are more primitive than bars. The figures were made from a skeleton of *Hoplophoneus occidentalis*, Leidy, recently constructed by Mr. E. S. Riggs in the University of Kansas Museum, and the artist had most perfectly mounted models of various recent cats to aid him in the restoration.

The chief peculiarities of the animal as seen in the picture are the extraordinarily elongated canine teeth. It will also be noticed that the tail is of unusual length and that the legs are short. The animal measured about seven feet in length aside from the tail. The lower jaws have a downward projection in front, as the picture shows, due to a flangelike widening of the jawbones, which doubtless served as a protection to the teeth, preventing their injury or loss. In some of the larger forms, from South America, this flange was not present, while the canine teeth were even more elongated than is the case with this species, attaining a length of over six inches and protruding far below the jaws when closed. Indeed, so far did they protrude that it was impossible for the mouth to be opened wide enough to permit anything to pass them. Skulls of these South American saber-tooths have been found, it is said, and one can readily believe the statement, in which the points of these teeth had become fastened in the lower jaws during life, preventing closure of the mouth, and in consequence casing starvation! It is difficult to quite understand just how these animals killed their prey. Doubtless some used their teeth as daggers, with a downward thrust, the mouth being closed. For this use the teeth were admirably adapted, being long, curved, and flattened, with each thin edge finely serrated.

In some of the most highly specialized of these animals the molar teeth in the back part of the jaws had been reduced in number, so that only one remained above and below on each side.

It is a pretty well established fact in natural history that such peculiar characters when once acquired are never lost. If this be true, it is quite certain that the saber-toothed cats have left no descendants behind them. Throughout North and South America they became extinct almost within historical times, and have left nothing behind them save their bones in the rocks.

THE QUESTION OF WHEAT.

By WORTHINGTON C. FORD,
LATE CHIEF OF THE BUREAU OF STATISTICS, TREASURY DEPARTMENT, WASHINGTON, D. C.

III.—RUSSIA.

RUSSIA is the United States of Europe in its economic aspects. An immense territory, much of which is still unused; a population of exuberant fertility and restless wandering, gradually spreading itself over the land; an agricultural basis for its economy; an experience of slavery that was conclusive on its wastefulness and social evils; and an industrial and commercial exclusiveness that has heretofore made it the one great power of the continent of unknown and unmeasurable resources—these characteristics may be found in this country, the opposite to Russia in political practice and social theory. The simile may be extended. For Russia has been urged forward by two potent ambitions. Panslavism created the vision of a united eastern Europe, with Russia at the head, and with a great Russian port—Constantinople—on the Mediterranean. The desire to be the controlling agency in Asia has led the Government to make heavy sacrifices to further that end, seemingly now to be crowned with success. For Russia commands the north of Asia through her railroad, and is in possession of ports on the Pacific which may give her an important share, if not the most important share, in Asia's commerce. No longer shut off from her outlying and half-closed port and fortress of Vladivostock, she has secured southern outlets and connections implying even greater political than commercial power over the destinies of Asia. From ocean to ocean, across Europe and Asia, and from the arctic to the Mediterranean, this huge unformed empire rests, the arbiter in both continents. Is there no likeness in this to the pan-American ambitions of the United States?

In 1870 the population of Russia in Europe was 65,70,559, or about thirty-five souls to the square mile of territory. If Poland and Finland be included, the total population will be increased to 73,504,592, but the density of population will not be changed, as the dense settlement of Poland is neutralized by the sparse population of Finland. In 1897 the total population had increased to 106,159,-

141, of which 94,188,750 were assigned to Russia in Europe, and the density of the population had risen to fifty-one to the square mile. The returns of Russia in Asia are naturally imperfect, but the census of 1897 gave 23,052,000 souls, and the density of population about four to the square mile. For the whole empire the density is fifteen souls to the square mile. This low figure is due to Siberia, where only 1.2 marks the population to the square mile, and to central Asia, which gave only 5.6 to the same territory. Poland is the most densely settled (one hundred and ninety-two to the square mile), and Caucasia does not greatly differ from the average for European Russia (53.3 to the square mile). If these figures be compared with the returns of the United States census it will be seen that European Russia has more than twice the density of population of the United States (21.3); that Poland is as thickly settled as New Jersey (193.8), and that New Mexico equals Siberia in sparseness of inhabitants.

The estimates of land under cultivation in European Russia have become more correct of late years, through the intelligent application of statistical methods by the Government. In 1850 it was believed that about eighteen per cent of the area (exclusive of Poland and Finland) was under cultivation, and of this cultivated portion nine acres in every ten were under grain. Accepting these official figures, the area devoted to grain would have been 219,569,000 acres. From 1850 to 1860 the cultivated ground increased by one tenth, and nearly the entire increase was devoted to grain. The social conditions introduced by the emancipation of the serf checked this development after 1860 in the northern and central government of the empire, but stimulated the settlement and cultivation of the more southern provinces—the black-earth region. The progress as a whole was small, for the gain of one region hardly overcame the loss of another, and in 1870 the figures gave an increase of only 1.5 per cent in the area of plowed land over the returns of 1860. After 1870 the rate of progression again rose, and in 1880 nearly ten per cent more land was in cultivation than in 1870. Again accepting the official figures, the area of tilled land was about 540,000,000 acres in 1880.

In that year nearly sixty per cent of this area was in the "black-earth" zone, a vast and rich arable plain, extending across the empire from the southwest corner (Podolia) to the Ural Mountains, and even reappearing in Siberia. This is one of the largest sections of fertile lands on the globe, and its pre-eminence arises from the decomposition through centuries of accumulated steppe grasses, and the shelter afforded by the outlying forests. "It owes its name to a layer of black humus, varying in thickness from, on the average, one foot and a half to five feet. The mold consists chiefly of loam, and in lesser proportion of oily clay mixed with organic matters. It dries up rapidly and becomes pulverized in the process; but it becomes with rapidity impregnated with moisture, and under the action of rain returns to its original condition of a sort of dough as black as coal." * The population in this region numbers from sixty-five to seventy-five to the square mile, and is increasing rapidly. In the United States the States producing the largest returns of wheat in 1896 were Minnesota, with a population of 16.4 to the square mile; California, with 7.7; and Kansas, with 17.4. The concentration in the Russian grain region becomes remarkable under such a comparison.

If the returns of cultivated land are defective, the estimates of product are even more open to question. In a report prepared by a Government commission appointed to investigate the condition of wheat in European Russia, exclusive of Poland, the area under winter wheat was given at 6,126,300 acres, and under summer wheat at 20,764,890 acres, or a total of 26,891,190 acres. That was about 1873. In 1892 the wheat acreage of all Russia in Europe, including Poland, was 34,100,835 acres. In 1897 the total area had risen to 36,738,500 acres, of which 24,411,500 were devoted to summer wheat. The gradual extension of territory included in the statistical returns makes comparison from year to year difficult, because the details of each year's aggregate differ. The following table will lack that definiteness which would make it scientifically valuable, yet is sufficiently clear to show the general tendency of wheat culture in Russia since 1872:

YEAR.	Acres.	Production.	YEAR.	Acres.	Production.
		Bushels.			Bushels.
1872	28,743,390	157,938,000	1885	....	172,378,173
1873	....	157,562,800	1886	....	156,546,447
1874	....	249,107,000	1887	....	269,085,104
1875	....	145,192,000	1888	....	286,476,461
1876	....	154,268,400	1889	....	172,909,590
1877	....	246,285,400	1890	....	206,329,430
1878	....	293,702,600	1891	....	163,475,063
1879	....	166,117,000	1892	34,100,835 †	234,034,662 †
1880	....	158,946,000	1893	....	360,104,546 †
1881	28,947,011	256,852,000	1894	....	353,629,452 †
1882	....	232,341,000	1895	....	....
1883	....	212,130,022	1896	....	....
1884	....	258,562,095	1897	36,738,500	340,470,000

From the earliest recorded statistics of exports from Russia, wheat has held an important position. When the repeal of the corn

* Anatole Leroy-Beaulieu. Empire of the Tsars, vol. i, p. 23. † Includes Poland.

laws was effected in England it was from Russia that the "avalanche" of corn was to come to destroy the English farmer and ruin the English landlord. The critical time, however, passed without any disturbing increase of imports from that direction, and Russia quietly enjoyed an increasing demand for its wheat from many quarters. The crucial test of its ability to meet the requirements of its neighbors came in the period of general failure of crops elsewhere, when a higher price for grain tempted the world to send the products to Europe, and on an equal plane of competition. The Russian crops of wheat were very large in 1870, 1874, 1877, and 1881, but in only two of these cases did the export movement expand in proportion. It must be borne in mind that the ability to export is controlled by the food supply of the whole empire. While some thirty-five governments of Russia produce a constant and at times excessive surplus, there are eight governments which vary between a sufficiency and a short supply, and some seventeen districts which never produce enough for their own consumption. The population of the grain districts is one half greater than the population of the other in insufficiently supplied regions, thus giving a home market of no mean size for the rye which forms the staple food of the people, and for some of the wheat. Whatever is not required to meet the home demand is available for export; but it by no means follows that the grain is exported. At this stage intervenes the imperfect economy of the empire—the want or deficiency in railroad transportation, the need of capital with which to move the crops, and the oppressive measures taken by the money lenders, who slowly ruin the peasant to secure a present advantage. The nearness to markets in part compensates for these obstacles, and the want of a large and steady market at home is more than sufficient to overcome the adverse influences which, standing by themselves, would almost prohibit competing in other markets except in famine years. Hence grain goes out in quantities, and is one of the controlling features in the foreign commerce of the empire, at once the result and a constant stimulus to developing this resource.

As late as 1888 the Minister of Finance deplored the want of proper intelligence and machinery among the farmers to get the benefits of the market open to them. In reciting the disadvantages incident to these conditions he wrote: "Being always well informed and not having mortgage charges to support, the American farmer is in a condition to resist more or less the maneuvers of speculation, and can form an idea as to the kind of grain of which the culture can be increased or diminished. With us the situation is very different; not only are the rates of transportation on our railways much higher than those of America (averaging fifty per cent more), but our farmers are deeply in debt, and are at the mercy of all kinds of intermediary agents whose honesty is not of a very high standard. With regard to this, the singular fact appears that last year, at such an important market as Kharkov, the farmers were not informed as to the prices current of grain; so that oats of the same quality were sold simultaneously at thirty-five cents and seventeen cents and a half the pood of thirty-six pounds. Further, instead of upholding our commerce in cereals with foreign markets, our exporters continue to compromise their reputation. A great number of merchants in London and other seaport markets complained in 1886 that the cargoes of cereals and flax coming from Russia contained an abundance of heterogeneous matter."

Owing to imperfect or expensive transportation, the peasant is not in the best position to obtain the full benefits of markets. "The harvest ended, each man brings his grain to market. Hoping to realize a more remunerative price by carrying his produce to a central or larger market, he makes application to travel. Here the factor steps in. In conjunction or in collusion with the local police, obstacles are thrown in his way week after week. Ten, twenty, or one hundred are in the same predicament. Finally, with the local station or market glutted with the yield of a county, the factor steps in and agrees to take all the grain in sight for about twenty-five per cent below its market value. They have no choice, and thus a crop grown at a cost of twenty-five per cent interest (paid to the factor for advances) frequently pays twenty-five per cent additional after its maturity." * Not only does such a system of handling grain cause loss to the farmer through low prices, but even more through the actual destruction of grain. It is estimated that millions of bushels of grain are lost annually on account of the failure of railways to afford transportation facilities or shelter for grain brought to them for transportation.

Nor is the question of transportation the only indication of inchoate economic conditions. The land is, as a rule, subject to a mortgage indebtedness, which takes each year an appreciable part of the produce. The usurer or money lender (in Russia the terms are almost synonymous) calls for his per cent on loans, and this per cent may range from a moderate rate to one that is virtual confiscation. A failure in the crops only throws the peasant deeper into debt, for he must borrow to obtain seed and food; the latter for immediate support, and the former as a venture in the future. Two bad seasons bring ruin, for the means of obtaining further advances have been exhausted, and only as a tenant, bound to the soil as

* Report by United States Consul-General Way, May, 1889.

closely as was any serf, can the peasant continue to cultivate the land. As every year does not produce a full crop at remunerative prices, it is rare to find farmers free from debts, with the coming crop already mortgaged to the factor in return for past favors.

Although rye is the great cereal consumed in Russia, wheat is also in demand at home. A short crop or a prohibition of import into a market is reflected in the domestic position of that crop. The mere fact that more than one half of the year's product is exported would explain the sensitiveness of Russia to conditions affecting supply and demand. From 1872 to 1880, when importing countries of Europe were obliged to look outside of that continent for supplies, Russia's yield of wheat did not grow as rapidly as seems to have been warranted. The backward and adverse seasons, following one another in almost unbroken line, discouraged an extension of area under wheat, and directed attention to the coarser and hardier grains more generally consumed throughout the empire.

The year 1880 stands out as one of manifold misfortune and disaster to agricultural Russia. The winter of 1879–'80 was of unusual length and severity, and lasted so far into the spring that the food for cattle was exhausted, and large numbers died of starvation. Storms of hail and rain caused great destruction, and the appearance of beetle and cattle plagues added much to the loss and suffering of the population. Had not the Government intervened, with supplies of grain for food and seed, and with public works undertaken for the relief of the starving, a famine of portentous proportion and permanent results would have been experienced. Want and suffering led to a veritable epidemic of diphtheria, "which carried away almost the whole child population of large villages." It was significant that this economic misfortune led to a social change of some moment. "The landed proprietors of the country (around Odessa) are, almost to a man, bankrupt and ruined, and the real property of the country is speedily passing into the hands of the Jews, who manage to make money from it where others starve. They divide the land into holdings, which they let to the peasants, and make a very handsome income of it."

It is remarkable how regularly the wheat production of Russia has fallen short. Beginning with 1880, already given, the next approach to failure was in 1886, with a crop of 157,000,000 bushels; and again in 1891, when 163,500,000 bushels only were gathered. Every fifth year is thus marked, and it is in these exceptional years that the real strength of the Russian wheat interest is to be measured. The year 1891 stands prominently as the year of famine (*année de disette*).

In the fall of 1891 Russia took the somewhat unusual step of prohibiting the exports of all kinds of cereals except wheat, and in November the prohibition was extended to wheat. As Germany obtained more than eighty-five per cent of its imported rye and more than half of its imported wheat from Russia, the measure was at once reflected in the prices of grain throughout Europe. The first explanation was that Russia sought to retaliate on Germany for the open hostility of Bismarck to Russian financial operations in Germany; but this explanation was based upon a mere supposition, and one that could not account for the general condition of the wheat market outside of Germany. The true reason came to light slowly, and in spite of the efforts of the Russian Government to conceal the gravity of the situation. It was a true famine from which Russia suffered. Both the spring and winter wheat gave very unsatisfactory returns, and one third of the provinces were appealing to the Government for the means to feed their people. The harrowing descriptions of extreme sufferings, of fearful destruction of men and cattle throughout the stricken regions, and of the comparative impotency of the administration to cope with the emergency, startled the civilized world, and brought aid even from the United States. So great a deficiency in Russia as almost to prohibit exports was aggravated by the very poor returns of grain crops throughout Europe. The price of a pood of wheat at four great markets of Russia was:

	1890 Kopecks.	1891. Kopecks.	1892. Kopecks.	1893. Kopecks.	1894. Kopecks.
St Petersburg	96.5	118.4	114.6	99.4	78.9
Riga	94.5	118	118.9	96.0	71.8
Odessa	89.2	107	89.8	71.3	58.5
Saratow	74.2	105.3	106	82.8	58.8

This range of prices is sufficient to warrant the name of famine year to 1891, an experience from which Russia did not recover until 1894, and from which important lessons in administration were drawn.

Scarcely had the full effects of the deficiency of 1891 been realized when a new complication arose in the serious commercial rupture with Germany. A treaty of commerce was in process of negotiation between the two powers. German manufacturers, who enjoyed a large market in Russia, complained that discriminating duties were imposed upon their products on the frontiers, and commercial treaties with other states were imposing obstacles on their operations. Russia assumed that Germany was dependent upon her for cereals, and desired as liberal concessions on grain as were given to any outside power. Germany had determined to yield no point on those duties, pointing out that the successive increases in the German tariffs in 1879, 1885, and 1887 did not hinder the development of Russian exports to Germany, whereas the Russian tariff legislation had produced a distinctly injurious effect on the trade of Germany. For nearly two years the negotiations for an agreement were continued, to be abruptly broken by the announcement on the part of Russia that the maximum tariff would be enforced against Germany after July, 1893. As this meant an increase of fifty per cent in all duties on German goods, Germany retaliated by imposing a corresponding penalty duty on all imports from Russia.

In 1891 the dutiable imports into Germany from Russia were 400,000,000 marks, of which 91,000,000 marks were in wheat. In 1879 the duty collected on wheat by Germany was fixed at one mark per one hundred kilos (twenty-four cents). This rate was in 1885 increased to three marks (71.4 cents), and in December, 1887, to five marks ($1.19). Under treaty arrangements the duty on wheat could be reduced to 3.50 marks (83.3 cents), but Russia did not enjoy this concession. In spite of this discrimination the trade in wheat progressed, and would have continued to increase, had not the disaster of 1891 occurred in Russia, and the tariff war followed. The effect on the total movement of wheat from Russia and on the exports to Germany is shown by the following comparison:

Year.	Russian Exports.		German Imports.	
	Total poods.	To Germany. Poods.	Total kilos.	From Russia. Kilos.
1889	190,545,698	14,110,471	516,887,000	301,247 000
1890	182,085,036	10,714,805	617,587,000	370,823,000
1891	176,369,063	17,931,110	905,332,000	515,212,000
1892	81,555,790	3,255,753	1,296,213,000	257,299,000
1893	156,229,650	2,724,043	703,453,000	21,636,000
1894	....	....	1,153,837,000	280,594,000

Fortunately, an agreement between the two countries was reached in March, 1894, but all of a year was required to correct the injury inflicted on this branch of Russian export trade.

Within eight years Russia's wheat interests have thus been subjected to severe tests, and have endured in a remarkable manner. It now becomes necessary to give some attention to the internal economy that makes this elasticity possible. The cost of production is a mere detail when set against the social revolution implied in the change from serfs to peasant farmers.

Any estimate of actual cost of production of wheat in Russia must be based upon so many different conditions as to afford little satisfaction. No two governments of that immense and variegated empire would return the same averages; and to complete a general and acceptable average would defy every known statistical method. Yet the attempt has been made in connection with the competition from the United States, and the result was published with the official recognition of the Minister of Finance. There is little doubt that this comparison deserves to rank with the curious French and English estimates already quoted—estimates which sought to determine an arbitrary limit of cost below which wheat could not and therefore would not be grown in the United States. It will be of interest to make a record of the Russian estimate, if only for future reference and comparison. "A pood, or thirty-six English pounds, of wheat costs the Russian producer fifty-six kopecks, or twenty-eight cents, whereas the same quantity of American wheat costs the producer sixty-six kopecks, or thirty-three cents. The transportation of this cereal from Russia to London costs about nine kopecks per pood, or four cents and a half, whereas the American exporter pays 9.7 kopecks, or 4.85 cents, per pood to transport his grain to the English markets." *

In the black-earth region the cost of production, including rent, was said to range from forty-five to sixty kopecks per pood, and even at the higher cost would have yielded a profit to the cultivator if sold at the market price. This made possible a fall of more than one fifth in the commercial value of wheat between 1881 and 1887, without affecting the production in any noticeable degree. In most cases, however, the profit was apparent, and the debt-burdened landowner derived little benefit.

In 1838 the serfs numbered forty-four out of every hundred in the population of Russia in Europe, but at the time of emancipation the proportion was less, and tended to diminish each year. The serfs on private domain, forming about one half of the total number of serfs in the empire, constituted the readiest asset of the proprietor for obtaining loans from the credit establishments of the state. So far was this practice carried, that at the moment of emancipation two thirds of these serfs were found to be so mortgaged. The act of emancipation transformed the serf into a landowner, and through this ownership and the autonomy of his commune he was supposed to be fully emancipated, at once economically and administratively. As compensation was due to the nobles for the land thus given to the freed serf, the state undertook to loan four fifths of the established value of the land, whenever the serf should wish to request that aid. The advances were made on a basis of a period of forty-nine years at six per cent, the annual payment of six per cent covering the interest and finally extinguishing the debt. The process of emancipation is thus still short of completion.

* Based upon a report issued in 1889 by the Russian Ministry of Finance.

Other circumstances had interposed to check the intended operation of this great economic revolution. In 1880 over one fourth of the peasants in the eight governments composing the richest region of the empire, comprising the agricultural zone of the center, were under "temporary obligations," and thus far from perfect freemen. "In the more fertile regions of the black-mold belt, where, owing to the outlets opened by the railroads, the value of land has rapidly increased, the landlords frequently found it to their advantage not to consent to its redemption, so as to retain the compulsory services of the peasants. Now the statute did not give the peasant the right to demand the redemption; this right belonged exclusively to the master, and all that the peasants could do in such a case was to reduce their lots to the legal minimum allowed for that particular locality." * To hasten the end, Alexander III made redemption obligatory.

Although nearly forty years have passed since the ukase of emancipation was promulgated, it is still too early to give a definite judgment upon its results. The expectations of its framers have not been attained, in part because of the immensity of the task and diversity of conditions to be met, and in part because the immediate application of the ukase was made not by those who had thought out the scheme, but by others, who were either indifferent or even hostile to the measure. The serf has not generally become an independent landholder, nor has he gained that economic self-reliance that was so ardently desired. He is even less able than before to encounter a bad season, short crops, or a cattle plague, for he has no master who may make good his losses and help him to tide over his difficulties. On the other hand, the peasant has not secured what he believed to be his rights, and is not a little discontented that his dream of full and free possession of the land has not been fulfilled. The many and increasing taxes bring home to him the responsibilities of property, but give him little for meeting the increasing burdens. "Great is the number of peasants who, to-day, pay taxes and dues as heavy as in the time of serfdom, while they have less land, less forest, often less live stock, and less credit than before the emancipation, which, under such crushing conditions, could not rapidly augment the well-being of the people nor improve the culture of the soil. It has frequently enriched wealthy districts, and sometimes appears to have still more impoverished poor ones. Official statistics have ascertained that in many localities the cattle had diminished in number, hand in hand with the lack of cattle goes that of agricultural implements and of manure, so that the peasant's already primitive mode of farming not only has not improved, but has in

* Leroy-Beaulieu. The Empire of the Tsars, vol. i, p. 443.

places actually deteriorated since he is free. The soil has become exhausted, the fields have even sometimes been abandoned, so that in many regions bad crops and dearth have come to be of almost regular occurrence."

The helplessness of the peasant, the importance of food supplies, and the necessity of foreign markets for surplus product have induced the Russian Government to devise an extensive system of state aid, apart from the measures arising out of the emancipation. This policy was initiated in 1888, and offers a most elaborate plan for facilitating the marketing and transportation of grain, without endangering the home supply. It was formerly the practice among rural communities to set aside a certain quantity of grain each year of good return to be held as a store against a deficient crop or actual famine. This salutary system had been allowed to fall into disuse in many governments where the development of agriculture seemed to promise an immunity from want or even from high prices that are inseparable from a really short production. The events of 1891 gave a rude shock to this feeling of confidence, and the Government determined to enforce the old system of storing grain, or to create a fund out of which actual suffering through a partial famine could be relieved. The Minister of the Interior, in calling the attention of the local authorities to this matter, proposed two methods of attaining the end desired: (1) by returning the grain borrowed, where a general store has been maintained, and filling new storehouses; or (2) by substituting a grain tax where the old stores have not been kept up, for a money tax designed to make a fund for the purchase of supplies when needed.

"The Ministers of Finance and of the Interior have solicited the imperial permission for giving the zemstvos the right to collect the land tax from peasants in grain instead of money, and that, furthermore, in order to give the zemstvos means to meet the necessary expenses, a credit should be opened for them in the Government bank at the low rate of three and a half per cent per annum and to the full amount of the sums they were entitled to receive in grains. The loans thus made must be returned to the bank out of the money received from the sale of the grain, or, if necessary, from special taxes, and not later than June 1, 1894." *

A second object to be gained through state agency was to relieve the peasant from the necessity of selling his grain as soon as gathered in order to provide the means of continuing the operations of the farm.

Since 1888 liberal loans have been made to farmers on grain stored in warehouses or delivered to the railroads. These advances

* Consul General Crawford's report, December, 1893.

are not to exceed sixty per cent of the current price for the grain at the nearest market place, and run for six months, or even for one year. A short-time loan, for six weeks or less, may reach eighty per cent of the current price. In every case the rate of interest is at least six per cent, but varies according to the condition of the grain and the nature of the security. Should the borrower default, the grain is sold at public auction by the railroad, which acts as the agent of the Imperial Bank, whence all the loanable capital is derived.

In actual practice the system does not meet with the success anticipated by its framers. Not only is the capital available for advances inadequate, but the ability to loan is given only on grain actually delivered to the railroads or stored in central warehouses on favored routes. For the grain retained in the peasant's hands no provision will apply. The natural result is to stimulate the moving of the grain away from the place of production and, as experience has often proved, away from the market where it may be most needed. To secure the widest application of the loans, the Government entered into arrangements with private banks, supplying them with the capital to advance on grain, and offering them a profit on the venture.

The Government also undertook to facilitate the marketing of grain. The current prices of the leading cereals were published at all railway stations with a view to instruct the peasant of the condition of the market. The railway tariffs were subjected to a severe examination, that there might be no gross discriminations in rates against certain localities, or through differences of distances. The actual freight charged could not at once be reduced to a complete and consistent system; but the power of the Government to control the rates made itself felt wherever an emergency pressed. When Germany excluded the wheat and rye of Russia from her territory, the Russian Government reduced by nearly one third the cost of transporting grain to the Austrian and Roumanian frontiers. This gave a saving of twenty-five dollars a car, or about six cents a bushel, on wheat carried farther than six hundred and sixty-three miles (one thousand versts), and enabled the exporter to sell his grain in markets where he had not found a ready sale because of the cost of transport.

The development of railroads in Russia has been slow, and controlled rather by military than by commercial factors. In 1871 there were 7,750 miles opened to traffic, of which no less than 4,523 miles had been opened between 1868 and 1871. In 1874 the mileage had risen to 10,368, and between that year and 1890 the length of lines in European Russia alone increased to 18,059 miles. Toward the end of 1896 the returns for all Russia gave 25,898 miles open to regular public traffic, of which two thirds were owned and worked by the Governments of Russia and Finland, and nearly 5,600 miles were under construction.

From time to time reports have come of the immense wheat possibilities of Siberia. Growing in definiteness as the land became better known, they yet have not attained to such a degree of accuracy or distinctiveness as to give a basis for testing their truth. As early as 1888 the representative of the United States in Russia reflected some of the glowing accounts. There were "vast bodies" of land in southern Siberia, capable of producing "an unlimited quantity" of all cereals. "Along the banks of the Obi, Yenisei, and Lena, and for hundreds of square miles between them, the land is a garden spot, the soil consisting of a rich, black earth. . . . It is virgin soil, and is as rich as the delta of the Nile. Owing to lack of transportation, the prices of land, grain, meat, and labor are ridiculously low."

In the famine year, when it may be assumed that all available sources of grain were drawn upon, about 9,000,000 bushels of Siberian grain were purchased, and it was stated that more than 6,000,000 bushels more could have been obtained had the means of transporting them existed. The sales in such an exceptional year can not be taken to represent the usual available quantities, and the possibilities of marketing at such distances are yet to be tested.

Thus Russia stands on wheat where the United States stood in the middle of the century. Her farmers are hampered by lack of transportation, by debts, and by the survivals of a *régime* of serfs. In Europe, Russian wheat finds a ready market, naturally protected against outside competitors by propinquity or geographical position. But the peasant of Russia will consume more of his product each year, and it is very doubtful if the wheat capabilities can develop to such an extent as to place the country in a position to command her present market. An economic revolution must first be accomplished, and there is evidence of its approach at the present time. It may be checked by the Asiatic ambitions of the Czar, but on its accomplishment depends the future of wheat in that great empire.

"PASTEUR," say Dr. and Mrs. Percy Frankland in their biography of him, "only worked at his ease in silence and meditation; in his vicinity he only tolerated his assistants; the presence of a stranger while he was occupied sufficed to disturb his work. One day, on going to visit Wurtz at the École de Médecine, he found the great chemist surrounded by students, the laboratory resembling a hive full of bees in its bustling activity. 'How,' exclaimed Pasteur, 'can you work in the midst of such commotion?' 'It stimulates my ideas,' replied Wurtz. 'It would effectually banish all mine,' was Pasteur's answer."

EYE LANGUAGE.

By LOUIS ROBINSON.

NO part of the human countenance engages our attention so frequently as the eyes. When face to face in conversation, we do not look at the lips—although, as a rule, the attention is very quickly taken by any movement—but at the eyes of the person with whom we are speaking. So much is this the case that the habit of many deaf people of watching the mouth always strikes us as peculiar. In fact, one usually feels that there is a sense of incompleteness in the association of mind with mind by means of conversation if there is not a continual interchange of glances making a kind of running commentary on the words spoken. The same may be said of ordinary greetings when two people shake hands: unless there is at the same moment a meeting of friendly looks the ceremony loses much of its meaning.

Now why is there this continual meeting of eyes accompanying all kinds of human intercourse? Partly, no doubt, it is attributable to certain habits of comparatively recent date. The eye, "the window of the soul," is a more truthful exponent of the inward thoughts than the tongue, and seeing that speech is very frequently used not to tell the thoughts but to conceal them, we look to the eye for confirmation or the reverse for what our ears are taking in.

Partly, I think, the habit is based upon an inbred instinct which we have inherited from very remote ancestors, and which is exhibited by many of the lower animals. One finds that very young children, long before they acquire any knowledge of words, establish an understanding with those about them by means of the eye. A babe of a few months old directs its glances to the eyes of those round about it quite as much as an older person. A dog watches its master's eyes habitually, and, as will be shown later, monkeys use this method of ascertaining what is in the minds of those round about them almost as much as we do. Many wild creatures instinctively understand when they are being looked at. Thus a hare in her seat will often allow a man to pass close by her if his gaze is directed at some other object, but when she sees his eyes turned toward her she seems to know that she is discovered, and is up and away in an instant.

Is it not Oliver Wendell Holmes who draws attention to the automatic way in which we challenge the eyes of those we pass in the street, and thus establish, every time we walk abroad, a species of understanding with many persons who are otherwise complete strangers? It is not too much to say that mind begins to communicate with mind at the moment when the eyes encounter, and that people whom we have acknowledged in this way stand on a somewhat more familiar footing with us than before the vague bond became established.

We, most of us, feel a hesitation about making our presence known, even to a friend, by any other form of advance. The beggar has long ago discovered that he gains by this most informal method of self-introduction. This fact has been brought home to me of late while I have been interested in ocular expression, and have made a habit of looking—perhaps rather more intently than is customary—at the eyes of persons whom I meet upon the pavement. If any member of the cadger fraternity happens to be on business in the streets, he is certain to regard the momentary interchange of glances as an invitation to attempt some more profitable form of commerce. The commonness of the habit can not be better emphasized than by calling attention to the fact that members of Parliament make use of the same mute telegraphy as mendicants when they desire permission to address the House.

Fencing masters lay great stress upon the importance of pupils keeping their eyes steadily upon those of their opponents. In all probability Nature herself would teach any of us this elementary lesson if we were face to face with a real enemy. I have noticed that all pugilists, trained and untrained, when sparring keep their gaze fixed upon the eyes of their antagonists. That such habits are instinctive is shown by the fact that all apes when they have hostile intentions invariably look steadily at the eyes, and never allow their glance to stray.

When we study the natural history of ocular expression we soon find an explanation of these facts. Obviously the nervous mechanism of such primitive and widely distributed methods of intercourse must be very ancient, and can have but little to do with the higher intellectual faculties. Undoubtedly eye language dates back far beyond the beginning of human speech, and was therefore established at a time when mental processes were infinitely less complex than they are to-day. One must not attribute the superior truthfulness of the eye over the tongue and the other organs of expression to any causes which have to do with morality. Nature knows nothing of ethics as we understand the term, and if she can gain an infinitesimal advantage by deceit she resorts to it without the slightest hesitation. But, unlike many human exponents of the art of lying, she is frugal and businesslike in her output of falsehoods. If it does not pay her to tell a lie her veracity is beyond suspicion. Broadly speaking, the language of the eye is the language of truth, because it was evolved at a time when elaborate lies were useless. When there were no highly developed brains social strategy of the more oblique kind was uncalled for, just as hundred-ton guns were uncalled for before the days of ironclads. We know that the development of the critical and plotting part of the brain is of comparatively recent date, but that the mechanism of the emotions and the more automatic mental processes is extremely ancient. Hence the surviving methods of communication which belonged to the earlier ages, and are closely connected with the machinery of emotion, do not so readily lend themselves to civilized mental artifices as the comparatively new-fangled organs of speech. They are to a great extent independent of the conscious will. I shall endeavor to explain, when discussing the physiology of ocular expression, how it is that the eyes maintain their pristine simplicity and often betray the lying tongue.

In his treatise on the Anatomy of Expression, Sir Charles Bell draws attention to the fact that the changes which take place in the appearance of the eye are due chiefly to the surrounding structures, and not to alterations in the eyeball itself. When, therefore, one is discussing the causes of ocular expression, it is necessary to take account of the muscles of the brow and also of those which surround the orbit. I think, however, that the eyeball *per se* undergoes more change under the influence of emotion than has been supposed. It has been said that the glistening or sparkling of the eye is simply the result of the ball being compressed from the outside; but careful experiments seem to show that the orbicular and other muscles surrounding the eyeball have less constricting power than they have received credit for. One finds, both in man and in animals, that the eye is capable of sustaining a good deal of pressure from the front without any marked change in its general aspect. Any one who has observed the large cushion of fat which lines the roomy orbit, and which forms a soft bed for the ball, will understand how easily the eye evades pressure from the orbicular muscle. Of course, if all the little muscular straps which proceed from the back of the orbit, and are attached to the sclerotic, were to contract vigorously at the same time, ocular tension might be sufficiently increased to cause the front surface to be tight and glistening. But it will be plain to every anatomist that if this took place the eye would be completely disorganized as a visual apparatus, because the distance between the lens and retina would be so increased as to throw the focusing machinery completely out of gear. The effect of pressure so applied would be to make the eye extremely short-sighted. Now, it is quite possible to have the eye sparkling with emotion and yet retain the normal powers of sight. We must look elsewhere for the mechanism of the sparkling eye, and I think we shall find it in the parts controlled by the sympathetic nerves which regulate the condition of the blood-vessels and their minute continuations. This will perhaps be best discussed a little later, when some points in the physiology of the eyeball which bear upon expression are dealt with.

The relation of the brow to the eye greatly influences its expression. If one examines the eye of an eagle one finds that its impressive aspect greatly depends upon the fact that it is overhung by a lowered brow. Although we speak of an "eagle eye" in a human being, there can be no doubt that it is the unconscious application of human physiognomical standards to the bird which makes us think its expression so imposing. The eagle has in an exaggerated form certain ocular characteristics which in a human being are a sure sign of formidable qualities. A clear and steady gaze—possibly emphasized by the sparkle indicating some fierce emotion—from beneath a lowered frowning brow means a great deal when seen in a man. Throughout all Nature a steady eye indicates courage. The possessor is confident in his own strength, and does not feel the need of looking hither and thither either for succor or for a way of escape. This fearlessness and fearless aspect under natural circumstances is generally fully justified. It is only when it is backed up by such physical qualities as to give a fair prospect of success in any encounter that warlike courage is one of Nature's conservative forces. Otherwise it would obviously expose its possessor to grave risks of extinction. It is because this sign of courage seen in the countenance is also almost invariably a sign of formidable power that it is so universally held in respect. In the "eagle eye" one has this bold clear glance, and above it the suggestion of a frown. Now a brow of this character usually means two things: First, that there is some feeling of resentment; and second, that the mind of the frowner is made up as to some course of action. When these are added on to the other qualities indicated by the "eagle eye," one naturally feels that the man displaying it is not one to be trifled with. Most savages frown horribly when they wish to intimidate their foes, and it is said the Chinese recruits are exercised in this maneuver as thoroughly as ours are in accomplishing the "goose step." Their words of command (as commonly reported) are, "Prepare to look fierce! Look fierce! Advance on the enemy!"

I am inclined to think that we have a remnant of this self-same piece of strategy in the peaked caps still worn by the soldiers of several nations. The cap which one sees most commonly represented in pictures of the French troops in the Franco-German War brings a frowning look to the brow, and shadows the eyes in such a way as to give the face a very stern and soldierly *ensemble*.

I remember being greatly struck with the transformation effected in the look of a number of "sandwich men" in the Strand who had been dressed up in cast-off French uniforms. The men seemed all of the feeble, woe-begone class from which sandwich men are usually recruited, but under the shadow of the military caps their faces looked stern and resolute, and their eyes had quite lost that watery, vacillating look which is engendered by alcohol and despair.

Sculptors and painters almost always exaggerate the brow and the shadow it casts when representing idealized human figures. It is an essential of the manly type of beauty to possess this certificate of manly qualities. We all know how weak and unimpressive is the prominent eye which is not shadowed by a lowered lid or brow. The reason of this is that people with such eyes have a startled look similar to that of a frightened animal. It is one of the painful duties of a physician to watch the facial changes which take place in various diseases, and in one known as *exophthalmic goitre* the eyes tend to become more and more prominent. The result is that the face has an aspect which so exactly simulates the expression of sudden fear that it is often difficult to believe that the patient is not feeling great alarm.

We are constantly influenced by the automatic tendency to form judgments about the character from ocular expression when we come in contact with those whose eyes are altered in appearance by accident or disease. Thus when a person is suffering from the involuntary to-and-fro shifting of the eyes known as *nystagmus*, it is by no means easy to believe in his sincerity. Probably all of us feel an instinctive prejudice against individuals who squint. The fact that the two eyes are looking in different directions creates an involuntary suspicion of double dealing. This is especially the case when the squint is an external one. Here obviously the fault is in the understanding of the spectator, and not in the moral character of the unfortunate who squints. It is the unreasoning "old man" who is within every one of us who insists on disbelieving in the virtues of a squinting *vis-à-vis*. Doubtless in those days of pristine simplicity when the ancestral "old man" was in his prime, and as yet incapable of articulate speech, the necessity of understanding ocular language was so great that any being whose eyes were a complete puzzle was justly regarded with distrust. Nearly all monkeys become angry and suspicious when looked at by a person who squints. When we reason the matter out we recognize that this distrustful feeling toward strangers who have crooked eyes is perfectly absurd, and that obliquity of vision can be no possible index of perverted morals. We all feel the prejudice, nevertheless!

Probably the world-wide superstition concerning "the evil eye" has arisen from the sinister aspect of a squint. Bret Harte, in The

Right Eye of the Commander, tells how a whole settlement was well-nigh ruined through its benevolent chief purchasing a staring glass eye from an astute Yankee trader. According to the narrative, this so altered the expression of the commander that even his intimates began to fear him, and it soon became rumored among the Indians that he was possessed with a devil. Possibly the uncanny effect produced by an ill-fitting glass eye is enhanced by its stony stare, resembling that of the abhorred serpent.

Emotion is largely shown in the eye—as elsewhere—through the medium of the sympathetic nerves. These are almost always outside the direct control of the will. One of their chief functions is to regulate the caliber of the blood vessels. Many people are painfully conscious that they are quite unable to keep themselves from blushing. When we blush, the sympathetic ganglia in the neck which control the facial circulation allow the small arteries to dilate, and hence the surface of the skin becomes suffused with red. Now the front surface of the eyes, although apparently non-vascular, is really filled with a network of microscopic canals containing a clear fluid. These are so minute that even the tiny red corpuscles of the blood can not enter them except under exceptional circumstances. Nevertheless, they, like the other channels of the circulation, are controlled by the sympathetic nerves, and when these give the command they become distended with lymph so as to lend to the *cornea* and *conjunctiva* a tense glistening aspect. We all know that the eyes become bright under the influence of fever, and this is obviously because the tiny lymph channels, like the larger vessels which convey the blood to the skin, are dilated and full of fluid. This, I think, is a satisfactory proof that the glistening of the eye does not wholly depend upon the muscular pressure from without. Not only do the sympathetic nerves regulate the brightness of the eyes in the manner above mentioned, but they are also the agents in bringing about changes of expression due to the enlargement or contraction of the pupil. Perhaps it may be as well to remind those of my readers who have not studied the anatomy of the eye that the pupil is a little window admitting the light to the ocular chamber, and that its diameter is regulated by the involuntary muscular fibers of the iris. Until comparatively lately there seems to have been a good deal of difference of opinion as to the action of the pupil under the influence of emotion. About five years ago I had some correspondence with Sir S. Wilkes, the distinguished president of the Royal College of Physicians, upon this very subject, and he informed me that after long inquiry he had been unable to get any trustworthy information as to how the pupil behaved in the lower animals when they were under the influence of emotion. The correspondence had been called forth by my stating in an article on Canine Morals and Manners (lately republished in Wild Traits in Tame Animals) that a dog's pupils dilate when he is angry. The evidence upon which I based this statement was gathered at the house of a friend who had a fox terrier which used to become furious when teased. It had a basket in the corner of the room to which it retired when offended. The light from the chandelier shone full upon its face, and I frequently observed that when the animal was especially angry the eye chambers reflected the light in the same way as do those of a human being when the pupils are dilated with atropine. Having no quarrel with the animal myself, I could approach him with safety when others were exciting his wrath, and found that on such occasions the pupils of his eyes were widely open. It so happened that about the same time Sir S. Wilkes had been making observations upon parrots, and found that the pupil contracted when the birds were under the influence of anger. On extending my observations to other animals, I found that cats and monkeys exhibited the same peculiarity as the dog when enraged and meditating mischief, but that in several instances, as soon as the creatures were provoked beyond endurance and flew at their persecutors, the pupils suddenly contracted. I offer the following conjecture as to the reason of this phenomenon: When an animal is angry and face to face with a foe, but has not made up its mind as to the most effective method of attack, it is important that the eyes should take in as much as possible of the enemy and his surroundings; but when the actual onslaught is made, the attention of the assailant is fully concentrated upon some particular point of his adversary's body.

One of the most remarkable instances of dilatation of the pupil during anger which I have observed was in a black panther at the Zoölogical Gardens. This dangerous brute, which had injured several people and was usually kept in the background away from the general public, sprang at the bars when the keeper touched him with a stick, and his yellow circular irises became narrowed to mere bands, so that the pupils were enormously dilated. This gave the eyes an expression of indescribable ferocity, for they reflected so much light from their interior as to appear as if red flames were glowing within.

There seems to be a good deal of doubt as to the reason why the eyes of animals shine in the dark. One often hears it stated that the eyes of certain beasts emit light on their own account as if they were phosphorescent. I have never been able to verify this statement, and am inclined to think that it is a mistake. In all cases where I have personally observed this shining of the eyes, the light has obviously been reflected. Our attention is usually drawn to the phenomenon when a creature is in a dark corner and we are between it and the light, or when we are carrying a lamp or candle at night-time. When it is dark the pupils of all animals naturally dilate almost to their full extent, and therefore the sudden appearance of an artificial light finds the eyes in much the same condition as they would be in if under the influence of atropine. Any one who has taken a bright lantern into a cow stall or stable at night must have been struck by the glinting eyes of the animals turned toward him. Pot hunters, in the days when deer were plentiful in America, used to go out at night with an assistant carrying some blazing pine knots just behind them. The eyes of the startled deer with their pupils dilated with terror and darkness at once afforded a deadly mark to the "sportsman." The method was not without its dangers, especially in the settled regions, and innumerable tales are told of domestic animals having been shot by some careless "fire hunter."

I have never been able to make out why the light coming from the eyes of most animals seems to be almost as pale as that from the glowworm. Welm we examine the human eye with an ophthalmoscope the light reflected from the retina is red, because that membrane is filled with a network of innumerable blood vessels. The eyes of the enraged panther mentioned above threw back a distinctly red light, but usually, especially when one is at some little distance, eyes shining in the dark look of a pale-green color.

Other emotions besides that of anger seem to cause an enlargement of the pupils, but it is by no means easy to explain why this should be the case. Like most of the functions which are under the control of the sympathetic system, exercise increases the tendency. Hence, wherever one sees a person whose pupils dilate or contract very readily, one may at once infer that one is dealing with an emotional and excitable nature.

I shall not attempt on this occasion to point out all the peculiarities observable in the human eyes which aid us in reading character, and, moreover, it would be exceedingly difficult to analyze verbally some of the intuitive judgments we form from such sources every day of our lives. As was remarked above, such judgments are frequently based upon mere instincts, and seem to spring from those lower mental centers which we possess in common with the lower animals. One generalization which was made several years ago by my friend Mr. J. A. Fothergill is, however, worthy of mention. When the eyes are somewhat prominent and are half veiled by drooping lids (a type well marked in the late Lord Beaconsfield), it is almost invariably a sign of superior mental qualities.—*Blackwood's Magazine.*

PRINCIPLES OF TAXATION.

By DAVID A. WELLS, LL. D., D. C. L.,
CORRESPONDANT DE L'INSTITUT DE FRANCE, ETC.

XVIII.—THEORY AND PRACTICE OF INCOME TAXATION. (CONTINUED.)

THE income-tax experiences of the United States are so little in accord with those of any other people or countries that their consideration with a view of obtaining a practical acquaintance and comprehension of the whole subject would seem to be best facilitated by grouping their most important characteristics under three heads—namely, their origin and history and undoubted influence on the political and fiscal policy of the nation.

Under the great financial necessities of the Federal Government by reason of the war the attention of Congress was directed to an income tax as a source of revenue as early as the summer of 1861; and in that and the following year laws establishing such a tax were enacted. Their provisions were, however, so complicated, and the methods authorized by them so inquisitorial, that the Commissioner of Internal Revenue reported in 1863 that they deprived the tax "of all claims to public favor." The revenue returns under such circumstances were very moderate: $2,741,858 in 1863, and $20,294,000 in 1864. In this latter year a more comprehensive and effective law was enacted, which was followed by better results, the collections to the credit of the income tax rising from $32,050,000 in 1865 to $72,982,000 in 1866, and $66,014,000 in 1867. But as the necessity for very large revenues on the part of the Government ceased with the termination of the war, and the spirit of patriotism engendered by the war on the part of the people abated, the collections fell off very rapidly. Thus, between 1866 and 1867 the total receipts on account of the income tax, without any change in the law, declined from $72,982,159 to $66,014,000; and in 1872, with an exemption of $2,000, only 72,949 persons in the United States, out of a population of over 39,000,000, admitted under oath that they were in receipt of any income liable to taxation in excess of the exemption. Those only who were officially and intimately connected at this time with the Internal Revenue Department of the United States Treasury can form any adequate idea of the amount of perjury and fraud that characterized and pervaded the country, during the years 1867 to 1872, as the outcome of the then existing system of internal revenue. And American ingenuity was never more strikingly illustrated—not even by the exhibits of the patent office—than it was at that time in devising and successfully carrying out methods for evading the taxes on incomes and distilled spirits.

One curious feature of Federal experience with this tax, the tolerance of which would now be regarded as incompatible with any just and efficient administration of it, was, that the returns made under it were thrown open to the public; and one commissioner of internal revenue instructed his officials to have them published in the pages of local papers, "in order," as he said, "that the amplest opportunity may be given for the detection of any fraudulent returns that may have been made." This idea did not, however, find much favor with the public, who, in fact, during the later years of the tax, were inclined to regard with great equanimity all successful attempts to evade it.

The income tax ceased to form a part of the internal revenue system of the United States after the year 1872. It was, however, made a part of the tax system of several of the States, and the following record (hitherto generally overlooked by the public) of the recent administrative experience of one State ought to be especially worthy of the attention of those who advocate the readoption of this form of taxation by the Federal Government.

No State in the Union has a more illiberal, all-pervading system of taxation than Massachusetts, and in no State is the administration of tax laws more stringent or arbitrary. What Massachusetts fails to accomplish in the assessment and collection of taxes would, therefore, seem to be of little use for any of the other States or the Federal Government to attempt with any anticipation of success. This Massachusetts system finds its fittest exemplification in the city of Boston; and the officials who constitute its department of municipal taxation never indulge, as the taxpayers well know, in much sentiment in the discharge of their duties. The acknowledged representative of this board for many years never hesitated to say that he recognized but one principle, and that was, that in matters of taxation the taxpayer had no rights which the State was bound to respect; and, as chairman of a State commission which some years ago made a report to the Legislature, and with the Declaration of Independence confronting him with its assertion that it is a self-evident truth that "all men are endowed by their Creator with certain inalienable rights," he also gravely asserted that "the individual person [in Massachusetts] has no inalienable rights except that to his own righteousness."

One of the specialties of municipal taxation in Boston, under the supervision of its Board of Assessors, is an income tax, and its methods of administration are substantially as follows: Taxpayers are required to make a return annually, and in detail, of all their property which the law makes subject to taxation (and that embraces almost everything in Massachusetts except their proprietary interests in graveyards); and in blanks officially furnished for such purpose there is a special space for a return of every individual's income. If no return is made, then the Board of Assessors meet in secret in an upper room of the City Hall, known as the "Dooming Chamber," and arbitrarily determine the amount of income for which each delinquent shall be assessed; and from such determination there is practically no appeal. The amount thus assessed for income to the individual is then "lumped in" with the aggregate of his other taxes; and if a dissatisfied taxpayer wishes to discover what amount has been decided upon as his income, the assessors will not afford him any information. Under such circumstances it might naturally be supposed that the administration of an income tax in the city of Boston would be an unqualified success. But what are the facts?

First, comparatively few of the taxpayers of Boston make any returns to the assessors of their income. *Second*, the returns that are made are not open to the inspection of the public. There is no law in Massachusetts covering this point, but one of the Boston assessors is reported as saying that if the returns were open to public inspection none would be made, as the chief objection of taxpayers to filing returns was the fear that their incomes from business or professions might be known. The statutes of Massachusetts, however, provide that the returns of each individual's property shall be made by the assessors of every city and town in the State to the secretary of the Commonwealth; but inquiry shows that the Boston assessors make no such returns. *Third*, although the amount annually collected from an income tax in the city of Boston is very considerable—$840,000 in 1892—it probably represents, according to the Boston Advertiser, "only about one fourth of what is due in the city from incomes." In the face of such an exhibit the question is pertinent, What measure of success do the present advocates of a Federal income tax expect will follow an attempt to expand the Boston system of its administration over an area of country extending from Florida to Alaska?

One would naturally think that the lesson of experience which the Government and the people of the United States have already had, would restrain further experimenting with this subject until the next war or the arrival of the millennium.

That a free government can not efficiently collect a tax which its people regard as unjust without a resort to despotic methods that public sentiment in turn will not tolerate is illustrated in this further tax experience of Massachusetts:

The State laws require that citizens who are shareholders in corporations organized in other States shall be taxed in Massachusetts on the market value of shares so held; and such owners are required to make a return under oath of the amount of such property in their possession.* Yet a petition recently presented to the Legislature of the State by representative members of boards of trade and chambers of commerce recites that the law in question "is ineffective and therefore ridiculous, as is proved by the fact that although the market value of shares of foreign corporations held by citizens of Boston alone is believed to be over $600,000,000, the amount taxed by the assessors of Boston was then only estimated at $45,000,000; and nearly all of this that is known is taxed to the unfortunate people whose estates are in trust." †

In the United States the income tax, as enacted in 1863, exempted $600 annual income for each person, together with whatever was paid annually for rent and repairs of residence. Five per cent per annum was then levied on all incomes above $600 and not in excess of $5,000; seven per cent on all incomes in excess of $10,000. In the income tax of the United States as it existed at one period there was, therefore, recognized the principle not only of exempting incomes below a certain amount from all taxation, which amount, in order to keep up the appearances of equity, was allowed to be equally deducted from all larger incomes; and in addition a further feature, not generally recognized in other existing systems of income taxations, of "graduating" the assessment by increasing the rate or the percentage on the larger incomes; a system most exceptional and peculiar, but which on first presentation seemed to find favor as an ingenious and equitable method of equalizing the burdens of the State between the rich and the poor.

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* The tax laws of New Hampshire and Vermont are drafted especially with a view to compelling the disclosure of income.

† If any one thinks that this extraordinary tax experience is limited to one section of the country, he would do well to acquaint himself with the recent results of the State of Ohio in attempting to tax money on deposit. Ohio has even a more efficient and minute scheme of taxing all classes of property than Massachusetts. Not only is every citizen bound under oath to make a complete return of his property, but the law, in addition, empowers each county in the State to contract with certain so-called "tax inquisitors" for the payment of twenty per cent of all taxes collected through their agency on previously assessed property. How successful this scheme has been in collecting taxes on money on deposit is shown by the fact, revealed in a recent report of the State Board of Tax Commissioners, that while the amount of money on deposit in the State, national, and private banks of Ohio in 1892, and subject to State taxation, was at least $190,000,000, the amount actually returned for taxation in the whole State during that same year was but a little over $32,000,000. There is a remark that has almost assumed the character of a proverb, that a text suitable to and illustrative of every situation may be found in the Bible. The text that is most applicable, and which ought to be full of instruction to every congressional advocate of the enactment of an income tax by the Federal Government in time of peace, will be found in the sixth chapter of the First Epistle of Paul to the Corinthians, where the apostle, as if he had the existing situation in view, remarks, "All things are lawful unto me, but all things are not expedient."

The present is therefore an advantageous opportunity for asking whether any income tax which discriminates in any degree is likely, as is often claimed, to constitute the one perfect form of taxation of the future. And at the outset attention is asked to the following considerations, to which popular attention is not always intelligently given:

A Federal income-tax system necessarily involves multiple taxation on one and the same income, person, and property. For example, in the United States a citizen of any one State would be liable, in the *first* instance, to the Federal tax on his income; *second*, to a State tax on the same income; *third*, to a tax on the property or business producing the income, in virtue of its location and consequent territorial jurisdiction of the State. In some States—Massachusetts, for example—the State, in virtue of its jurisdiction over a person, taxes him also for property beyond its territorial jurisdiction and subject to taxation in the State where it is an actuality. Doubtless such duplications in a greater or less degree will be inevitable in the case of all Federal taxation. But where there are so many sources available to the national Government for obtaining revenue, it would seem to be impolitic for it to encroach on those methods which are particularly applicable to the States—as income taxes, taxes on legacies and successions, which are governed and protected by State laws, and franchises, which are almost exclusively granted by the States and rarely by the Federal Government. Certainly there would seem to be no warrant in either justice or expediency in unnecessarily favoring such a system of multiple taxation; thereby increasing the real or fancied grievances of the people in respect to all taxation, and creating, by reason of a sense of injustice, additional temptations on the part of the taxpayer to fraud and evasion.

Again, all modern systems of income taxation have recognized the principle of discriminating in favor of persons in receipt of comparatively small incomes, and have provided as a fundamental feature of their policy, that all incomes below a certain rate should be exempted from assessment. Such exemptions, except in the case of the United States, have always and until within a recent period been of a comparatively small amount. In Great Britain it is £160 ($800) per annum. No difference is made in England in levying the income tax, though often proposed and advocated, on account of the source whence the income is derived. Whether the income is earned by the exertions of its possessor, or arises from property, so that the recipient is sure of it without the slightest exertion at all on his part, the same proportion has always been deducted from it. In the administration of its income-tax system England has abandoned the idea of assessing an income derived from multiple sources as a whole to one taxpayer, and in place divides an assessable income into schedules according to its source; and, in fact, has given to such a system the popular designation of "the stoppage at source plan." Thus at present the sources of income in Great Britain are classified as pertaining to one or more of five schedules—designated as A, B, C, D, and E. For example, the profits or income derived from agricultural industry are classified as under schedule A, and those from manufactures, mines, gas works, and water supplies under schedule D, and the like; and it is only in schedules A and D that the income receiver must make a return of agricultural, mercantile, or manufacturing gains or profits.*

* A recent number of the London Times reports the following additional illustration of the ingenuity of the people of every country subject to an income tax to evade the payment of the same.

"There is an argument in favor of the separation of the incomes of married couples for the purpose of income tax which has not yet been advanced. It is the immoral state of the law as it stands at present. John and Mary, each possessing incomes of less than £500, but in the aggregate exceeding that sum, agree to live together as a certain 'advanced' couple did who made themselves notorious only a short time since. They are both entitled to relief under the act Should they, however, legalize their union, neither is entitled to any rebate, and they are actually taxed for rendering themselves respectable members of society. And this is in moral England."

In the earliest of Mr. Gladstone's budget speeches, that of 1853, he distinctly refused, while admitting that a great deal might be said in favor of taxing incomes at different rates, according as they proceed from property or from skill, to break up the income tax into classes, and to make a difference in the assessment according to the source from which the income was derived. Mr. Gladstone's argument, in this instance, applied to the difficulty of discriminating between the various degrees of the durability of incomes; but his definite refusal to "vary the rate of the tax according to the source of the income"—on the ground, to use his own words, that "I think that I should be guilty of a high political offense if I attempted it"—may suffice as a sufficient expression of his opinion in favor of a proportional system. In a recent number of the Nineteenth Century Mr. Gladstone referred to his budget of 1853, in which he continued his income tax, and to his proposal, in 1874, to carry on the national finance without its assistance. He refers to the preparations made, through successive reductions of the tax, for its ultimate abolition, and observes that "in 1874, for the first time since 1845, the opportunity arrived. The nation had its opportunity and took its choice. It may have been wise or unwise; but it was made by competent authority. The result is told in our present expenditure."

In general discussions on the income tax, especially those which have characterized the financial debates in the British Parliament, the proposition has been often advanced that it is a hardship that incomes arising from the exertions of a man's brain should be charged at as high a rate as those resulting from invested capital; and during the present Parliament (1896) a motion was made by a leading member that the financial committee of the House may have permission to amend the assessment in such cases. In a debate which followed (instituted by Sir John Lubbock) it was stated that "while there was an immense difference, no doubt, between the two classes of incomes, if extreme cases were considered, they nevertheless passed the one into the other by imperceptible gradations. Nor had any satisfactory treatment of investments ever been suggested. Let them take one class—the securities of foreign nations. Some were excellent, others, The result of a progressive income tax instituted a few years since in Vaud and other prosperous and populous Swiss cantons is reported to have already verified the predictions and prophecies of the European economists. The project has been often discussed in England, France, and other countries, but the tendency of economic discussion has always been generally adverse to it, on the ground that such forms of taxation would discourage the permanent investment of capital, and encourage capitalists to transfer their capital and business to other and foreign localities. Vaud, however, in particular, determined to ignore the economists and impose the tax, and the inevitable disturbance of capital is reported to have taken place. One of the chief capitalists of Lausanne, a Swiss tanner named Mercier, employing several hundred workmen, is moving his business from Lausanne to the other side of the lake (Geneva) at Evian. Evian is in French territory, and there is no progressive income tax there. "Up to this time," wrote M. Mercier, in a letter published by the Lausanne papers, "I have paid over 20,000 francs a year in state and town taxes. The new law would raise that figure to 80,000 francs or more. I owe it to my family to withdraw out of reach of what I can not consider otherwise than downright spoliation."

A recent economist, commenting on this transaction, thus curtly developed the whole subject: "The fact is that a progressive income tax will not work under modern conditions. The modern movability of capital has made all the difference. The Florentine

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unfortunately, as investors knew to their cost, were almost valueless. An arrangement, however, proposed by Sir Robert Peel in 1858 gave a substantial relief to those who had precarious incomes. They made their returns on an average of the income during the three preceding years, and, if the amount fell short, a rebate was given on the difference. He urged that they might make an effort this year to induce Parliament and the Government to revert to the old system, which, it was evident, would be only fair and a great boon to all those whose income depended upon their own exertions, whether in law, medicine, or commerce." He contended that the rising and successful man was assessed on less than his income, while the man whose income was falling was made to pay on more than his income. The Chancellor of the Exchequer said in reply that "his friend had urged the desirability of returning to the system that existed prior to the passing of the act of 1865. He seemed to have overlooked the fact that the alteration effected by that act, which he now wished to overthrow, was introduced at the express instance of Mr. Hubbard, who was a strong advocate for lightening the burden of the income tax wherever practicable. Taking the average of a man's income for three years was a plan specially devised to meet the difficulty in the way of appeal that would be experienced by business and professional men. He was quite willing to allow that system to continue, as he believed that it was, on the whole, fair to both parties. The proposal of his friend, however, while adhering to the form of making a return upon the average, did not in fact carry out that principle at all, for the first year was only to be struck out where the fourth year showed a loss. Surely, therefore, if the revenue was to collect only on the small receipts, the principle of average ceased at once. For this reason he did not feel justified in accepting the amendment."

democracy taxed capital to death, no doubt, but in the middle ages once a Florentine always a Florentine. Cosmopolitanism was not invented, and a man hesitated long before seeking his fortune among strangers when 'stranger' and 'enemy' were almost equivalent terms. All that is now changed. A progressive income tax in England, unless very moderate and managed with the utmost circumspection—and even then the experiment would be too dangerous to try—would certainly result in an enormous transference of English capital to Belgium and Germany. If the idea of progressive taxation is feasible at all, it is only feasible in the death duties, and even there the difficulties are formidable enough." *

In Germany, the income exemption being very small, nearly the whole population of the country, male and female, are made subject to the provisions of the income tax. According to M. Soetbeer, the German economist, the total income of the classes in Germany who pay income taxes is $2,190,000,000, and of this amount fifty-one per cent is owned by people whose incomes range between two hundred and twenty-five dollars and four hundred and twelve dollars. And the New York Nation surmises that a similar state of things would be found if an analysis of all classes of income-tax payers were to be made in England.

In Austria a new law has been reported by a special Government commission since a previous statement (see Chapter XVIII). At present all persons of Austrian nationality whose annual income exceeds six hundred florins will be liable to a personal income tax,

* The rate of tax progression in Canton Vaud is much less heavy in the ease of real than in respect to other descriptions of property. The amount of taxation is fixed yearly. It was for the first year, after the law was passed, at the rate of one hundred and twenty per mille on the lowest class of personal property, with exemptions on movable property, tools, kitchen utensils, clothes, and household furniture. A much more intricate arrangement exists for income derived from personal exertions. Sixteen pounds a year is allowed to be deducted from the income, and exempted from taxation, for the head of the family himself, his wife, for each of his children or descendants who are minors, and for each person for whose maintenance the head of the family is legally liable. Thus, a man with a wife and twelve children, possessing an income of five thousand six hundred francs (two hundred and twenty-four pounds) a year, would be entirely exempt from taxation, as also would be a man with a wife and three children and an income from labor of two thousand francs (eighty pounds) a year. It can not be supposed that a low taxation of this character, with all the risks involved of causing capital to emigrate, and of preventing strangers, who, after an interval, are also to be subject to the same tax, from settling in the canton, or from remaining there, with all the differences of class-feeling which it evoked, could have become law without calling forth some strong and almost passionate expressions. It has to be remembered that besides the taxation for the administration of the canton proper, those levied for the expenses, which we include under the head of local government, such as roads, watercourses, education, free to all classes in Switzerland, and carried out with much vigor and cost, are likewise levied according to the same system. We may form some idea of the weight of the burden thus imposed.

which will be levied on a sliding scale. The scale is graduated so that five per cent will be levied on small incomes and as much as six per cent on large ones. Employees whose total incomes are less than six hundred florins per annum are exempt. In addition to the income tax, persons of either sex trading or carrying on business on their own account are subject to an additional impost. The new law is intended to supersede the existing system by the introduction of a general tax on private trading and industrial establishments of all descriptions, a tax on all joint-stock companies and other enterprises legally bound to publish annual balance sheets, a tax on incomes derived from invested capital, and a personal income tax based on a progressive sliding scale.

In France, the republic, although groaning under an almost overwhelming burden of debt, has recently refused, by a vote in its Chamber of Deputies of 267 to 236, to reconstruct its income-tax system, with a view of increasing the revenue derived from it; and subsequently, by a majority of 289, refused to reconsider its position, although the organic law framed for France in 1875 gives the national legislature unlimited power over taxation, direct as well as indirect. During the popular discussion that preceded this legislative action, it is interesting to note that a progressive income tax was not properly regarded as more oppressive than many other forms of taxation, and as a matter of French experience a heavy income tax—about four per cent—is now levied on French bonds and shares, in fact, on every dividend of a French company, while no income tax is levied on French Government stocks or foreign bonds; and this apparently unfair treatment is accounted for because the revenue derived from French companies can be easily ascertained and the companies made responsible for it, while such a result would be impossible in the case of foreign bonds or foreign stocks and shares, and hence the difficulty has arisen of how to compel the taxpayer to pay: as, if the declaration was left to him, it was not unreasonable to suppose he would not declare it, or only declare it in part; while if left for ascertainment by French officials, it was feared that the income tax in France would become a political weapon, which would be freely used against the legislators in power.

M. Paul-Beaulieu, a distinguished French economist, has recently advanced and advocated the view that a state in instituting an income tax for the sole purpose of obtaining revenue, ought not to grade the tax at all, or lay a higher rate on large incomes than on smaller ones; or, in other words, that it is better to tax all incomes that are taxed at all at one uniform rate; and the reason for this is that the large incomes form so small a percentage of the total that the increased rate adds no great amount to the revenue, while it greatly increases the difficulty of assessing large incomes at their true value.

In support of this view he submits in general terms the following results of his careful examinations in Prussia, Saxony, and England: In Prussia, where incomes above one hundred dollars were taxed, for the year selected by M. Beaulieu, about one fourth of the people were entirely exempt. Of the rest, thirty-five thirty-sixths paid on incomes of from one hundred dollars to seven hundred and fifty dollars. Only one person out of forty-three had more than seven hundred and fifty dollars income. Only a little over four per cent of the total income of the country belonged to persons having an income of from $4,000 to $20,000, and only 1.7 per cent to those having over $20,000 income.

In Saxony one fifth of the total incomes belonged to persons having less than one hundred and fifteen dollars yearly. The incomes of those having less than four hundred and seventy-five dollars each aggregated about two thirds of the total income. The great incomes, exceeding $25,000 to the person, belonged to seventy-three individuals, and comprised less than one and a half per cent of the total.

In England incomes under one hundred and sixty pounds, or eight hundred dollars, are not taxed. In the year selected by M. Leroy-Beaulieu 381,000 persons paid income taxes of a total of $750,000,000. Of the contributors 342,000, or about nine tenths, paid on incomes of less than $3,000, but it is noticeable that they were taxed on not much more than a third of the total amount. Thus nearly two thirds of the taxable income belonged to 39,000 persons. One fifth of the total incomes assessed belonged to 1,222 persons, with an income of over $50,000 each.

It will be seen that there is a striking difference in the results shown by M. Leroy-Beaulieu's figures in Germany and England. Much of this difference is due to the nature of the laws, by which all small incomes in England are free from taxation, but a part of it is to be attributed to the larger fortunes in England.

ITALY.—There is no income tax in Italy in the sense in which that term is used in England and the United States, but there is a so-called professional income tax which was by an old law fixed at seventeen per cent on half the estimated income, and which has been somewhat increased by a new law in which there are variations made according to the sources of income. While Italy is, in fact, potentially one of the richest countries in Europe, and in ancient times was so regarded, its name to a certain extent has come to be synonymous with poverty. The explanation of this is that its government is prodigal and dishonest; and in gathering its income the dishonesty of its officials causes its taxation to fall most oppressively on the classes which a wise statesmanship would protect, and leaving the minimum burden on those who are most capable of bearing its maximum.

A new feature of the British fiscal system, which in a certain sense may be regarded as an increase of the exemption under the existing income tax, has recently been sanctioned by Parliament under the name of the "Farm Rating Act," which proposes to mitigate existing agricultural depression by relieving farm lands of a large part of their share of local taxation—i. e., as pointed out in debate in the House of Commons, by Sir William Harcourt, "by taking £2,000,000 ($10,000,000) out of the general taxation of the country," inasmuch as, if certain existing sources of revenue supply less, other taxes must supply more. "This will bring up the total governmental contribution for like purposes to £6,000,000 in 1868, and £11,000,000 in 1892." In a debate on this subject before the Royal Statistical Society, it was maintained that an assessment of the English poor rate, to which nearly all other English rates were now mere additions, was originally founded on the principle of ability to pay, and that principle had never been expressly repudiated. But the making of this expenditure a local charge was in itself a negation of the principle of taxation according to ability, and the only question now was whether an attempt to establish in each locality a principle which had been established as regards the nation as a whole. The answer was in the negative.

"Speaking very broadly," wrote Mr. Goschen a quarter of a century ago, "in England fifty years ago land bore two thirds of the taxation on real property, and houses and other property one third; the latter now bears two thirds, while lands bear one third. In France lands bore over two thirds more than fifty years ago, and bear more than two thirds still. Land, in short, is not as a rule highly rated in England, and where it is highly rated what is wanted is a revised assessment."

What is Exemption from Taxation?—An exemption is freedom from a burden or service to which others are liable; but an exemption for a public purpose, or a valid consideration, is not an exemption except in name, for the valid and full consideration, or the public purpose promoted, is received in lieu of the tax. Nor is an exemption from taxation a discriminating burden on those who pay an income tax, provided the person or institution benefited by the exemption is a pauper, or a public charitable institution; for then there is consideration for the exemption, and it is justified as a matter of economy, and to prevent an expensive circuity of action in levying the tax with the sole purpose of giving it back to the intended beneficiary of the Government. The avoidance of this unnecessary circuity of action is not, moreover, an injury but a gain to those who pay the tax. It can not, however, be seriously claimed that a man having $100,000 dollars of productive capital, and receiving from it $4,000 of annual income, is entitled to receive support from the Government as a public pauper.

An income tax which permits of *any exemption whatever* is a graduated income tax, not by the rate of the tax but by the amount of the exemption, because all incomes below an arbitrary line are entirely exempt from the tax. Again, in treating of an income tax it should be always borne in mind that, when a Government taxes the *income of property*, it in reality taxes the property from which the income is derived. In England and on the Continent of Europe land is taxed on its yearly revenue, or income value, and these taxes are always considered as land taxes. Alexander Hamilton, in discussing the taxation of incomes derived directly from property, used this language: "What, in fact, is property but a fiction, without the beneficial use of it? In many instances, indeed, the income is the property itself." (Hamilton's Works, vol. iii, p. 523.)

As in theory all citizens ought to contribute in proportion to their revenue to the support of the Government under which they have chosen to live and to which they look for protection in respect to their persons and property, the exemption of any from an income tax can only be justified on the assumption of the non-receipt by the citizen of an income beyond what is necessary to defray the expenses of a moderate living. In truth, any exemption under a general income tax is in principle an act of charity on the part of the Government. It is interesting, therefore, to note where the authors or special advocates of the income tax of 1884 proposed to draw the line in respect to charity and as to the amount of property the possession or enjoyment of which, in their opinion, constituted riches.

If the law exempts from taxation income from property to the extent of $2,000, it in effect exempts property to the capital value of $50,000 from taxation, for at present *four* per cent is about the average profit of money, land, or other property, over and above all charges and taxes, and at that rate of profit $2,000 will be the annual income value of $50,000. If, however, we asssume five per cent as about the present annual average profit on money, land, or other property in the United States, over and above all charges and taxes, then an exemption of $4,000, the rate fixed upon in the income-tax act of 1884, would represent an accumulation, or business, or profession, of the value of $80,000. If we take the rate at which the United States can borrow money—namely, three per cent—then an exemption of $4,000 would represent an accumulation of a citizen, invested in United States securities, of

$133,333+. And, according to any fair interpretation of the action of the committee which reported in 1884 a $4,000 exemption, a citizen who is worth less than $80,000 of ordinary property yielding income, or $133,000 of property invested in United States bonds, was a legitimate object for national charity; the above sums representing the dividing line in the United States between those who were entitled to be regarded as poor and those who were entitled to be considered rich. Such an assumption finds no precedent in fiscal history, and was an unwarranted favoritism to nine tenths of the well-to-do people of the country, who were abundantly able to pay any just proportion of the taxes which the Government then considered it necessary to impose for its support. Under such circumstances it would be a misnomer to call such an extortion taxation. It was unmasked confiscation and a burlesque on taxation. In the case of the income tax of 1868, when the amount of exemption was $1,000, experience demonstrated that more than nine tenths of the entire property of the country, and more than ninety-nine hundredths of its property owners, escaped payment from this form of taxation.

Again, an income tax which exempts $4,000 of income in the United States can not be defended by any rational rule or doctrine, legal or economic, for the property and income exempted would be infinitely greater in the aggregate than the property and the income of the same class made subject to the tax. Under this form of an income tax there could be no equality between taxed-producers and non-taxed-producers, and more especially as the non-taxed-producers will be the most numerous and the greatest producers in quantity as a body.

No man is a freeman whose industry and capital are subject to exaction, and from which his immediate competitors are entirely exempt. Equality of taxation of all persons and property brought into open competition under like circumstances is necessary to produce equality of condition for all, in all production and in all the enjoyments of life, liberty, and property; and government, whatever name it may assume, is a despotism, and commits acts of flagrant spoliation, if it grants exemption or exacts a greater or less rate of tax from one man than from another man, on account of the one owning or having in his possession more or less of the same class of property which is subject to the tax. If it were proposed to levy a tax of five per cent on annual incomes below $4,000 in amount, and exempt all incomes above this sum, the unequal and discriminating character of the exemption would be at once apparent; and yet an income tax exempting all incomes below $4,000 is equally unjust and discriminating. In either case the exemption can not be founded or defended on any sound principles of free constitutional government; and is simply a manifestation of tyrannical power, under whatever form of government it may be enforced. The great republican principle of equality before the law, and constitutional law itself, alike preclude any exemption of income derived from like property.

M. Thiers, in his work on the Rights of Property, thus forcibly condemns confiscation under the name or form of a graduated income tax: "Proportionality," he says, "is a principle, but progression is a hateful despotism. . . . To exact a tenth from one, a fifth from another, and a third from another is pure despotism—it is robbery."

Finally, the principle involved in this question of discriminating income taxation is one that affects the foundation and continued existence of every free government—namely, the equality of all men before the law. Any exemption whatever, under an income tax, be it small or great, except to the absolutely indigent, is purely arbitrary; and the principle once allowed may be carried to any extent. Any exemption of any portion of the same class of property or incomes is an act of charity which every patriotic American citizen ought to reject upon principle and with scorn, except under circumstances of great want and destitution. Equality and manhood, therefore, demand and require uniformity of burden in whatever is the subject of taxation.

THE INCEPTION OR ORIGIN OF THE INCOME TAX IN THE UNITED STATES.—The subject of taxation in the new Government which it was proposed to establish in place of the colonial system which the Revolution had supplanted, constituted one of the most important and salient points of interest in the convention which framed the Constitution of the United States, and was the cause of much difference of opinion among its members and earnest contention between the States. The great source of weakness of the Confederation was its inability to levy taxes of any kind for the support of its Government. To raise revenue it was obliged to make requisitions upon the States which were respected or disregarded at their pleasure. Great embarrassments followed the consequent inability to obtain the necessary funds to carry on the Government. One of the principal objects of the proposed new Government was to obviate this defect of the Confederacy by conferring authority upon the new Government by which taxes could be directly laid whenever desired. Great difficulty in accomplishing this object was found to exist. The seaboard States were unwilling to give up their right to lay duties upon imports, which were their chief source of revenue. The inland States, on the other hand, were unwilling to make any agreement for the levying of taxes directly upon real and personal property, the smaller States fearing that they would be overborne by unequal burdens forced upon them by the action of the larger States. In this condition of things great embarrassment was felt by the members of the convention. It was feared at times that the effort to form a new Government would fail. But happily a compromise was effected by an agreement that direct taxes should be levied by Congress by *apportioning them among the States according to their representation.* In return for this concession by some of the States, the other States bordering on navigable waters consented to relinquish to the new Government the control of duties, imposts, and excises, and the regulation of commerce, with the condition that the duties, imposts, and excises should be *uniform throughout the United States;* so that, on the one hand, anything like oppression or undue advantage of any one State over the others would be prevented by the apportionment of the direct taxes among the States according to their representation; and, on the other hand, anything like oppression or hardship in the levying of duties, imposts, and excises would be avoided by the provision that they should be uniform throughout the United States.

The Federal Constitution accordingly upon completion divided the taxes that Congress might impose under it into two classes: those which are *direct* and those which are *indirect*, or, as the letter of the Constitution expresses it, "duties, imposts, and excises." It also provides that the former shall be apportioned, equally with representation in Congress, among the several States of the Union, according to their respective numbers, that "no capitation or direct taxes shall be laid unless in proportion to the census"; and that the latter class of taxes shall be "uniform throughout the United States."

But from the beginning of the Federal Government the determination of the exact legal meaning of the word "direct" as applied in the Constitution to taxation has been one of great difficulty and embarrassment, although the doctrine in England and her colonies, before the adoption of the Constitution, was a favorite one, that "taxation and representation should go together." *

* The framers of the Constitution intended that the apportionment of direct taxes among the States should be in more exact ratio to the population even than it is possible to apportion the representation. For example: Suppose one representative to every ninety thousand inhabitants, a State might have a large fraction left over; but the apportionment of direct taxes was designed to be with mathematical accuracy to the precise number of persons ascertained by the census. After the first apportionment of representatives had been made in the Federal Convention by estimated population, before an actual census, it was held that the estimate of the population of the different States was not sufficiently accurate for the apportionment of a direct tax; and that, consequently, the General Government could not lay a direct tax until a census should have been taken. Elbridge Gerry, of Massachusetts, moved that until a census be taken direct taxation be apportioned to the

In almost one of the first cases that came before the United States Supreme Court after the adoption of the Constitution it was decided that a tax on carriages, the payment of which was resisted by one Hylton, of Virginia, on the ground that such a tax was a direct tax, and had not been apportioned among the States as required by the Constitution, the court held that the tax in question was to be considered as a tax on the expenses of living and not a direct tax within

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number of representatives. Mr. Carroll, of Maryland, replied that "*the number of representatives did not admit of a proportion exact enough for a rule of taxation*" (Elliot's Debates, v, 451). Mr. Ellsworth "thought such a rule unjust. There was a great difference between the number of inhabitants, as a rule, in this case. Even if the former were proportioned as nearly as possible to the latter, it would be a very inaccurate rule. A State might have one representative only, that had inhabitants enough for one and a half or more, if fractions could be applied" (ibid., 453). Mr. Gerry's motion was defeated. The convention, after debate, *decided that direct taxes must be apportioned in the States in more exact ratio to the population than the representatives could possibly be apportioned* (Elliot, v, 453).

Many of the leading patriots of the Revolution—Patrick Henry among them—were distrustful of granting this power, even with the restriction placed upon its exercise. Massachusetts accompanied her adoption of the Constitution with a resolution, signed by John Hancock, recommending an amendment of the Constitution which should prohibit Congress from levying a direct tax until they should first have made a requisition on the States (I Elliot, 323). The same amendment, word for word, was recommended by the State of New York and the State of North Carolina, and similar resolutions were adopted by South Carolina, Rhode Island, and Virginia.

In the apportionment of the direct taxes which had been laid by Congress previous to the income tax the ratio to the census was preserved with scrupulous accuracy, and the actual use of the authority up to the time of the imposition of the income tax was in accordance with the understanding of the framers of the Constitution.

Mr. Madison, who was probably the most active participant and member in the convention that framed the Constitution of the United States, in a letter written after the adoption of the Constitution but before the organization of the new Government, and never discovered (by Mr. Worthington Ford) and its contents made public until 1895, embodies much new information in regard to the intent and purpose of the term "*direct*" taxes as used in the Constitution and in regard to the understanding of the people of the United States concerning that term when they adopted the Constitution. It shows, what is extraordinary, "that the term, in the estimation of the men who used it, did not refer to the kind, or character, or nature of the tax itself, and that the framers of the Constitution never considered the subject of taxation from the philosophical or politico-economic point of view, but were wrestling with the stern necessities of the question, How shall the people of these several States be induced to pay a Federal tax?

"Manifestly, it could be raised by but one of two methods: either *indirectly*, by 'requisitions' on the several States, as under the still existing Confederacy, or by taxes laid *directly* by the Federal Government. Duties and excises were not indirect taxes; they were not under discussion or consideration; they were not in the case at all. *Indirect taxes* were taxes procured indirectly by 'requisitions' on the States; *direct taxes* were taxes laid *directly* by the Federal Government. The framers of the Constitution evidently had never looked at the subject from a politico-economic point of view; they had never given a thought to the philosophy of taxation; the term 'direct taxes,' as they used it, did not refer to the kind or character or nature of the tax, but to the fact that such taxes were no longer to be laid indirectly through 'requisitions' upon the States, but directly upon the taxpayer by the newly constituted taxing power. Indirect taxes would be a thing of the past, of the

the meaning of the Constitution, as the evils which would attend its apportionment according to population would be so great "that the Constitution could not have intended that an apportionment should be made."

On the other hand, when a citizen of Illinois—Hon. William M. Springer—resisted, in 1880, the payment of a national income tax on the ground that such a tax was a direct tax, and, not being levied in the proportional manner presented by the Constitution, was not legal, the court decided that "direct taxes, within the meaning of the Constitution, are only capitation (head) taxes, and taxes on real estate; and that the tax of which the plaintiff complains (i. e., a direct tax) is within the category of an excise or duty."

If, now, it had been clear and certain as to the exact meaning that the framers of the Constitution intended to apply to the word *direct* when they used it in connection in former years with prospective Federal taxation, the cases referred to would never have begun. But they left no clear and certain expression of opinion on this subject, and it was doubtful if they collectively ever had one. On this point the evidence of Hamilton is conclusive; for in his legal brief in the carriage case, in which he appeared as counsel for the Government, he says: "What is the distinction between direct and indirect taxes? It is a matter of regret that terms so uncertain and vague on so important a point are to be found in the Constitution. We shall seek in vain for any antecedent settled legal meaning to the respective terms. We shall be as much at a loss to find any distinction of either which can satisfactorily determine the point." But it is to be further noted that in his argument in behalf of the Government in the carriage case, Hamilton mentioned as taxes which were to be considered, capitation (poll) taxes, taxes on land and buildings, and general assessments. (See his brief in the case referred to.)

All historical data explanatory of the constitutional meaning of the term "direct" have accordingly been of an indirect character, and so imperfect that the court has heretofore apparently not regarded them as worthy of consideration. But this condition of

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expiring Confederation; taxes directly laid by the future Government would supply its extraordinary revenue when needed.

"But here State jealousy had entered into the problem which the framers were solving—the difficult problem of taking power from the individual States and transferring it to this new, unknown, and distant central authority. If Congress could lay a tax directly upon the property of the citizens of all the States, might it not be so laid that the citizens of Virginia would have to pay more than the citizens of New York? How should the power so transferred be restrained?

"The convention answered the question by the word population. The new power of direct taxation should be given to Congress, *but the system of quotas*, with which the people of the country were familiar, *should be retained*."—*New York Nation.*

things no longer exists; for in the brief submitted to, and in the argument made before the United States Supreme Court adverse to the constitutionality of the provisions of the income-tax enactment of August, 1894, by Hon. Clarence A. Seward, a department of national history which no historian or jurist had ever before completely exploited, was so traversed by him that it is difficult to see how any one can acquaint himself with its results and doubt that, although the framers of the Constitution and the people they represented might not fully agree as to a full and comprehensive definition of a direct tax, there was apparently a perfect unanimity of opinion among them that an income tax was a typical example of that kind of taxation.

Previous to the adoption of the Constitution there were no Federal taxes, and all precedents for helping to a correct determination of the constitutional meaning of direct taxation must therefore be drawn from the prior experience of the several States.

What was that experience? Recent historical research shows that Massachusetts had taxed incomes for more than a hundred years prior to the assembling of the Constitutional Convention; other of the leading States were imposing like taxes at or about 1787, and the receipts therefrom were used to help pay the quotas demanded by the then Government of the Confederation for the maintenance of the Federal Government. The income tax so paid, and all the other internal taxes collected by the States, were known as and called direct taxes and are so called to-day.

The Constitutional Convention empowered Congress to levy any of the authorized forms of taxation on the States; but the levy of direct taxes was guarded by a provision that such taxes should be apportioned to the population. The explanation of this curious anomaly is that the consensus of opinion in the convention was that wealth at that period was so equitably divided among the people of the States that population was the best measure of wealth and consequently of equitable taxation. But what would become of the element of equality if the levy was in the form of indirect taxes—duties, imposts, and excises—which, falling on the consumption of tea, coffee, sugar, spirits, and the like, leave it optional with the citizen in a great degree whether he will pay or not? Hamilton certainly thought that the door had been effectually closed against the possibility of any such evasion, for, when speaking of direct taxes in The Federalist, he says: "An actual census or enumeration of the people must furnish the rule; a circumstance which effectually shuts the door to partiality or evasion."

But any doubt on this subject ought no longer to be tolerated, for we now have, almost for the first time, a definition of or distinction between direct and indirect taxes that is founded on sound philosophy and large experience, and can not be refuted—namely, a direct tax has always in it an element of compulsion. The person against whom or on whose property or income a direct tax is levied has no option whether or when he shall pay. There is nothing voluntary about it. On the other hand, an indirect tax, whoever may first advance it, is paid voluntarily, and primarily by the consumer of the taxed article.

But the most important and vital issue involved in the income tax enacted 1894 (August 18th) was that it designedly provided for discriminating taxation, and this fact may be best demonstrated and brought to popular comprehension in the following manner: In a recent interview (1885) with a leading British parliamentary authority, the conversation turned on the new and unprecedented discriminating rates in the legacy and succession taxes imposed by the present British Parliament, and the opinion of the writer was asked respecting them. He returned, offhand, the answer that he could only discuss them from a British point of view, for, under the Constitution of the United States, such taxes could not be levied by the Federal Government, contemporaneously, and how promptly foreign authorities recognize the truth of this position is shown by the following extract from an editorial in the London Times on the phase of the income statute then before the United States Supreme Court: "Were we," it said, "under the United States Constitution, Sir William Harcourt's budget would have been declared unconstitutional. Populist leaders in America must envy us the freedom of dealing with other people's property, enjoyed in this motherland of liberty." This conversation led to a historical investigation, and the recognition of what seemed to be a fact little or not before noted, that the United States is the only nation that now exists or ever has existed which, through constitutional or other provisions, has, or has had, any limitations on its Government in respect to the general exercise or extent of the power of taxation. If there are any exceptions, they are to be found in the legislative enactments of the French National Assembly of 1789, and possibly in what is now known as the referendum system of Switzerland.

But a government that has no limitations on its power of taxation, that can arbitrarily take in whatever manner, to whatever extent, and at whatever time it pleases, the property of its people or subjects, whether that right exists in theory, as in England, or in actual practice, as in Germany, Austria, and Russia, is a despotism. If this assumption and reasoning may seem to any one extravagant and unwarranted, his attention is respectfully asked to the following expression of opinion on this subject by the United States Supreme

Court, as given through Justice Miller in the celebrated "Loan Association *vs.* Topeka" case (20 Wallace, 665):

"*It must be conceded that there are rights in every free government beyond the control of the State. A government which recognized no such rights, which held the lives, the liberty, and the property of its citizens subject at all times to the absolute disposition and unbounded control of even the most democratic depository of power, is after all but a despotism. It is true it is a despotism of the many—of the majority, if you choose to call it so—but it is none the less a despotism.*"

And yet can there be any doubt that the American people would have abandoned its proud historical position if the Supreme Court had decided in 1885 that the income-tax enactment of 1894 was constitutional?

For such a decision would practically have removed any constitutional limitation on the exercise of the power of taxation by Congress, and in this way: First, by establishing that an income tax is not a direct tax, there can be practically thereafter no direct taxes to which the constitutional mandate of apportionment will apply, for popular sentiment will never sanction the enactment of a general "capitation" or "poll" tax, or a direct tax on land.

Then it certainly could not be unconstitutional to multiply classes for taxation according to wealth and increase the rate up to the point of confiscation. Can any one, furthermore, doubt that the primary object of the enactment proposed in 1889 was not the raising of revenue for the national Treasury, but rather to permit a part of the people of the country to impose discriminating taxes on the people of another part, and then fixing a general exemption at so high a rate that those of the first part, who are entirely able, should not be required to pay anything? If this exemption, in place of $4,000, had been fixed only to include the average annual wages or earnings of the working masses of the country, is it probable that Congress would have even considered the enactment of the income tax of 1884? Even before the form of the statute of 1884 was reported from the proper committee, speculation was indulged in to the effect that the constituents of certain districts would not have to pay anything in the way of income taxes under it. That the Government also practically conceded that the income-tax enactment of 1884 was pre-eminently class legislation is also evident from the following extract from a statement made in a brief by the Attorney General of the United States pending the consideration of the income-tax question by the United States Supreme Court: *

* By an enactment of Congress, August 18, 1894, establishing an income tax for the United States, a tax of *two* per cent was imposed on the gains, profits, and incomes of

"Congress," he said, "has adopted as the *minimum* income for the purpose of taxation the limit of four thousand dollars. This limit may be said to divide the *upper* from the *lower middle class*, financially speaking, in the larger cities, or to divide the *middle class* from the wealthy in the country districts." (Opening argument by William D. Guthrie, in support of the contention that the income-tax law of 1894 was unconstitutional.)

Attention is next asked to what seems to be by far the most serious point in this whole matter, and which has not as yet attracted public attention in any marked degree. The American people have been trying an experiment as a nation which has never before been attempted by any other nation—namely, that of universal suffrage, by which the power to elect legislators and shape the policy of the Government has been put under the control of those who, through no fault of their own, have not enjoyed such educational facilities as will enable them independently to form correct opinions on great constitutional, legal, financial, or economic questions, thereby creating almost endless possibilities for injudicious legislation. How such possibilities were being made actualities in the case of the income-tax statute of 1894 can be made evident to almost any one who makes himself fully acquainted with the circumstances attendant on its inception and almost concurrent legal adjudications and contentions.

The members of the convention that framed the Constitution of the United States had the very questions before them that have already been in issue before the American people, and may at no distant day be again presented for their serious consideration. It was inequalities in methods and facilities for the raising of revenue among the States of the Confederation for the support of the Federal Government that threatened the existence of the Confederation and necessitated the assemblage of the Constitutional Convention. And the members of this convention, taught by experience, incorporated in their work the provisions respecting the exercise of the power of taxation, the meaning and validity of which are now called in question. And in so doing they gave to the people of the United States an instrument of which one great feature, if not its chief feature, and one not recognized as it ought to be, is that it guards the rights of minorities as no other governmental instrument devised by mortal

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persons derived from any kind of property, including rent and the growth and produce of lands, and profits made upon the sale of land if purchased within two years. Every element that could make real or personal property a source of value to an owner was taxed. An excise duty was also imposed upon income derived from any profession, trade, employment, or avocation. The tax upon persons generally was not upon their entire income, but on the excess over and above the sum of four thousand dollars. All persons having incomes of four thousand dollars or under were exempt.

man ever has done. As long as this great feature is preserved intact and the nation adds to it another principle, that every question of doubt concerning it shall be always determined in a way to strengthen it, the perpetuity of the present Government is assured. But if now the Supreme Court invalidates this great feature by nullifying the mandate of the Constitution, and thereby practically removes all limitations on the power of Congress to impose taxes, sanctions discriminating taxation and disregards the rights of minorities, the hour when this Government enters upon the path of decadence will have struck. How puerile it is for any one to favor such a decision and its inevitable results, on the ground that a contrary decision would oblige the Government to repay to the people a large sum of money that it had illegally collected from them! This would, however, have one recommendation—namely, that it would approximately solve the difficult question, How much, in terms of money, is the existing Government worth?

CONCLUSION.—The following extract, incorporated by Mr. Justice Field in his opinion, delivered in concurrence with a majority of his colleagues, and adverse to the constitutionality of the income-tax statute of 1884, which imposed discriminating taxes on the American people, is also pre-eminently worthy of notice in connection with any general history or review of this great subject:

"Here I close. I could not say less in view of questions of such gravity that go down to the very foundation of the Government. If the provisions of the Constitution can be set aside by an act of Congress, where is the course of usurpation to end? The present assault upon capital is but the beginning. It will be but the stepping-stone to others, larger and more sweeping, till our political contests will become a war of the poor against the rich—a war constantly growing in intensity and bitterness. 'If the court sanctions the power of discriminating taxation, and nullifies the uniformity mandate of the Constitution,' as said by one who has been all his life a student of our institutions, 'it will mark the hour when the sure decadence of our present Government will commence.' If the purely arbitrary limitation of four thousand dollars in the present law can be sustained, none having less than that amount of property being assessed or taxed for the support of the Government, the limitation of future Congresses may be fixed at a much larger sum, at five or ten or twenty thousand dollars, parties possessing that amount alone being bound to bear the burdens of government; or the limitation may be designated at such an amount as a board of walking delegates may deem necessary. There is no safety in allowing the limitation to be adjusted except in strict compliance with the mandates of the Constitution which require its taxation to be uniform in operation and, so far as practicable, in proportion to their property, equal upon all citizens. Unless the rule of the Constitution governs, a majority may fix the limitation at such rate as will not include any of their own number.

"Cooley, in his Treatise on Taxation (second edition, 215), justly observes that 'it is difficult to conceive of a justifiable exemption law which should select single individuals or corporations, or single articles of property, and, taking them out of the class to which they belong, make them the subject of capricious legislative favor. Such favoritism could make no pretense to equality; it would lack the substance of legitimate tax legislation.'

"The income-tax law under consideration is marked by discriminating features which affect the whole law. It discriminates between those who receive an income of four thousand dollars and those who do not. It thus vitiates, in my judgment, by this arbitrary discrimination, the whole legislation. Hamilton says in one of his papers (The Continentalist): 'The genius of liberty repudiates everything arbitrary in taxation. It exacts that every man, by a definite and general rule, shall know what proportion of his property the State demands. Whatever liberty we may boast of in theory, it can not exist in fact while [arbitrary] assessments continue.' (1 Hamilton's Works, edition 1885, 270.) The legislation, in the discrimination it makes, is class legislation. Whenever a distinction is made in the burdens a law imposes or in the benefits it confers on any citizens by reason of their birth, or wealth, or religion, it is class legislation, and leads inevitably to oppression and abuses, and to general unrest and disturbance in society. It was hoped and believed that the great amendments to the Constitution which followed the late civil war had rendered such legislation impossible for all future time. But the objectionable legislation reappears in the act under consideration. It is the same in essential character as that of the English income statute of 1691, which taxed Protestants at a certain rate, Catholics, as a class, at double the rate of Protestants, and Jews at another and separate rate. Under wise and constitutional legislation every citizen should contribute his proportion, however small the sum, to the support of the Government, and it is no kindness to urge any of our citizens to escape from that obligation. If he contributes the smallest mite of his earnings to that purpose he will have a greater regard for the Government and more self-respect for himself, feeling that, though he is poor in fact, he is not a pauper of his Government. And it is to be hoped that, whatever woes and embarrassments may betide our people, they may never lose their manliness and self-respect. Those qualities preserved, they will ultimately triumph over all reverses of fortune."

GERARDE AND THE GERARDIAS: THE HERBALIST AND HIS NAMESAKES.

By MARTHA BOCKÉE FLINT.

ON shaded hillsides and in woodland glades there blooms through August, a stately plant, the most beautiful of a varied group which, as the genus *Gerardia*, perpetuates a name too little honored. Few men have done more for English botany than the "diligent and paineful apothecary," John Gerarde, some time gardener to Cecil, Lord Burleigh. It is just three hundred years since, in December, 1597, was published The Herball, or Generall Historie of Plantes Gathered by John Gerarde of London, Master in Chirurgerie. The second edition thereof, the only copy known to be in the city of New York, is "very much enlarged and amended by Thomas Johnson, Citizen and Apothecary," and bears the imprint "London, printed by Adam Islip, Joice Norton and Richard Whitaker, anno 1633." On the frontispiece of the thick folio is Gerarde's title, given above, inscribed upon an oval supported by Corinthian columns, and bordered by six woodcuts. At the head of the page is represented the sun bursting through clouds, and on its disk is a triangle bearing a Hebrew legend; below are the words from Genesis: "*Ecce dedi vobis omnes herbas semen tantes semen quæ sunt.*" In the upper corners are figures of Ceres and of Pomona, offering grains and fruits. At the left of the columns stands Theophrastus, a scroll in one hand, in the other flowers; at the right, Dioscorides holds an open book. Beneath the title is the portrait of Gerarde, supported on either side by vases heaped high with pyramidal masses of fruits and flowers. The face is the serious countenance of the sixteenth century: oval, with a pointed beard; a long, straight nose, well-arched eyebrows, and deep-set eyes, fixed, as if looking into the hidden mystery of life:

> "Little flower, but if I could understand
> What you are, root and all, and all in all,
> I should know what God and man is."

It is a sad face, but with the serenity of a meditative mind. He wears the quilled ruff and the embroidered doublet of the period, and holds in his hand a spray—perhaps of wild rose. Here is not the exactness which marks Gerarde's own drawings.

The book is dedicated to "The right Honourable, his Singular good Lord and Master, Sir William Cecil," and is written from his "House at Holborn within the Suburbs of London, this first of December, 1597." Holborn—named from Old Bourne, a branch of the Fleet—was itself a rural region which then afforded a fair field for the collector. Years later, Sir Henry Wotton could say, "I know all the plants of my time, and have scarcely simpled farther than Cheapside." In Gerarde's day wild flowers grew all over London; the water violet was found at Lambeth; "a field at Southwark, back of the theatre," the Globe Theatre, was all abloom; wall rue grew on Westminster Abbey, and wall pennywort over "the door that leadeth from Chaucer's tomb to the old Palace," while bugloss mantled "the drie ditch banks in Pickedille." In "An Address to the well Affected Reader and Peruser of this Booke," he says, "Myselfe, one of the least among many, have presumed to set forth vnto the view of the world, the first fruits of my owne Labours." But he was meanwhile "constrained to seeke after his living, being void of friends to beare some parte of the burden." He further notes the difficulties which beset an honest searcher after truth, saying, "Let a man excell neuer so much in any excellent knowledge, neuer the les many times he is not so much regarded as a Iester, a Booster, a Quacksaluer, or Mountebank."

Gerarde was born at Namptwich in Cheshire, in the year 1545. Thence he came early to London, and both as gardener in the lordly domains of Cecil and as an apothecary, he made wise use of the knowledge gained as "a paineful Herbarist" and "a curious searcher of simples." He studied surgery, and practiced to some extent in the empirical methods of the time, but his heart was centered in his garden at Holborn. There was his seminary, or "seed plot and nursery for young plants," as the word is defined in Bailey's Dictionary. There he collected the English flora, and established many foreign plants, studying their habits, their possible uses, and their adaptation to the climate of England. His diligence in searching out new species was unwearied. Drayton alludes to his work as the limit of possible accomplishment:

> "To those unnumbered sorts of simples here that grew,
> Which justly to set down even Dodon short doth fall,
> Nor skillful Gerard yet shall ever find them all."

Botanists of to-day say that Gerarde knew little of science, but it is worth while to consider what science was in the sixteenth century, when the glamour of alchemy and of astrology diffused a false light over every department of natural philosophy. Gerarde died in 1607, just one hundred years before Linnæus was born, and a dozen years before the birth of John Ray, who laid the corner stone of the natural system and made the first formal catalogue of British plants. For a man then to have studied in any spirit of careful observation means much. His belittlers emphasize Gerarde's ignorance of the classic writers on botany. He might be none the worse for that, but he quotes with discrimination from Theophrastus and

Dioscorides, from Pliny and Galen, and from his contemporaries, Gesner and Fuchsius and Lonicerus. His classification was based on Dr. Priest's translation of Dodoneus, published in 1583, but in the details of arrangement he more closely followed Lobel.

His special excellence was in the careful enumeration of native plants, in the loving study of their properties, real or imagined, and in the vivid descriptions which, with his faithful drawings of English plants, make him an authority in cases of disputed nomenclature. Other cuts in the Herball are from the *Kreuterbuch* of Tabernæmontanus, published at Frankfort in 1588, and used by Dodoneus, by Lobel, and by Clusius.

He delights also in the old English names of plants, and one reads of goldes and of paigles, of pawnce and of floramour, as on a page of Chaucer or of Spenser. Much of the best poetry of plant lore is found in the unconscious charm of his writing. Through it all runs the current of conscientious adherence to truth as he could best discover it. His most marvelous ascriptions of "vertue" to any plant, if not tested by himself, are qualified by "I have heard it reported." He denounces all "ridiculous tales, whether of old wives or some runnagate surgeons and physicke-mongers," and is slow to accept mere hearsay. With every plant he treats in a separate section "The Kindes," "The Description," "The Places," "The Names," "The Temperatures," and "The Vertues" of each. He mentions those which "doe grow in my Garden" with especial tenderness, and one can almost hear the sigh with which he sometimes confesses, "this, I have not seene."

The American genus of the family *Scrophulariaceæ* which bears the name of *Gerardia* includes two groups of plants, related in structure, but very different in appearance. The false foxgloves are stout herbs, the various species from two to five feet in height. In some, the reddish stems are covered with the blue bloom of raspberry briers. In others, the glaucous growth is replaced by a delicate pubescence. The leaves, sinuate or pinnatifid, are thick and usually a bluish green, although in *Gerardia pedicularia* they are thin, pale green, and downy, and in the southern *Gerardia pectinata* they are decidedly hairy. The exquisite yellow of the flowers is the very tint of the butterflies, at their blooming, hovering in thousands over the country roads. The corollas are more open than those of the English foxglove, to which it has little resemblance, and the flaring flowers would furnish better hats than gloves for the little folk in green. Indeed, this etymology of the common name of the *Digitalis* may well be questioned. So careful a student of plant lore as Hilderic Friend says "fox" is not a corruption of "folk," but that the name was probably first fox-gleow—*gleow*, equivalent to glee or music—its spire of bell-shaped flowers rising above the covert of fox and hare, suggesting the old tintinnabulum, a chime of small bells fixed on an arched support.

The other group of the Gerardias seldom exceeds a foot in height; the foliage is scant, often filiform, and the flowers are open bells of a purplish pink, very gay when blooming profusely on sandy barrens. The one group are the plants of rich woodlands, the other of thin, arid soil, of salt marshes, and of the seashore, but each one records the name of John Gerarde as he would have best liked it to be preserved. Never within his loved garden at Holborn, they are still a fitting memorial of him who so carefully studied their kindred, and

"Kydst the hidden kindes of many a weede."

THE PSYCHOLOGICAL CAUSE OF LAUGHTER.

By M. CAMILLE MÉLLINAND.

WE laugh under the most diverse circumstances. Curious incidents of the most various character, some absurdly trifling and others rising into different degrees of importance, will provoke the feeling that prompts laughter, or the emotion of the ludicrous; for it is this with which we have to do, rather than with the audible explosion. Our inquiry is into the interior cause, into the moral element in the incident that provokes the feeling, and into what takes place in the nervous centers. The study of this is important, and has been well prosecuted by recent authors of the day, but the purely psychological element should not be neglected.

At the beginning of our inquiry we meet the common opinion that the feeling of laughter is caused by joy. This has the merit of simplicity; but joy does not always make us laugh, for there are serious joys; and we frequently laugh without being joyful, and even sometimes at things that are sad.

Another opinion, to which Darwin inclines, is that laughter is provoked by what is queer, unusual, by what disagrees with or is contrary to our mental habits, or interrupts the familiar course. The queer, the old-fashioned, the provincial, partake, we admit, of the ludicrous. Caricatures amuse because of their exaggerations of proportions in contradiction to all natural laws. We recognize that there is something queer in everything that excites laughter, and that no word, act, situation, or attitude can be really laughable without having something strange about it.

Yet the queer does not always make us laugh. There are things contrary to the normal order that have nothing ludicrous about them; and if the view were true that queerness is the laughable element, those things that are strangest and most unusual should be the very ones most certain by their very nature to excite laughter. But we do not laugh at the dancing horses, the jumping pigs, the musicians playing on bottles, of the circus, all of which are most contradictory of what we are accustomed to. If we laugh at the circus, it is at the accessory jokes and incidents in the detail.

A conjuror's tricks, seemingly contradictory as they are of all our experiences and notions, do not make us laugh. We laugh at his jokes and his funny ways of proceeding, but wonder at the tricks.

In a theory proposed by M. Penjou in the *Revue philosophique*, laughter is excited by whatever appears as free and exempt from law, and as produced by a playful activity or the capricious manifestation of an unrestrained will, as in jokes, plays on words, equivocations, a schoolboy's pranks, deformities, or freaks of Nature. "The same cause of laughter," he says, "will be found in all the cases I can cite. . . . They always involve, under a thousand shadings, the sudden manifestation of a freedom that destroys our prepossessions, but without harm to us or real injury to others. However we may regard it, it is always this abrupt spontaneous outburst, with the entire absence of ostensible cause, that makes us laugh. . . . Spontaneity or liberty makes us laugh, and is, in fact, the essence of the amusing and the ludicrous in all their forms; and laughter is simply the expression of a liberty we feel, or of our own sympathy with the real or fancied manifestation of another's liberty, and is the natural echo in us of liberty." This hypothesis, with a few minor variations, is simply the theory of the odd.

We are ready to acknowledge that there is considerable truth in this view. Liberties are taken with words in a pun and with æsthetics in a grimace. Such freedoms are, however, often exhibited to us without our feeling any inclination to laugh. For an extravagance or a caprice some trait which has not yet been determined must be present.

Another considerably prevalent theory supposes the abrupt perception of a contrast between the attempt and the outcome, the appearance and the reality, the mask and the face, the tone and the words, the form and the substance, that provokes laughter. "Laughing," says Hegel in his Æsthetics, "is a sign that we are wise enough to comprehend the contrast and take note of it." According to L. Dumont, it is occasioned by the conflict in our mind of two contradictory thoughts, causing a shock. "The recognition of an object," he says, "at first gives a certain impulse to our understanding and stimulates its activity in a certain direction, when immediately a contradictory impression of another quality of the same object comes in and forces it into a contrary direction." Still the same common theory of contrast, except that with Dumont the contrast rises to a contradiction.

Many contrasts are unquestionably ludicrous. In a parody, the comic effect is produced by the contrast of the gravity of the original work and the irreverence of the travesty. In the child's innocent expression that we laugh at, there is a contrast between the bearing of the word and the candor of the one who speaks it. Certain kinds of transpositions make us laugh for a similar reason: a tragedy rendered into a trivial style, sublime sentiments expressed in slang.

There are other contrasts in which there is nothing ludicrous. The false note of a singer is in most cases only painful; but the effect of it is a contrast. The sight of a deformed body, after looking at sound and well-proprtioned bodies, does not amuse. We do not laugh when black is set upon white. We laugh when a clown, pretending to imitate a cavalier, makes an awkward tumble, but not if a real horseman gayly trotting by meets with disaster; yet there is equally a contrast in both cases. A saying, amusing in itself, does not please when pronounced under solemn circumstances that contrast with its tenor; and nothing is so insupportable as a companion who insists on being funny when one is absorbed in admiration of something or with grief. Everything that is out of tune creates a contrast, but does not make one laugh.

Bain suggests the explanation that laughter is provoked by what he calls a degradation, meaning that we laugh when we all at once perceive something degrading, a trickery, a weakness, or a pettiness in some person or object which we respect; as when the infirmities of human nature disclose themselves in a person of importance, or when some trivial affair occurs in a solemn ceremony to drag us down, or when the wrong side of some great thing or some great man is exposed. "The occasion of the laughter is the degradation of a dignified person or interest, under circumstances that do not excite a stronger emotion. In all theories of laughter the more or less important fact is marked . . . that the feeling of the ludicrous arises when something which we respected before is presented in a mean light; for we have no disposition to laugh when something that we already regarded as such is depicted as tricky and vile."

It can not be denied that this solution agrees with many facts. We frequently, perhaps most frequently, laugh at degradation. Those words are often amusing which bring up all at once the eccentricity or the vice of some person. Degradation is even the essence of parody. We laugh at the lapse of an orator, because the man, with his weaknesses, is suddenly exposed in the midst of his sublime flight. An uncouth expression or sound uttered in an assemblage of grave men makes us laugh for the same reason, because humanity is detected under its mask of gravity. Monkeys make us laugh because they by their grimaces and attitudes degrade the men they imitate to their own level. In general, fatuity, pretension, and affectation are ludicrous because vulgarity is betrayed under the mask at every instant.

Yet this is not the real cause, for we often witness the spectacle of a degradation without having any disposition to laugh at it. When we perceive a pettiness in a person for whom we have reverence, we are only sorry. We do not always laugh when the eccentricity of another is exposed. Our laughing depends much on the way the exposure is made. Thus, not the odd or the exhibition of freedom or contrast or degradation is the real cause of laughter. There are queer spectacles that are not amusing, free actions that are austere, contrasts that are sad, and degradations that are solemn. The one thing that is always present, that provokes laughter, to suppress which is to suppress laughter, a variation of which has an immediate effect on the intensity of the emotion of the ludicrous, is still to be found.

Let us study a few cases; first, of what we find to amuse us in acts, and then in words. We find the application of great effort to move a load that proves to be a trifle, ludicrous; as when a man exerts all his strength to force open a door that yields at a touch, or when the clown on the stage brings all his strength to bear to lift the mock cannon ball which we know is only pasteboard. Our first impression of such actions is that they are strange or absurd. Such Herculean efforts to raise a load we know to be trifling, to overcome a resistance which we know is as nothing, are, on the first impression, incomprehensible. A second impression, however, comes on, which the psychologists seem to have missed, and which may go far to account for the ludicrous aspect of the proceeding. A rapid process of thought within us makes the act which at first seems absurd appear natural from the point of view of the actor. We think that the man supposed the door was solidly fastened, and the clown that he had a real cannon ball to lift. The effort they made was therefore natural; we should have strained ourselves too if we had been in their place, and all for nothing; and we laugh at that. What seemed queer was simply natural, an unusual fact was a habitual one, and what we thought was surprising was after all familiar. We experience a sudden revulsion of feeling, and are amused.

So in words and expressions which we regard as witty or funny. They are first presented to us in a sense and with associations which seem queer or remote; then we find that they have also a natural and even simple interpretation. Our natural surprise at the discovery is expressed in laughter.

In the scenes which comedians present upon the stage, these double interpretations and instantaneous transitions of feeling are artfully provided for, and the success of the comedy is proportioned to the skill and plausibility with which they are worked up. When the play turns upon complicated situations and the mistakes and blunders of the character, we first perceive the absurdity of the whole as seen from our position; then instantly recognize that with the actors the matter is a serious one, and that what they are doing is correct from their point of view. The point of the joke lies in this double perception.

Some persons are slow in perceiving this point, and come in with their laughter after all the others are done. Their minds work more sluggishly, and they require more time to discover the duplex element.

Many conjurors' and circus tricks seem absurd and interest us without exciting laughter, because only the unaccustomed side of them is presented to us, and we fail to perceive wherein they have a natural side; and we are more puzzled than amused by them.

Laughter is favored by various circumstances and conditions—as a good state of physical being, infancy and youth, exultation over success, the buoyance we feel after having escaped danger, and cheerful moods. Some writers have sought the causes of laughter among these conditions; but we think they are only incidents, and simply help it by promoting freedom and agility of the mind. Children, who have no fixed habits and are vastly more susceptible to impressions than their elders, perceive the different sides of objects and their contrasts more speedily than they, and are more prone to laughter.

Mental dullness, physical trouble, disappointment, mistakes, anxiety, or mental pain are restraints upon laughter, or prevent it. Thus the more a thing appears to us at once unusual on one side and familiar on the other, the greater is the tendency to laughter; and the less pronounced the contrast the less we are amused at it.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

Sir Andrew Ramsay appears to be the first person who solved the mystery of the authorship of the Vestiges of Creation. He wrote in his diary, on the 14th of February, 1846: "At home at night reading the fifth edition of the Vestiges. Saw in it things I had told Chambers in Edinburgh after the publication of the fourth edition. He is the author."

SKETCH OF MARIA AGNESI.

By M. JACQUES BOYER.

TO assert that women have had an important influence on the progress of science would certainly be exaggeration; but to say that they have always been wholly foreign to it would be still more inexact. The female sex have, in fact, been for many centuries contributing to the extension of the field of scientific knowledge; and now that they are beginning to take a more prominent part in affairs of this category it seems a favorable time to review some of their achievements, and to notice some of the women whose scientific accomplishments have been most remarkable.

We begin with a Milanese mathematician of the eighteenth century—Maria Agnesi, a woman who was unique among the few who have occupied themselves with the exact sciences. Her precocious intelligence and a prodigious memory, which permitted her to express herself correctly in seven languages, and her rare aptitude for one of the most arduous branches of mathematics—the infinitesimal analysis of which Leibnitz and Newton had only just indicated the formulas—the saintliness of her life, divided between study, prayer, and charitable works—all contribute to make her one of the most agreeable characters which the scientific history of the last century offers us.

This illustrious learned lady was born in Milan, May 16, 1718.* Her father, Dom Pietro Agnesi Mariami, was a royal feudatory of Monteveglia, and her mother was named Anna Brivia. Baptized on the 23d of May in the basilica of Santo Nazzaro il Maggiore, she was given the name of Margaretta Gaetana Maria. She showed marked aptitude for languages from a very early age. She spoke French well when five years old, as we learn from the following sonnet by a friend of her father's: "At that age which retains only the first forms of the language of her country, and which is still easily fatigued by the task, a pretty little girl uses the French idiom with such grace and ease that a nymph on the banks of the Seine could not speak in a sweeter and more pleasant manner. It seems as if Time was afraid his flight could not keep up with the

* In the Éloge historique de Maria Gaetano Agnesi, demoiselle célèbre par ses grands talens dans les mathématiques, par se piété et sa bienfaisance, ouvrage traduit de l'Italien de Frisi (Paris, 1807, 8vo, p. 5), she is said to have been born March 16, 1718, but that is a typographical error. We should read May. This work, composed from the archives of the Agnesi family, is otherwise very exact, and a large number of the facts that follow have been derived from it. It is needless to add that the general dictionaries, including even the Biographie Universelle de Michaud (new edition, 1843, vol. i, p. 233), have rejected Frisi's error.

mind of this young person, and had appeared to slacken his march; and I, between the sight of so young an age and the charm of such an elocution, do not know which to believe—what I see or what I hear." *

It was not only in French that Agnesi made wonderful progress. She followed also the lessons in Latin which the Abbate D. Nicolo Jemelli gave to one of her brothers, and when nine years old she translated from Italian into Latin an essay which she recited before several auditors. She thus maintained—nearly two hundred years before Marya Chéliga and Maria Pognon—the right of women to study letters, the fine arts, and science if they feel called to it. This essay is dedicated to Dom Augustino Tolotta, a friend of her family and a very well educated man, to whom she modestly attributed all the merit of it. She mentions in it, among other celebrated women, Cornelia Piscopia (the oracle of seven languages), to whom the University of Padua awarded the laureate of philosophy, and Madame Dacier, translator of Homer.

Agnesi's coming out was then a brilliant one, and the rest of her life did not contradict the hopes it awakened in the minds of her friends. When eleven years of age she knew enough Greek to recite the Office of the Virgin in that language, a pious practice which she kept up till her death. Long before reaching her twentieth year, besides speaking Greek, Latin, French, and Italian, she was acquainted with German and Spanish. These many idioms, according to Mazzuchelli,† caused no confusion in her mind, and she translated freely from one language into another. She also left in manuscript a Greek translation of *Il Combattimento spirituale* of P. Lorenzo Scupoli, the two books of Supplements to Quintus Curtius of Freikshemius, translated into French, Italian, German, and Greek; three small volumes of a Greek and Latin Lexicon containing more than thirteen thousand words; and a Greek translation of a work on mythology. ‡

Miss Agnesi's health was seriously disturbed by so close application, and in December, 1730, the doctors advised her father to find some way of diverting her mind from her studies. But she, in the ardor of her application, doing everything with passion, followed

* The sonnet was dedicated, "*Alla nobile fanciulla D. Maria Gaetano Agnesi, che nell' eta cinque parla mirabilmente Francese*" (To the noble child Donna Maria Gaetano Agnesi, who, when five years old, spoke French admirably), and was written in Italian. We give it in an English unversified translation.

† Mazzuchelli. Gli Scrittori d'Italia, vol. i (1795), Part I, p. 198.

‡ The Ambrosian Library of Milan possesses, besides, numerous scientific manuscripts of Agnesi which bear witness to her prodigious industry. The principal among them are: Metáfísica e fisica, fisica e matematica, Studi di Cosmografia, Gnomonica geometrica, Fisica e matematica, Studi e correspondenze sopra varii punte del Trattato analitico.

the prescriptions too faithfully and too far, and balls and horseback riding, instead of curing her, brought on convulsions. Her disorders continued to increase immediately after the death of her mother, March 13, 1732, but she was subsequently gradually restored to quiet. This death gave rise to some changes in the family life, and Maria's father, who had five daughters and two sons by his first wife, was married a second time, February 23, 1734, to a Milanese lady, Mariana Pezzi. Two children resulted from this union, which was unfortunately brief, the second Madame Agnesi dying August 19, 1737, at the age of twenty-three years.

As a means of consolation in the grief that had fallen upon her father's household, Agnesi extended the field of her knowledge, and at last found her true career in the cultivation of philosophy and mathematics. She was not destined, it is true, to make a very prominent mark, but simply to occupy a highly honorable place among the great algebraists of the eighteenth century. Father Manera, of Cremona, and Father Michaelo Casati, professor in the Royal University at Turin, who was afterward (in 1754) nominated Bishop of Moudoir, taught her logic, metaphysics, Euclid's elements, and physics. She soon acquired great proficiency in all these sciences, and sustained theses in the presence of qualified persons. In these assemblies, after having discussed and refuted the arguments of her antagonists, she was accustomed to express her own opinions in very pure Latin. Her sister, Maria Teresa, an accomplished musician, introduced the artistic element into these meetings, which at last became so celebrated that princes and illustrious travelers passing through Milan often attended them. Many persons retained pleasant recollections of them, as is attested by the following passage from De Brosses' Letters from Italy, which is cited in M. Robière's excellent book on Women in Science, and which we quote as the story of a witness: "I would like to tell you, Mr. President, of a kind of literary phenomenon I have recently witnessed, and which has seemed to me something more stupendous than even the Duomo of Milan, and at the same time I was not taken unawares. I have just been to Signora Agnesi's, where I told you yesterday I was going. I was introduced into a large apartment, where I found thirty persons of all the European nations arranged in a circle, and Mademoiselle Agnesi seated alone with her younger sister on a sofa. She is eighteen or twenty years old, neither pretty nor plain, with a very simple and pleasant expression. First, plenty of iced water was brought in, which seemed to me a good augury. I was anticipating, when I went in, only an ordinary conversation with the lady; but instead of that, Count Belloni, with whom I was, now planned a kind of public act. He began by making the young lady a fine address in Latin, so that every one could understand it. She regarded him attentively, and they then began to converse in the same language on the origin of fountains and the cause of the flow and ebb, like that of the sea, which some springs exhibit. She spoke like a superior intelligence on the subject; I have heard nothing upon it that gave me more satisfaction. After this conversation, Count Belloni invited me to talk with her in the same way on any subject I pleased, in philosophy or mathematics. I was astonished to find that I was expected to speak *impromptu* and in a language to which I was little used; but, be it as it might, I paid her a handsome compliment, and then we discoursed concerning the way in which mind could be affected by corporeal objects and communicate concerning them with the organs of the brain; and afterward concerning the emanation of light and the primitive colors. Toppin conversed with her on the transparency of bodies and on the properties of certain geometric curves, of which I understood nothing. Evidently Agnesi's parties are hardly of this world!"

When Agnesi was nineteen years old, she had already sustained one hundred and ninety-one philosophical theses.* Of course, they are somewhat superficial theses, in which, after having cited the principal views of various authors, Agnesi discussed and affirmed her own opinion. This proves, nevertheless, that she had received a somewhat more solid instruction than was till recently given to the young women of our time. The inquiring quality of her mind and her taste for science are likewise revealed in her correspondence. On April 26, 1733, she received from Father Manara a letter from Rome which resolved some of her doubts concerning ballistics. In another letter she sent Count Charles Belloni the solution of a problem in analytical geometry; and a response from him (July 5, 1735) cleared up some difficulties which she had met in reading the Conic Sections of the Marquis de l'Hôpital, published in 1707, of which she had undertaken to make a commentary.

Not these labors alone engaged her thoughts. Toward her twentieth year, in the very midst of her success, she contemplated retiring from the world to enter a religious society, now suppressed, called the *Celeste*, or *Turquine*, from the color of their dress, or *Carcanine*, from the name of their founder, Giovanni Pietro Carcano. But, in view of the distress that this resolution cost her father,

* They have been published under the title Propositiones philosophicæ quas crebris disputationibus domi habitis coram clarissimis viris explicabet ex tempore et ab objectis vindicabat Maria Cajetana de Agnesis Mediolanensis (Philosophical propositions which Maria Gaetana Agnesi, of Milan, explained *ex tempore* and vindicated from objections in frequent disputations held at home in the presence of the most distinguished men), Mediolani (1738), and they are dedicated to Charles Belloni, of Paris.

she did not insist upon it, and returned to her interrupted studies. She only asked "three favors" from her father, and these were such as many women would hardly have been satisfied with: that she might dress simply, go to church when she pleased, and give up all unreligious amusements. She then devoted herself to algebra and geometry, "the only provinces of the literary world in which peace reigned," and soon her fame, passing beyond the circle of her friends, was spread through the whole learned world. Giovanni Battisto Bertucci intrusted her with his manuscript *De Telluris ac siderum vita* (September 19, 1738). She detected some inaccuracies in it, which the author corrected at once. Giacomo and Giordano Riccati read her works with great interest. Eustaccio Zanotti entertained her with his observations on eclipses. Paolo Frisi (brother to the one who composed her biography) sent her his manuscript, *De Figura et Magnitudine telluris.* Carlo Belloni intrusted his writings to her. The president of the Institute of Bologna, Beccani, submitted to her judgment the *Acta* of his academy; and finally—a well-merited distinction—Zanotti announced to her, June 20, 1748, that that learned society had just called her to be one of its members.

This election to the academy still further, if possible, stimulated Agnesi's zeal for science; and, notwithstanding the death of the last of her brothers, October 23, 1748, she published at the close of that year the great treatise on analysis which definitely established her reputation as a mathematician. Begun under the advice of Father Rampinelli, professor of anatomy and physics in the monastery of St. Victor, the *Instituzioni analitiche ad uso della gioventu italiana di dona Maria Gaetana Agnesi Milanese dell' Accademia delle scienze di Bologna,* in two quarto volumes, was received with enthusiasm, and soon took the place of the Marquis de l'Hôpital's Infinitesimal Analysis and Father Reyneau's Practical Analysis. The first volume included algebra and its applications to geometry, and the second treated of the differential and integral calculus. They were dedicated to the Empress Maria Theresa, who in recognition of the homage gave the author a box made of rock crystal and adorned with a brilliant. Pope Benedict XIV sent Agnesi a coronet of precious stones and a gold medal, which Cardinal Antonio Rufo brought to her, together with a very flattering pontifical letter, in which among other passages we read: "We undertook in the flower of our early youth the study of analysis, but afterward gave it up. We therefore only know enough of analysis to appreciate its importance and to realize how glorious it is for our Italy that it has professors of it. So far as we have been able to judge from looking over the table of contents of your work, and particularly from reading a few chapters of the analysis of finite quantities, we are in a position to declare sincerely that you are incontestably one of the foremost professors of that subject, that your work will be very useful, that it will contribute to the literary reputation of Italy and of our Academy of Sciences at Bologna." In another quarter, two members of the Royal Academy of Sciences of Paris, de Mairan and de Montigny, were commissioned to examine the *Instituzioni analitiche*, and they observed in their report that order, lucidity, and precision reigned in all parts of the work. They regarded it, in short, as "the most complete and best composed treatise" extant on that difficult subject. De Montigny, too, in the letter accompanying the transmission of the report to Agnesi, informed her that he had desired to see her while traveling in Italy, in 1740, but circumstances had disarranged his plans, and he had been obliged to return by way of Geneva without passing through Milan. He added: "I much regretted thus missing you, but my regrets are much increased now, after having read your book; and I can never console myself for not having had the pleasure of seeing you and talking with you, for Italy has not offered me any object more worthy of my admiration. I admire especially the art with which you have brought together under uniform methods so many facts scattered through the works of the geometricians, most of which have been acquired in very various ways." The work of our learned lady had therefore a very flattering success. Other evidences of its merit are afforded by its having been translated into English by Colson in 1801, and by the translation of the second volume by d'Anthelmy into French, with notes by Bossu, under the name of *Traités élémentaires du calcul différentiel et du calcul intégral* (1775). Its remarkable character is further indicated by an observation by M. Rebière that the first works on so difficult and new a science as the infinitesimal calculus are of extreme importance.

Besides his gift to Agnesi, Pope Benedict XIV nominated her in 1750 professor of mathematics in the University of Bologna. But notwithstanding the invitation of the Roman pontiff, who reminded her that Bologna had already heard persons of her sex in its public chairs, and that he pressed her to "continue so commendable a tradition," she did not teach. Her delicate health and the education of her brothers, with which she had charged herself after the death of her father (March 19, 1752), confirmed her determination to give up her scientific work.* After that, Agnesi no longer existed as a mathematician. Maria Gaetano devoted herself exclusively to the care of the orphans and bade good-by to the world in a profession of faith in which she proclaimed, in substance, that "man ought always

* Her father had married his third wife, the noble Milanese lady, Dona Antonia Barati, and had by his three wives twenty-four children.

to work for some end—the Christian for the glory of God; my studies have had this glory in view, for they were conformed to the desire of my father. Now, finding better means of serving God, so near me, I must use them."

She began by taking two infirm persons into her rooms; and afterward she withdrew into a remote part of her house, and gave a home there to a considerable number of women, which the sale of the Empress Maria Theresa's valuable gift to a rich Englishman enabled her to increase. In 1759 she hired a house near the church of San Benedetto, at the gate called "Vigentina," in which she lived with one of her brothers after the division of the family estate was made in 1764. When this house was sold in 1771, she moved into another between the churches of Santa Maria de la Visitatione and Sant Appolinare, where, assisted by the liberality of Prince Antonio Ptolomeo Trioulzi, she took care of four hundred and fifty poor persons of both sexes. She still found means, with all these multifarious occupations, to accept invitations to dinner, for she was a foe to even the slightest eccentricity. She won the admiration of her fellow guests by the sweetness of her manners and the easy grace of her conversation. This did not cause her to neglect the reading of the Holy Scriptures, for she composed theological and ascetical writings. But after 1791, having suffered an attack of gout and her sight being weakened, she became a frequent visitor to one of the country houses of her father's estate. She died of dropsy of the breast, after a long illness, January 9, 1799, and was buried in the parochial basilica of Santo Stephano, where she is described in her epitaph as a woman remarkable for her piety, knowledge, and benevolence.*

Sir Archibald Geikie, in his memoir of Sir Andrew Crombie Ramsay, describing the misapprehensions to which the geologist is liable while pursuing his studies in the field, tells a story of one of the English survey staff "who, poking about to see the rocks exposed on the outskirts of a village in Cumberland, was greeted by an old woman as the 'sanitary 'spector.' He modestly disclaimed the honor, but noticing that the place was very filthy ventured to hint that such an official would find something to do there. And he thereupon began to enlarge on the evils of accumulating filth, resulting, among other things, in an unhealthy and stunted population. His auditor heard him out, and then, calmly surveying him from head to foot, remarked, 'Well, young man, all I have to tell ye is that the men o' this place are a deal bigger and stronger and handsomer nor you.' She bore no malice, for she offered him a cup of tea, but he was too cowed to face her longer."

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* The inscription on her tomb reads: Maria Gaetano Agnesi: Pietate, Doctrina, Beneficentia Insignis. H. S. E. Dec. An. MDCCXCIX, V. I. D. IAN. Aetat. LXXXI.

Correspondence.

MR. SPENCER'S TELEOLOGY.

Editor Popular Science Monthly:

SIR: In your review of the Rev. Dr. Zahm's article on Evolution and Teleology, which appeared in the April issue of the Popular Science Monthly, there are two points which are strangely at variance with the logical acumen displayed in the remainder of the review.

The first of these is the method you employ to repudiate Dr. Zahm's inclusion of Huxley and Spencer among the teleologists. You state that Huxley has been misinterpreted and that "Mr. Spencer is not a teleologist," but you give no facts to corroborate these assertions. As presented by you they are mere statements and as such can not carry weight.

But the second point is a far more serious one. When you deny that Mr. Spencer is a teleologist you overlook the fact that he has declared himself to be one. In his response to Mr. Sidgwick he discriminates between "a legitimate and an illegitimate teleology," and, after illustrating this difference, concludes his demonstrations as follows: "I am . . . arguing teleologically but in the legitimate way."

Were Dr. Zahm's conception of teleology the only possible one, your statement in regard to Mr. Spencer would undoubtedly be true. But, as the above quotation from Mr. Spencer shows, there are at least two possible conceptions. One of these, the "illegitimate," is that accepted by Dr. Zahm; while the other, the "legitimate," is doubtless that referred to by Huxley when he says, "It is necessary to remember that there is a wider teleology which . . . is actually based upon the fundamental principle of evolution."

The fallacy of Dr. Zahm's argument does not lie in his assertion that modern men of science have given evidence in favor of teleology, but in his failure to perceive the two meanings of the word.

MARGARET CHASE.

NEW YORK, *April 30, 1898.*

[In saying that Spencer and Huxley were not teleologists we expressed ourselves broadly and, in relation to the matter in hand, we think correctly. What Mr. Spencer speaks of as a legitimate teleology is not teleology at all as the word is generally understood, and has nothing whatever in common with the teleology of Dr. Zahm. "Teleology of a kind," Mr. Spencer says, "is necessarily involved in the discussion of human conduct"; and he gives a biological illustration to prove that it is possible to argue teleologically and yet in a legitimate way. This is hardly the same thing as "declaring himself a teleologist." Now what is Mr. Spencer's "legitimate teleology"? According to the example he furnishes it is legitimate teleology to say that the chief end subserved by the hardness of the shell of a particular seed is the preservation of the life of the plant producing the seed; but he is most careful to rule out absolutely the idea that the preserving of the life of the plant had anything to do with the hardening of the seed in the first place. The hardening occurred through physiological causes; and this peculiarity, happening to favor the life of the plant, became in course of time, under the action of the law of selection, an established characteristic. The teleology here may be legitimate, but it is of a very shadowy nature, and we do not think we were far wrong in ignoring it altogether.

As regards Huxley, his position is simply that it is impossible either to prove or to disprove a teleological thesis that takes in the whole universe and all recorded and unrecorded time. When he says that "there is a wider teleology which is not touched by the doctrine of evolution, but is actually based upon the fundamental proposition of evolution," he does not mean, as our correspondent, following Dr. Zahm, seems to suppose, that the fundamental proposition of evolution *supports* the teleological view, but that the upholders of the doctrine in question take their stand upon that proposition. What is the proposition as formulated by Huxley? It is that "the whole world, living and not living, is the result of mutual interaction according to definite laws of the forces possessed by the molecules of which the primitive nebulosity of the universe was composed." The new teleology, as represented by Dr. Zahm, accepts the proposition, and says that the whole machine was *designed* to work exactly as it has worked in the past, is working in the present, and will work in the future. You may tell the person who makes this assertion that he does not know anything about it, but that will not make him budge. Huxley's own position is that we do not know anything about it; and we were therefore entirely justified in saying that he was not a teleologist. He consistently held that such problems transcended human faculties.

Our treatment of Dr. Zahm's article in the Editor's Table was necessarily very brief, and we are glad our correspondent has given us this opportunity of bringing the views of two of the leading exponents of the evolution philosophy into fuller relief.—ED.]

Editor's Table.

SCIENCE AND ITS CRITICS.

It is somewhat difficult to account for the attitude which a number of able men take toward science, an attitude of grudging recognition, of carping criticism, and too often of sarcastic misrepresentation. In England Carlyle and Ruskin have been the leading representatives of this phase of thought, if such it can be called; in France we have M. Brunetière and his school; in Russia, Tolstoi. The latter has lately republished in a Russian periodical a *brochure* by Edward Carpenter, the English title of which we at this moment forget, but the object of which is to show the abstract and unpractical nature of science; and to this he has prefixed a preface in which, following the English author, he gives science a very severe hauling over the coals.

What is it all about? What has science done to these gentlemen that they look upon it with so evil an eye? Do they dine less agreeably because science has discovered some of the laws which underlie good cookery? Are they angry with science because it has diminished disease and appreciably improved the expectation of life of each of them? Are they out of humor with it because it has done so much by anæsthetics and antiseptics to relieve human suffering? Is their grievance that a certain rational order has been introduced into our conceptions of the universe, so that, while we are still profoundly ignorant of many things, our ideas, so far as they go, have a certain harmony and coherence? If one only knew just how and where science had trodden on the corns of these very able writers, it would perhaps be possible to understand their attitude; but, as it is, in their deadly determination to find fault with science, they remind us very much of the wolf that had so heavy a bill of indictment against the lamb. The parallel stops here; the grumblings of the wolf were the necessary diplomatic prelude to the devouring of the lamb; but these gentlemen can not devour science. They grumble, and they grumble, but science goes on its way: *nulla vestigia retrorsum.*

Let us, however, examine the terms in which the great Russian author formulates his complaint:

"The strong, sensible laborer supposes that men who study, and are supported by his labor, shall be able to tell him where to find happiness. Science should teach him how to live, how to act toward friends and relatives, how to control instincts and desires that arise within him, how and what to believe. Instead of telling him these things, science talks about distances in the heavens, microbes, vibrations of ether, and X rays. The laborer is dissatisfied. He insists on knowing how to live. . . . The essential thing is the total view of life, its meaning and aims. Science can not rise to that view, religion alone can do so. . . . Science is constantly pointing to its victories over the forces of Nature, to electricity, machinery, and the like; but sensible men see not those things, they see only the misery, suffering, degradation, and hardships to which so many are subjected, and the little prospect of relief that is in sight. Were our men of science to teach men more about religious, moral, and social truths, we should not see the hundredth part of suffering and hardship which are now seen on every side."

Now, what is the answer to all this? The first answer we feel disposed to make is that the illustrious critic does not seem to have taken up as definite a standpoint as could be wished. He says at one moment that science can not rise to the point of view necessary for supplying moral guidance to the people—that religion alone can do it. A moment after he says that ninety-nine hundredths of all the suffering in the world would disappear if men of science "were to teach men more about religious, moral, and social truths." How are they to do it if science is powerless to deal with these things? Waiving this point, what may be said is this, that science reaffirms all the important moral truths that the experience of the ages has imparted to mankind, and places them on something better than an empirical basis. Mr. Spencer's two volumes on the Principles of Morality are full of valuable observations and illustrations bearing on the conduct of life; and other writers have dealt with the same general subject with various degrees of force and impressiveness. There is this distinction, however, to be drawn between moral truths and other truths, say the truths of purely physical science: the latter only require to be intellectually apprehended, the former require to be *lived*. We heard long ago of the servant who knew his master's will and did it not. Was any one but himself to blame for his disobedience? We are not told so; and Count Tolstoi has a great respect for the writings in which this type is given to us. Unhappily, the type is eternal; which of us can say with assurance that we have never fallen into like transgression?

This simple consideration, it seems to us, serves to show the folly of blaming men of science because the world is not better than it is, or for pursuing, while society is still so imperfect, their researches into distant regions of space and time, into the infinitely great or the infinitely small. Let the accusers of science say what moral truth of importance to mankind science has weakened. Let them say to what moral truth it has not at least added some strength. The Founder of Christianity did not rail at science. He did not say that it was because the Scribes and Pharisees did not teach sound and penetrating moral doctrines that the world was as bad as it was. As reflected in the fourth Gospel, what he taught was that there was a light which was ready to lighten every man that came into the world, but that "men loved darkness rather than light because their deeds were evil." To day there are thousands of agencies in operation for instructing men in their duties and teaching them the significance of life, and there is reason to hope that they are not all working in vain. Only we must bear in mind that all moral teaching is a summons to moral effort, a summons to rise above our everyday selves, a summons to more or less of self-renunciation. Why should men of science be blamed because they are not infinitely more successful than ministers of the gospel in enlightening dark minds and strengthening weak wills? If it is the function of religion, as Count Tolstoi says, to take the total view of life and seize its true significance, why does it not fulfill that duty? It really is most singular that no sooner has the eminent critic got to the point of seeing where the responsibility lies for the proper instruction of mankind, than he turns savagely round on the men of science, and tells them that if *they* would deal out religious, moral, and social truths to mankind, the miseries and hardships of our present social state would all but disappear.

Mankind, let us trust, is slowly

climbing the ascent to a higher moral state and better social relations; but what all reasonable persons should recognize is that it is not merely knowledge that is needed to sway men in the direction of right action. Whether knowledge is effectual in prompting to any action depends upon the manner and circumstances in which it is applied. Men sometimes gain wisdom from experience, and sometimes their moral natures respond to the appeals of some great teacher; but it is probable that the most solid gains which humanity makes result from the action of selection—the kind of selection which social life sets in operation. To say that science puts forward claims which it can not make good is a misrepresentation, as we have often shown in these columns. Science gathers knowledge and makes this knowledge available for all the world. If it is not more actively engaged in missionary work we fail to see matter for surprise. There are, as there have always been, diversities of gifts in the world, and it is not only possible but probable that the skilled observer, or the acute inductive reasoner, might not have any great talent for evangelizing the masses. Still, in a world where knowledge and theory are both so much required, such laborers are surely worthy of their hire. Why they should be singled out for the taunts and reproaches of eminent men of letters it is difficult to see. It would come with better grace from these gentlemen if they would direct their strictures first to those of their own craft, and ask the critics, essayists, and novelists of to-day why they do not take in hand the regeneration of society instead of spending their energies, as so many of them do, in the search for mere literary adornment or in striving to say cleverly things that might better never be said at all. But the great truth which should never be lost sight of is that moral progress is for every individual a personal question and is a matter of personal endeavor. Whether virtue can be taught is a question as old as Plato and probably much older. However that question may be decided, one thing is certain, that growth in virtue can not come from teaching alone, and that to blame men of science for not converting the world by means of lectures on moral philosophy is idle in the extreme.

SCIENTIFIC INSTRUCTION IN GIRLS' SCHOOLS.

The article on this subject by Mrs. Caroline W. Latimer which we published in our last number is one deserving of careful attention. A careless reader might possibly dismiss it as a plea for less science and more literature in girls' schools; but we do not ourselves so understand the writer. The contention is that in many, if not in most, schools scientific instruction is not judiciously imparted; that too many different sciences are driven abreast, as it were; and that, in seeking to cover too wide a field of knowledge and embrace too great a multiplicity of facts, the best results of scientific study are lost. We hold it entirely possible that such is the case, and when our contributor says that she knows from experience that it is so, it is reasonable to allow considerable weight to the statement. At the same time the very overloading of school curriculums with scientific studies—admitting all that our contributor says on the subject—must be regarded as an encouraging sign, for it shows that science has fairly conquered a domain from which only a generation ago it was almost wholly excluded. If it has overrun the territory in too promiscuous a manner, that can easily be remedied; and, by the aid of a little reflection and experience, scientific instruction in girls' schools can be so organized as to produce the best results as regards not only the direct imparting of scientific knowledge, but also the infusing of new life and significance into other branches of study.

We quite agree with our contributor when she says that scientific teaching unaccompanied by practical work on the part of the student is a very ineffectual, not to say wholly useless, thing. Mere oral instruction or the study of text-books will never impart any adequate sense of the need for evidence or of the nature of verification; far from weakening, it can only tend to strengthen the habit of dependence on authority. But set young minds to make their own observations and draw their own conclusions, to verify experimentally the theories contained in the text-books, instead of simply taking them on trust, and the intellectual benefit will be lasting and far-reaching. Lessons of patience and exactness will be taught that can not fail to be of value in after life; and the highest purely intellectual result of education will be achieved in the acquisition of a true conception of the manner in which knowledge is built up and rational certitude acquired in all matters accessible to the human mind. The difference is vast between a mind which knows what verification is, what an experiment is, and one that wholly lacks such knowledge. The one can take a more or less accurate measure of the facts of life and of any given situation, while the other is to a great extent at the mercy of haphazard impressions. The one sails a definite course, making the best use of every wind; the other is apt to change its course with every change of wind.

In girls' schools the study of science assumes a specially important function. The fashionable doctrine to-day in some quarters is that there is no sex in mind; but, for our own part, we incline to think that even in these latter times there is sufficient difference in the mental habits of men and women to render instruction in the facts and methods of science of more pressing need from the point of view of individual development in the case of the latter than in the case of the former. Writers who are not open to the suspicion of prejudice dwell on the greater "instinctiveness" of women as compared with men. Instinctiveness may be a valuable quality, but it has the drawback of dictating a very summary and personal manner of deciding questions which really depend wholly on external evidence. It is common enough among men for the wish to be father to the thought; but in the case of women we may use with considerable appropriateness the ponderous paraphrase of Dr. Johnson, and say that "desire superinduces conviction." Not merely a thought, be it remarked, but *conviction*; and how convinced a woman may be on the side of her desires perhaps most people have experienced.

Some one may say that this is an interesting condition of mind, a kind of sweet unreasonableness, which no one should seek to interfere with. Banter of this kind may at times be amusing, but it does not decide any serious question. The study of science affords precisely the intellectual exercise best adapted to check waywardness of thought and bring the mind into a right relation to the questions which have to be faced in everyday life. It shows one clear road, one well-established highway, to true conclusions, and reveals the danger of short cuts and hasty judgments. It accustoms the mind to ask, in regard to any proposition or statement, "What is the evidence for this?" It accustoms the mind also to a condition of suspense in regard to questions which there are not sufficient data for deciding. This condition of suspense is precisely what untrained minds find it most difficult to endure. We have lately had experience of this on an immense scale in this country. When the explosion occurred by which the Maine was destroyed, how few were willing to await the result of expert investigation before arriving at a conclusion consonant with their own feelings on the subject! It is not uncommon to find people who show irritation if you express a doubt whether some statement they have read in the papers, and happen to be interested in, is well-founded. Belief is of the nature of an emotion, the indulgence of which is to the mass of mankind a pleasure. The student of science early learns that the emotion is one which requires control, and gradually he or she forms the habit of making reasonable verification a necessary condition of belief.

Another great advantage that science possesses, especially in relation to the female sex, lies in its impersonal character. In other spheres of activity personal leadership counts for much; but in the study of science, while individual teachers may exert a powerful stimulating influence, they do not impose their opinions. In all scientific work the one "ever-fixed mark" is truth, the proved conformity of fact with hypothesis. How interesting soever the views of this or that eminent professor may be, they must at all times submit to this test; and the humblest student may at any moment shatter by an experiment or an observation the most brilliant generalization of the most renowned speculator. We do not know of any lesson that can be more usefully taught in girls' schools than this—that truth is above all, and that truth depends, not upon any form of personal authority, but upon the direct revelations of Nature to those who interrogate her aright. This does not involve any depreciation of personal influence, which must always remain a powerful factor in the government of human life; it simply gives the mind a wider outlook upon the world, enabling it to pierce beyond opinion to something greater and more enduring than opinion, the ever-unfolding reality of things.

> "Our little systems have their day,
> They have their day and cease to be."

This utterance of a great poet is at one with the teachings of science; but what it is well to remember is that, as system after system fails, truth shines forth with ever clearer radiance and more benignant grace: it does not sink in their fall, but escapes to assume better forms and confer still higher blessings on human kind.

We are in sympathy with what our contributor says as to the desirability of supplementing the careful teaching of one or two sciences with general views, intelligently imparted, of all other leading branches of science. She recommends for special study in girls' schools physiology as a necessary subject, and either botany or zoölogy. We should like to put in a word for astronomy on account of the strong appeal it makes to the imagination, and the opportunity it affords for bringing into use whatever the pupils may have learned in the way of mathematics. Another reason may be found in its extremely interesting history. No young person should leave a school claiming to give a solid education without having learned something of the labors of the old world astronomers, as well as of Copernicus, Galileo, Kepler, Newton, and Herschel. One of the keenest of intellectual and emotional, we might perhaps say moral, pleasures is lost to him or her who, in the

"Rolling heaven, with all his signs revealed,"

sees nothing but a medley of scintillating points, some brighter and some less bright, and knows far less of the movements of the heavenly bodies than the old Chaldean shepherds. The study of astronomy, we have reason to believe, is generally taken up by girls with much interest when an opportunity of doing so is afforded them; and we should like to ask Mrs. Latimer to try if she can not, in addition to the well-chosen sciences she mentions, find room for some really educative work in astronomy. With this addition her scheme would have our hearty approval.

Scientific Literature.

SPECIAL BOOKS.

Mr. *Evans's Evolutional Ethics and Animal Psychology* * deals in the first place with the origin and early growth of ethical conceptions, but more especially as the treatise goes on, with the physical and mental relations of animals and men, and the rights of animals as flowing out of these. "The intimate connection between evolutional ethics and animal psychology," the author says, "must be apparent to all who carefully consider the influence necessarily exerted by a proper appreciation of animal intelligence upon the recognition of man's moral relations and obligations to the creatures with whom he is so closely associated, and who are so largely subject to his dominion"; and "the measure of our duty toward lower organisms is determined by the degree of their mental development. . . . The only foundation of animal ethics is animal psychology." The discussion is opened with a View of the Ethics of Tribal Society, or that stage of the development near the beginning when rights were not recognized outside of the narrow circle of the tribe, and all others than those of the tribe were regarded as enemies. The idea was gradually expanded through the symbolism of the brotherhood of blood, the sacred rite, as we might call it, of hospitality, and the suppositious or ceremonial recognition of the kinship of tribal chiefs. Then the bond of community of religious belief came in to be a basis of moral obligation. Psychology and ethics were still, however, anthropocentric, and man was considered as essentially different and inseparably set apart from all other sentient creatures, a superior being, bound to them by no ties of mental affinity or moral obligation. The doctrine of metempsychosis, under which the soul was supposed in the next stage of existence to become incarnated in another man or a beast, came in to modify this view, and to prepare a way for the recognition of animal rights. Men came to observe the intelligence of beasts, and to find in them evidences of the possession of something more or less remotely resembling the mental faculties of man.

* Evolutional Ethics and Animal Psychology. By E. P. Evans. New York: D. Appleton and Company. Pp. 386. Price, $1.75.

The growth of this view is traced in its various aspects, the results deducible from them are set forth, and we are brought to the present state of the discussion, in the chapter on Mind in Man and Brute and those which follow it. "Modern scientific research has not only discovered a multitude of physical correspondences—analogical and homological—between man and brute, but it has also detected and brought to light many irrefragable proofs of their psychical kinship. The more exact and extended our knowledge of animal intelligence becomes, the more remarkable does its resemblance to human intelligence appear." The capacity of animals to adapt themselves to new conditions is discussed, and incidents are adduced in which it has been shown, in a chapter on Progress and Perfectibility in them ; their power to form concepts, plan, and pursue a systematic course are considered under the head of Ideation in Animals and Man, and cases of the organization of communities, trial by courts, the use of tools, etc., by them are cited. The existence of such a barrier as the possession of the power of speech by man and the destitution of it by animals is questioned. Finally, evidences are adduced of the presence of an æsthetic sense and the foreshadowing of a religious sentiment in animals. "It is through the portal of spiritual kinship, created by modern evolutional science, that beasts and birds, 'our elder brothers,' as Herder calls them, enter into the temple of justice and enjoy the privilege of sanctuary against the wanton or unwitting cruelty hitherto authorized by the assumptions and usurpations of man."

In *Aristocracy and Evolution* * Mr. *W. H. Mallock* first inquires what determines the production and ascendency of superior men, what their office in the world is, and what they effect; and then applies his conclusions to current social questions, particularly to that of the distribution of wealth. By *aristocracy* he means in this book no artificial or conventional class, but "the exceptionally gifted and efficient minority, no matter what the position in which its members may have been born, or what the sphere of social progress in which their exceptional efficiency shows itself." He prefers the word to *oligarchy*, "because it means not only the rule of the few, but of the best or most efficient of the few." He regards it as a fundamental error in modern sociological study that it attributes all progress to *man*, while, according to his own doctrine here set forth and expounded, progress is the work of only a few men who have led the others; that it regards great men as products or at most incidents of human and social evolution, while he would regard them as pioneers and chief factors of it. No hard-and-fast definition is predicated for greatness, but it is regarded as various in kind and degree. "Great men are not necessarily heroes, as Carlyle thought, nor divided absolutely from all other men," but there is a certain minority of men who resemble each other in being more efficient than the majority, as we may see in literature and art, in the scholarship of boys at the same school, and similarly in practical life. A man may be ordinary in one respect and great in another, but the majority are not great in any. The great-man theory asserts that if some men were not more efficient than most men no progress would take place at all. Such men promote progress not so much by what they do themselves as

* Aristocracy and Evolution: A Study of the Rights, the Origin, and the Social Functions of the Wealthier Classes. By W. H. Mallock. New York: The Macmillan Company, pp. 385. Price, $5.

by what they help others to do. Greatness, however, is not in all cases equally beneficial, but the influence of some great men is more advantageous than that of others. Progress, therefore, involves a struggle through which the fittest great men shall secure influence over others and destroy the influence of the less fit. The discussion turns to the office of the great man in wealth production and his power in politics, to the parts contributed to a joint product by the few and the many, to the dependence of exceptional action on the attainability of exceptional reward, and to the motives of the exceptional wealth-producer. Under the last head the justification of income from capital is shown to rest on the fact that the power of capital to yield income is what mainly makes men anxious to produce it, and that it must be transmissible and heritable, else those social results would not be produced which make it valuable. While the majority may and do acquire a share of the increment produced by the great man, it can never be such as to make social conditions equal, for opportunities can not be made equal. Educational help may do much indeed to increase the supply of exceptional though not great talent, but when applied to those whose exceptional gifts are ill balanced or whose intellects are not sound, it results in mischief, stimulating talents that will be ill applied and developing tastes that can not be satisfied, breeding agitators and causing discontent. "The average man should be taught to aim at embellishing his position, not at escaping from it." The unequal distribution of wealth has no natural tendency to cause unhappiness, for men's desires vary. Equality of desires exists only for the necessaries of life, for this desire rests on men's physical natures, which are similar, while the desire for superfluities depends on their mental powers, which vary, and the special appeal of luxury is mainly to the mind and the imagination. The desire for wealth is speculative, and implies no pain caused by the want of it, and is, in fact, in proportion to each man's belief that wealth is attainable by him. Finally, the socialistic teaching of to-day creates a spurious desire for wealth by its doctrines of impossible rights to it, and its theories merely cause a barren and artificial discontent that interferes with that harmonious progress on which the welfare of the many depends. They make enemies of classes who would otherwise be allies, to the incalculable injury of the cause of true social reform. Mr. Mallock's purpose in this work is to show the fallacy of these theories, and to demonstrate the dependence of the many upon the co-operation of the few.

GENERAL NOTICES.

We have already, in our sketch of James Croll (Popular Science Monthly, August, 1897), given a picture, however inadequate, of the heroic struggles of that student who, to use the words of Lord Kelvin, "presented in his life a rare case of inborn passion for philosophy and science conquering all obstacles and attaining to the object of lifelong devotion in scientific research and philosophic speculation"; and can hardly have failed to convey some idea of the incidents which his life developed, and which are set forth more in detail and consecutively in the autobiographical sketch and memoir of his life and work prepared by his friend *James Campbell Irons*,* to which we were most largely indebted for the material for our sketch. It is only necessary here to call attention to this book for the information of all persons who would like to know more of Dr. Croll's life and work, as well as of those

* Autobiographical Sketch of James Croll, LL. D., F. R. S., etc. By James Campbell Irons. London: Edward Stanford. Pp. 553.

who would exalt the noble qualities displayed by the hero of the story, and laud his successful achievement. The autobiographical sketch, which was never completed, occupies thirty-two pages of the volume, and is given as Dr. Croll left it, upon the advice of Professor Masson, that "it is so characteristic that it would be best to preserve it entire, as it would be a pity to lose anything of the simple and pleasant peculiarities of the autobiographical original." To this has been added the more detailed account of Croll's life and scientific work, making up the rest of the book. Mr. Irons has been assisted in his work by many of the distinguished scientific men of Great Britain, who have furnished Dr. Croll's correspondence with them, criticisms, suggestions, etc. To the biography are added obituary notices by Lord Kelvin, Nature, and J. Horne, of the Geological Survey of Scotland; a letter from Prof. R. W. McFarland, formerly of Ohio State University, on Croll's relations with America and its geologists; and a list of Dr. Croll's publications.

In Mr. *Ramsey's Philosophy of Phenomena* * all phenomena are classified as physical and metaphysical (matter phenomena and life phenomena). The cosmic forces of gravity, heat, and life are recognized as chief factors of all phenomena. The author's method is to present his views—which are usually very peremptory—in maxims or detached sentences; and we have not been able to perceive that the book as a whole leads up to anything in particular. His observations cover most of the branches of knowledge, and embrace general statements of reviews or opinions on the several points, with his own verdicts. He seems to apprehend that he will arouse animosity; but the world is more likely to respect the independent thinker who is not afraid to utter his views in plain language, and will simply take the liberty of differing from him where it does not agree.

M. *Félix Le Dantec*, whose publisher styles him "a young zoölogist of great promise for the future," confesses to having no new facts to present in his book on *Individual Evolution and Heredity*.* The important feature of his present study is to him the method, which he believes is different from that employed by any other author who has written upon the subject. His object is to account for the inheritance of acquired characteristics, and this he endeavors to do by purely deductive methods. He believes that the sole difference between living bodies or plastids and crude substances lies in the presence or absence of the property of assimilation. This property, then, should be the basis of all biological study, and all that is general in biology should be deducible from it. Heredity is therefore a form and the work of assimilation—assimilation of the traits of ancestors transmitted to posterity and perpetuated through them.

"One approaches Hegel for the first time," says the author of *The Secret of Hegel*,† "as one might approach some enchanted palace of Arabian story. New powers, imagination is assured (were but the entrance gained), await one there—secrets—as it were the ring of Solomon and the passkeys of the universe. But very truly, if thus magical is the promise, no less magical is the difficulty; and one wanders round the book—as Aboulfaouris round the palace—*irrito*, without success, but not without a sufficiency of vexation. Book—palace—is absolutely inaccessible, for the *known* can show no bridge to it; or, if accessible, then it is absolutely impregnable, for it begins *not*, it enters not. What seems the doorway receives but to reject, and every attempt at a window is baffled by a fall. This is the universal experience." We are not disposed to question the appositeness of the figure as illustrating Hegel's style of thought. What now is the student to do when he finds the expositor whom he hopes to use as the passkey to this strange palace falling into the same way of inaccessibility and impenetrability as his master? Dr. Stirling's chapters on Hegel consist for the most part of certain members of a series of notes "which, as it

* Philosophy of Phenomena. By George M. Ramsey. Boston: Banner of Light Publishing Company. Pp. 208.

* Evolution individuelle et hérédité; Théorie de la Variation qualitative. By F. Le Dantec. Paris: Félix Alcan

† The Secret of Hegel. Being the Hegelian System in Origin, Principle, Form, and Matter. By James Hutchison Stirling. New York: G. P. Putnam's Sons. Pp. 751.

were, fell by the way during the writer's own *struggle* to the *Logik* and the *Encyclopaedie*." The thought of publishing them was not entertained at the time, but, while some of them were destroyed before any such thought occurred, what remain are given unchanged; and the hope is entertained that "they may assist, or, should they fail to assist, they may succeed to encourage; for, representing various stages of success or unsuccess in the study of Hegel, they may be allowably expected to have peculiar meaning for more than one student, who, finding his own difficulties reflected in what claims to have passed them, may feel himself stimulated afresh to a renewed attempt."

A new feature presents itself at first sight in the volume on metals of Mr. *Bailey's Tutorial Chemistry*.* Chemical physics is given prominence, and the first place. Yet the author has sought to include only such topics as are essential to a due appreciation of the modern science. The section, however, contains many subjects that are not commonly brought before the student at so early a stage. The elements are taken in the order suggested by the periodic system, and the characteristic properties of each family are summarized. This has been done, the author says, so as to bring out the relationships which exist between the different members of the same family, and so as to represent (by a consideration of these summaries progressively) the whole of the chemical elements in a continuous series. A list of experiments is given in the appendix. The literary style of the book is concise and clear.

Professor *Ladd* has written his *Outlines of Descriptive Psychology*† with the definite intention constantly in view of adapting it to certain beginners—students in colleges and normal schools—with an average grade of culture and the average amount of time at disposal. He has therefore had in mind throughout both the pupil and the teacher in their mutual relations, and has taken all pains so to present the subject that it can be "intelligently and 'economically' yet thoroughly studied and successfully taught." The subject, the phenomena of human mental life, is treated from the different points of view, and with the aid of all the methods of research, particularly those of experimental and physiological investigations, which belong to modern psychology. These investigations are, however, at least for the present, liable to the criticism that they are unable to deal with the later and more complex developments of the mind. "Unless we describe, and as far as possible explain, the growth of intellect, the knowledge of self and of things, the formation of the higher sentiments and emotions, and the conditions for the attainment of character, we neglect the main part of the task of the psychologist." Without overlooking the treatment of more fundamental processes, the author has tried to give these "higher faculties" the amount of space they deserve and require. Admitting that the value and success of the experimental method ought not to be questioned, Professor Ladd believes that its representatives are tempted to exaggerate its promise and its superior productiveness, and maintains that it can never be pursued without dependence upon introspection. Both the analytic and the genetic methods of treating the subject are followed. In the first part of the work, The Processes of Mental Life, those elementary forms of functioning which analysis discovers as entering into all mental life are described. In the second part, The Development of Mental Life, the evolution of the principal faculties of mind is traced as much as possible in their combined and interdependent action. Clearness, conciseness, and order are sought in the presentation.

Mr. *Edward Bradford Titchener* aims in his *Primer of Psychology** to outline, with as little of technical detail as is compatible with accuracy of statement, the methods and results of modern psychology, and to stimulate the reader by means of questions and

* The University Tutorial Series. The Tutorial Chemistry. Part II, Metals. By G. H. Bailey. Edited by William Briggs. London: W. B. Clive, University Correspondence Press. New York: Hinds & Noble, Cooper Institute. Pp. 300

† Outlines of Descriptive Psychology. A Textbook of Mental Science for Colleges and Normal Schools. By George Trumbull Ladd. New York: Charles Scribner's Sons. Pp. 428. Price, $1.50.

* A Primer of Psychology. By Edward Bradford Titchener. New York: The Macmillan Company. Pp. 314. Price, $1.

exercises and of references to more advanced treatises to further study of the subject. The primer stands in close relation to the author's previously published Outline of Psychology, but, being intended as a first book, its exposition is simpler, while its range is wider. Greater emphasis is laid throughout upon the fact of mental evolution. The definition of psychology and its work are discussed in the first chapter and its method in the second; and after these follow the several chapters on the conditions, operations, and powers of the mind, advancing from the simpler, sensation, etc., to the more complex, memory and imagination, thought and self-consciousness, sentiment, etc. The treatise ends with the discussion of abnormal psychology and an exposition of the province and relations of the science. The whole discussion goes, as the author believes, to show that psychology, so far as it has gone, makes up an orderly and systematic body of knowledge.

To the Concise Knowledge Library Maps D. Appleton and Company have added *Astronomy*, by *Agnes M. Clerke* and two other well-known students and writers on the subject.* The aim of the work is to present in concise form a popular synopsis of astronomical knowledge to date. For this purpose authors are employed who are thoroughly conversant with the science and its literature, with the present theories and with current observations and their results, and who have earned a reputation for ability to present these things in a style intelligible and interesting to the general reader; and the reports of the most recent work in astronomy in the United States and abroad have been consulted. The work of authorship is systematically divided among the three writers whose names stand as sponsors for the book. Miss Clerke gives a brief historical sketch of the science from Hipparchus to the present time and furnishes the account of the solar system. Mr. Fowler, demonstrator of astronomical physics to the Royal College of Science, briefly outlines the general principles of spherical and gravitational astronomy, and describes the instrumental means now at the command of observers in the various branches of astronomical research; and Mr. Gore treats of the sidereal heavens. The work is illustrated by a large number of diagrams, and other designs prepared expressly for it, and by a number of reproductions of photographs and drawings made by distinguished astronomers in Europe and America. Among the observers and others to whom acknowledgments are made we find the names of American astronomers frequent and conspicuous.

A great deal of useful information and as much good taste are embodied in Mr. *Bailey's* little book on *Garden Making*,* and it is further full of suggestions for readers who may be able and disposed to plan and carry out gardening enterprises beyond the limits of the immediate teachings of the book. It deals with the kitchen garden and the ornamental grounds, their laying out, the tools to be used upon them and the best methods of operating, what to put into them, and all matters pertaining to their care and cultivation. The first section is General Advice, the second on the Plan of the Place. Then follow hints and instructions on Planting the Ornamental Grounds, the Fruit Plantation, the Vegetable Garden, lists of trees, shrubs, flowers, fruits, and vegetables, and calendars of operations for the North and the South. The author has been aided by L. R. Taft, F. A. Waugh, and Ernest Walker, professors of horticulture in Michigan, Vermont, and South Carolina.

A manual of *Laboratory Experiments on the Class Reactions and Identification of Organic Substances*, prepared by Prof. *Arthur A. Noyes* and Prof. *Samuel P. Mulliken* and published by the Chemical Publishing Company, Easton, Pa. (50 cents), describes experiments upon the class reactions of organic compounds; experiments illustrating the methods of detection of nitrogen, sulphur, and halogens in organic compounds; and methods of identification and separation of unknown organic substances. While the primary purpose of the experiments described is to illustrate the characteristic reactions of organic compounds, the importance of

* The Concise Knowledge Library. Astronomy. By Agnes M Clerke, A. Fowler, and J. Ellard Gore. New York: D. Appleton and Company. Pp. 581, with plates. Price, $2.

* Garden Making; Suggestions for the Utilization of Home Grounds. By L. H. Bailey. New York: The Macmillan Company. Pp. 417. Price, $1.

their analytical features is insisted upon, and that side has been made prominent; and an important part of the course consists in the identification of unknown compounds and the quantitative separation of mixtures by methods devised by the student himself with the help of the knowledge gained from the experiments with known substances.

In his book on the *Freezing Point, Boiling Point, and Conductivity Methods* of chemical laboratory work (Easton, Pa.: Chemical Publishing Company, 75 cents), Prof. *Harry C. Jones* aims chiefly to give an account of the operations involved in carrying out these methods in the laboratory. But, observing that they are rarely treated in a single work from the points of view of both theory and practice, and regarding the mere mechanical application of any scientific method as a matter of comparatively little significance, he has sought also to give enough of the theoretical ground on which each of them rests to enable the student to work with them intelligently, and to see clearly their scientific significance and use.

Another addition to D. Appleton and Company's series of Home-Reading Books is *The Animal World, its Romances and Realities*, a reading book of zoölogy, prepared by *Frank Vincent* on a similar plan with his book on The Plant World, which has found much favor. As in the other book, the subject has been approached from as many conspicuous and characteristic points as possible. The selections are made with a view to the entertainment they may give as well as to the instruction, and to their fitness to awaken the curiosity of readers and stimulate them to independent observation and investigation. Poetical extracts are admitted, Wordsworth, Emerson, Ferdinand Freiligrath, Shelley, Procter, Matthew Arnold, Holmes, Charles Lamb, and William Blake being represented among them. Something is given about every grand division of the animal kingdom; and articles are inserted on The Task of Classification and The Distribution of Animals.

The Forester, a valuable journal advocating the preservation and care of forests, arboriculture, and the economical management of timber, formerly published and edited by Mr. John Gifford at Princeton, N. J., has passed under the control of the American Forestry Association, which, enlarging and improving it, will make it its organ. It is intended to give prominent attention in each number to some one phase; as the White Pine Situation in the January number of 1898, the National Forest Reserves in the February, the Spruce Supply in the March, and Tree-planting in the April numbers.

Prof. *David P. Todd* insists, in his *New Astronomy for Beginners*, on the value and adaptability of astronomy as a laboratory study. It is pre-eminently a science of observation, and there is no sufficient reason why it should not be so pursued. "Although the pupil's equipment be but a yardstick, a pinhole, and the rule of three, will he not reap greater benefit from measuring the sun himself than from learning mere detail of methods employed by astronomers?" The science is presented, not as a mere sequence of isolated and imperfectly connected facts, but as an interrelated series of philosophical principles; rudimental principles of navigation in which astronomy is concerned are explained; observatories and their instruments are described; the law of universal gravitation is more fully expounded than is usual in elementary books; various questions receive special attention; while mathematical results are given, the beauty and interest of the study are not obscured by unnecessary mathematical processes; and the importance of the student's thinking rather than memorizing has been everywhere kept in mind. The book is commendable in its matter and manner. (Published by the American Book Company. Price, $1.30.)

The principal subject mentioned in the *Records of the American Society of Naturalists* for December, 1896, is the report of the committee on the practicability and the ways and means of further prosecuting antarctic research. The committee had given the matter some time and consideration, but was not yet in a position to state definitely the possibilities of the undertaking in question.

Under the title of *Parasitic Wealth, or Money Reform* (Chicago, Charles H. Kerr & Co., $1), *John Brown* issues "a manifesto to the people of the United States and to the workers of the whole world," calling attention to financial and social reforms which he thinks are needed and proposes. He thinks it a monstrous wrong that so few men should hold so vast a proportion of the property and domain of the country as is in the possession of the corporations and the relatively small group of wealthiest men; that the system of interest is wrong; that the monetization of gold is a mistake and contributes to the growth of parasitism; and that the protective system is unjustly oppressive. His plan of reform includes nationalization of land, railroads, waterways, and telegraphs by purchase, the certificates issued in payment for these franchises to constitute our money; the value of the money to be regulated by a land-tax rate, and its volume to be maintained on a uniform *per capita* basis and to be of such amplitude as to avoid premiums; the demonetization of money metals and the redemption of all coin money and paper obligations in the new lawful money; the nationalization of banks and the establishment of a bank service charge in lieu of interest; the repeal of all tariff, excise, and internal revenues, to be replaced by the land tax; maintenance of a public improvement fund; the removal of all public service out of the reach of partisan influence or interference; and selective immigration.

From a study of *The True Route of Coronado's March* (1540) through New Mexico and the intervening districts to the Arkansas River, in the light of the writings of the period, F. S. Dellenbach has come to conclusions entirely at variance with those of all previous investigators. His paper is very interesting for this reason and in itself.

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Fragments of Science.

An Episode in the Early History of Animated Photography.—The following interesting letter from Henry R. Heyl is published in the Journal of the Franklin Institute for April: "Among the earliest public exhibitions of photographs taken from living subjects in motion projected by the lantern upon a screen, was that given at an entertainment held in the Academy of Music, in Philadelphia, on the evening of February 5, 1870, and a repetition of this exhibition was made before the Franklin Institute at its next following monthly meeting, on March 16th, by the writer. The printed programme of this event contains the following allusion to this feature of the entertainment: 'The Phasmatrope. This is a recent scientific invention, designed to give various objects and figures upon the screen the most . . . lifelike movements. The effects are similar to those produced in the familiar toy called the zoëtrope, where men are seen walking, running, and performing various feats in the most perfect imitation of real life. This instrument is destined to become a most invaluable auxiliary to the appliances for illustration, and we have the pleasure of having the first opportunity of presenting its merits to our audience.' The subjects exhibited embraced waltzing figures and acrobats, shown upon the screen in life size, while the photographic images were only three fourths of an inch in height. At that day flexible films were not known in photography, nor had the art of rapid-succession picture-making been developed; therefore, it was necessary to limit the views of subjects to those that could be taken by time exposures upon wet plates, which photos were afterward reproduced as positives on very thin glass plates, in order that they might be light in weight. The waltzing figures, taken in six positions, corresponding to the six steps to complete a turn, were duplicated as often as necessary to fill the eighteen picture spaces of the instrument which was used in connection with the lantern to project the images upon the screen. The piece of mechanism, then named the 'phasmatrope,' consisted of a skeleton wheel having nine radial divisions, into which could be inserted the picture-holders, each consisting of a card upon which was mounted two of the photo positives, in such relative position that, as the wheel was intermittently revolved, each picture would register exactly with the position just left by the preceding one. The intermittent movement of the wheel was controlled by a ratchet and pawl mechanism operated by a reciprocating bar moved up and down by the hand. It will be apparent that the figures could be moved in rapid succession or quite slowly, or the wheel could be stopped at any point to complete the evolution. In the exhibitions at the Academy of Music, above alluded to, the movement of the figures was made to correspond to the time of the waltz played by an orchestra, and when the acrobat performers were shown a more rapid motion was given, and a full stop made when a somersault was completed. A shutter was then a necessary part of the apparatus to cut off the light rays during the time the pictures were changing places. This was accomplished by a vibrating shutter placed back of the picture wheel, that was operated by the same draw-bar that moved the wheel, only the shutter movement was so timed that it moved first and covered the picture before the latter moved, and completed the movement after the next picture was in place. This movement reduced to a great extent the flickering, and gave very natural and lifelike representation of the moving figures."

The American Professor.—Prof. Joseph Jastrow looks upon the American college professor as constituting a type of which it would be hard to find a counterpart anywhere else. His situation has recently been fully discussed in one of the magazines, and Professor Jastrow, commenting on the views there expressed, asks if the environment of our professor gives to his services a maximum of intellectual and moral value, and if it tends to develop most easily and successfully his own resources, and to urge him to the fulfillment of that function in the community for which his talents and training qualify him. The author can not answer these questions in the affirmative. There are undesirable factors in the professor's environment "which obstruct his public usefulness equally with his private happiness." He is "the type of the great underpaid, and this lack of income is, for many reasons, to be regarded as a calamity. . . . It is quite true that it were a pity that in the colleges of all places high thinking and plain living should be quite divorced; but it is a greater pity that the living should perforce be so arduous as severely to tax the energies that make for high thinking." From an investigation of the financial status of the professor, Professor Harper has found that he is on a par as to that with conductors, foremen of works, etc., with an average income of about sixteen hundred dollars, and that as a mere matter of justice his salary should be raised by one half—a conservative estimate. The average American professor suffers as much from the want of proper leisure as from the lack of a proper income, and the evil effects of the two are similar in kind; for the necessity of supplementing his inadequate salary will often direct his efforts into channels that promise some prompt remunerative rewards, rather than in the direction of the development of his maximum efficiency as a member of the university and as a personal influence. "Investigation and research, originality and scholarship come only as the slowly ripened fruits of leisure."

Montana Sapphires.—The existence of sapphires in Montana has been known for several years, but first attracted serious attention about 1891, when companies were formed and claims were taken up and examined with a view to mining for them. The sapphire region, according to Mr. George F. Kunz, extends for about six miles along the Missouri River, the central point being Spokane Bar, twelve miles east of Helena. Another region is between seventy-five and a hundred miles east of this, centering at Yogo Gulch. Mr. Kunz describes marked differences as existing between the sapphires from these two regions. All are of the same size, but they differ in crystallization, the Missouri River gems being prismatic, and those of Yogo Gulch largely rhombohedral. The value of these sapphires in jewelry can hardly yet be estimated. "Much beautiful material has already been obtained, but little of high value. Those from the Missouri bars had a wide range of color—light blue, blue-green, green, and pink—of great delicacy and brilliancy, but not the deep shades of blue and red that are in demand for jewelry. As semi-precious or 'fancy' stones they have value, however. The Yogo Gulch Judith River region is more promising, the colors varying from light blue to quite dark blue, including some of the 'cornflower' tint so much prized in the sapphires of Ceylon. Others incline to amethystine and ruby shades. Some of them are 'peacock-blue' and some dichroic, showing a deeper tint in one direction than in another; and some of the 'cornflower' gems are equal to any of the Ceylonese, which they strongly resemble."

The Filtration of Milk.—The wide area over which milk is collected for supplying a large city renders it practically impossible to regulate the supply in a hygienic way by control of its sources. For this reason some general method of purification, which can be applied to the milk in bulk after it has been collected, becomes an essential to a safe product for general consumption. The ordinary tests, while fairly accurate in determining adulteration, are of no value in indicating the presence of disease germs or ordinary dirt. In fact, nearly any sample taken from the milk wagons of a city will be found to contain a number of bacilli which would immediately condemn any water as unfit for drinking. Sand filtration has been practiced for several years in some Continental cities, and apparently with very satisfactory results. The filters used by Messrs. Boll, large milk dealers of Berlin, consist of cylindrical vessels divided by horizontal perforated diaphragms into five superposed compartments, of which the middle three are filled with fine, clean sand, sifted into three sizes, the coarsest being put into the lowest and the finest into the uppermost of the three chambers. The milk enters the lowest compartment, and, having traversed the layers of sand from below upward, is carried by an overflow to a cooler fed with ice water, whence it passes into a cistern, from which it is drawn direct into the locked cans for distribution. The filtered milk is not only freed from dirt, but the number of bacteria is reduced to about one third, without sterilizing. The loss of fat is, in new milk, stated to be small, but the quantity of mucus and slimy matter retained in the sand—which is, of course, renewed every time—is surprising.

Spirit Drinking and Mental Depression.—Facts brought out by Mr. Bateman, of the British Board of Trade, in reference to the amount of drinking in different countries make the people of the United Kingdom more moderate in their drinking habits than has generally been supposed, and place them among the more temperate nations; for while in the consumption of beer, 30.7 gallons a head, they exceed the Germans as a whole with 25.5 gallons a head, the relatively small quantity of wine drunk, less than half a gallon per head, as against 29.50 gallons in France and the adjoining countries, more than restores the balance. And this result is not changed when the stronger drinks than wine are taken into consideration—1.94 gallons per head in Germany, 1.85 in France, and 1.01 in the United Kingdom. The Bavarians are the greatest beer drinkers, consuming an average of fifty gallons each in a year; next to them are the Belgians, with 43 gallons. The United States appears in the table as a vastly more temperate nation than any of these, its average rate of consumption of beer, wine, and spirits being less than half that of Great Britain. The London Spectator, taking Mr. Bateman's tables as its text, tries to find a mental rather than a physical cause for the appetite for drinking, and discovers it in the use of spirits as a means of obtaining relief from depression. In the United States, where the climate is exhilarating, life is easy, and the people are satisfied, drinking is decreasing; while "it is in France that drinking is now most prevalent, and is assuming the form least connected with the actual enjoyment of fermented liquor." Though wine is plenty and all are trained from childhood to drink it, the people "are taking to strong spirits of peculiarly nasty flavors," and some are spending nearly half their wages upon them. This, it thinks, is because "in France more than in any other country the people are becoming depressed and pessimistic, partly through the general loss of their faith, partly through a consciousness that they are not as great in the world as they think they ought to be, partly through the rise of the savage pecuniary discontents which produce what we are accustomed to call socialism."

Insects, and Books about them.—In a Brief Historical Survey of the Science of Entomology, by C. L. Marlatt, president of the Entomological Society of Washington, an estimate is made of the extent of entomological literature. Hajen's Bibliotheca, in 1862, listed 4,766 authors, 18,130 distinct titles, and 851 anonymous publications. The last volume of the Zoölogical Record, for 1895, gives 1,251 titles of publications on insects, which might perhaps be equivalent to seventy-five 500-page volumes; and Mr. Marlatt supposes, as a very conservative estimate, that what would amount to 2,000 such volumes have been published since the date of Hajen's work. In economic entomology, Henshaw's Bibliography of 1888 contains 5,424 titles and the names of more than 500 writers; and about 700 entomological papers have appeared since then from the agricultural experiment stations. Hence, the author estimates the bulk of writings on insects available now at between 12,000 and 15,000 volumes; and this does not include the recent literature of apiculture. On a similar basis of calculation it is estimated that there are between twelve and fifteen hundred people now living whose works on insects are of such a character as to be noticed in the standard annual books of record. Besides these are the writers on bees, and the very large number of collectors of insects who rarely write on the subject. The number of species of described insects, excluding arachnids and myriapods, is estimated at 250,000; and it may be that, the world over, there are 10,000,000 species in all. Thus only one in forty of probably existing species is known—a fact that seems to throw grave doubt on much of our classification and characterization of genera. About 1,200 new genera and subgenera are added every year. "That the entomologists of the world have ample material with which to work, and that there is no alarming prospect in the immediate future of exhaustion of the field, is strikingly apparent." Dr. David Sharp has recently computed that in the matter of bulk insects probably outrank all other animals together, their small size being more than counterbalanced by the vast number of species and enormous multitude of individuals.

Economical Uses of Bacteria.—Prof. H. Marshall Ward, in his presidential address, which was read in his absence before the Botanical Section of the British Association, dwelt at considerable length on the many industrial processes which depend more or less for their success on bacterial fermentations. The subject is young, he says, but the little that has been discovered makes it imperative that we should go on, for the results are of immense importance to science, and open up vistas of practical application which are already taken advantage of in commerce. A bacillus has been discovered by Alvarez which converts a sterilized decoction of indigo plant into indigo sugar and indigo white, the latter then oxidizing to form the valuable blue dye, whereas the sterile decoction itself, even in the presence of oxygen, forms no indigo. Certain stages in the preparation of tobacco leaves and of tea depend on a carefully regulated fermentation, which must be stopped at the right moment, or the product is impaired or even ruined. While in flax and hemp the best fibers are separated by steeping in water till the middle lamella is destroyed, not every water is suitable for the process, but only that containing a particular bacillus, which destroys the pectin compounds of the lamella and leaves the cellulose. A process depending on this fact has been patented in the United States. The steeping of skins in water preparatory to tanning involves bacterial action for removal of the hair and epidermal coverings; and the swelling of the limed skins is a fermentation process. Hay and ensilage have to go through fermentations involving bacterial action. The various flavors of butter and cheese are each produced by special bacteria, and the cultivation of them has become a considerable business, so that the production of whatever flavor may be desired has become a matter of reasonable certainty.

Areca and its Properties.—The areca nut, a favorite stimulant of the many millions of people living in the East Indies and beyond, is the fruit of a tree, the *Areca catechu*, which, as described by M. Ernest Martin, following Chinese authors, has a trunk like that of the bamboo, straight and without branches, jointed in the upper part, with leaves like those of millet or sugar cane, under which are spathes containing fruits about as large as plums and protected by thorns. These nuts are edible. The bark of the tree is like that of the Paulownia; and it is on the whole very like the cocoa palm. It is regarded as one of the handsomest ornaments of the woods of the southern part of the extreme East. The nut is extensively used as a stimulant and as a remedy. It forms the basis of a preparation, with betel and lime, which is made to be chewed. After it has been used for a little while the teeth begin to assume a dark yellow or even blackish hue, from which the Chinese say that the Cochin-Chinese, Annamites, Cambodians, etc., tattoo their teeth. The effect sought in chewing areca is an excitation which, affecting the sali-vary glands first, extends from them through the whole organism. When the indulgence passes beyond the bounds of "moderation," disorders set in, which first affect the teeth; and even young Annamites are not infrequently found toothless in consequence of excess. Medical properties are claimed for the areca by the Chinese doctors. It is said to help digestion, to drive away the deleterious miasms that ferment in the body, to be an efficient vermifuge, to prevent flatulence, to heal ulcers, and to be a prophylactic against malarial influences. The people of marshy regions use it instead of tea, on account of its properties as a febrifuge. When taken in strong doses, it produces intoxication. A Chinese poet, Sou Tong, who lived in the eleventh century, celebrates this property in his verses, but adds that when one is drunken with wine he has only to chew areca to be relieved of his heaviness and brightened up. The nut has the other properties of assuaging hunger, of being an excellent eupeptic, of drying up suppurations, for which the Annamite doctors use it powdered, and above all as a remedy for worms, particularly the tapeworms; and it has other uses in Indo-Chinese medicine.

Trees in Tennessee.—But few States in North America can show a greater variety of valuable timber trees than Tennessee. Almost every tree to be found in the United States grows in that Commonwealth. The fact is ascribed by Colonel J. W. Killibrew, in a paper he read before the American Forestry Association, partly to the great diversity of soils, partly to the great differences in elevation and consequently of climate, and partly to the abundant rainfall. Colonel Killibrew has collected a hundred and thirty kinds of wood, eight or ten of which are, however, exotics. Among the indigenous trees are four varieties of ash, three of birch, two of beech, two of magnolia, five of elm, two of fir, four of gum, eight of hickory, four of locust, three of mulberry, three of maple, four of poplar, six of pine, three of sycamore, fourteen of oak, three of willow, and two of walnut, besides many single valuable kinds, such as red cedar, chestnut, cypress, cottonwood, pecan, linden, spruce, dogwood, tiswood, etc. Nearly all the western counties of the State were originally covered with heavy forests, in which many species are nearly evenly distributed. The tulip tree, the white oak, red oak, hickory, gum, black walnut, wild cherry, basswood, ash, elm, and beech are interspersed with one another, while cypress abounds in the swamps. In Middle Tennessee, the supply of good timber is very scarce in the richer agricultural districts; but in a few counties in the southwestern part of this district is a large area of virgin forest. The most valuable timber trees in East Tennessee are the tulip, pine, chestnut, and white oak. The timbered tracts throughout the State consist largely of woodlands attached to farms. In some parts of East Tennessee there are, according to Mr. George H. Sudworth, dendrologist, hundreds and in other parts thousands of acres of standing white pine which would yield very large amounts of timber. The bulk of it lies in the northern half of East Tennessee, but it extends in a more or less scattered growth clear down to the southeastern corner of the State. Much of it is old, and in some localities it has ceased to grow. The bulk of this pine occurs alike in the narrow valleys and on the long, steep, sharp mountainlike ridges. The destruction of the forests is growing with alarming rapidity. The State, however, still has a large supply of timber; and in the future forestry of East Tennessee the regeneration of the white pine must be an important feature. Fortunately, the conditions are such as to make it comparatively easy.

North American Grasshoppers. — The common short-horned grasshoppers one sees every summer day—constituting a group which is described as forming the prevailing type of orthopteran life throughout North America—is the subject of an elaborate essay by S. H. Scudder which is printed in the papers of the United States National Museum (Revision of the Orthopteran Group *Melanopli* (*Acrididæ*)). These active insects, whose gymnastic feats cheer and enliven our summer walks through fragrant meadows, are of considerable economical importance, as may be realized when we recollect the destruction inflicted several years ago by the Rocky Mountain locusts, and the careful investigations and elaborate reports of which they were the subject. This voracious acridian, Mr. Scudder says, has numerous closely related allies in all parts of the United States, many of which often abound to such an extent as to do serious damage to crops, and a few of them have been known to migrate in a similar fashion to the Rocky Mountain species. The *Melanopli* are almost exclusively an American group. A single genus is represented in the Old World, north of 35° north latitude. With that exception, almost all the genera and species of grasshopper are in North America; although four genera, not described by Mr. Scudder, with twenty-four species, are found in South America. Eleven of the North American genera, with nineteen species, live exclusively in Central America and Mexico, passing the border of the United States only narrowly, and these countries also make two South American species at home. Six genera range over twenty degrees of latitude; two are known only in Florida. Most of the genera are Western; four are peculiar to the Mississippi Valley; three are found on opposite sides of the continent, and are therefore presumed to range over the whole of it; five are characteristic of the extreme West; and four are confined, or nearly so, to the region north of latitude 35°. For the purpose of his essay, Mr. Scudder examined nearly eight thousand specimens, of which about seven thousand belonged to the single genus *Melanoplus*.

The Invention of Printing.—From a recent number of The Chap Book we learn that the much-discussed question of who invented printing has been recently reopened by Gilliodts-van-severén, curator of the Archives of Bruges, who claims that a Jean Brito, of Bruges, printed from movable types before Gutenberg or Coster. The volume on which this claim is based, which is now in the Bibliothèque National at Paris, is an edition of the Doctrinal of Jean Gerson, the celebrated chancellor of the University of Paris, who died in 1429. There is no date on the volume, but on the last page are some Latin verses, the literal translation of which is something as follows: "Notice the beauty of this present writing; compare this work with other works; put this book by the side of another book; see with what neatness, with what care, with what elegance, this impression is made by Jean Brito, bourgeois of Bruges, who discovered without teaching from any one his marvelous art, and as well his astonishing implements, no less worthy of admiration." In 1773 the Abbé Ghesquière called attention to these verses, but the two schools of Mayence and Haarlem, which had narrowed the controversy down to Gutenberg and Coster, refused to admit a third competitor. M. Gilliodts-van-severén, who has reopened the controversy, has written a large volume on Brito. He has discovered many new documents in support of the latter's rights and much interesting matter concerning his life.

Women opposed to Woman Suffrage.—The energetic pressure of the agitation in favor of woman suffrage has met its natural reaction in the organization of women opposed to having the duty of voting thrust upon them. An association of this kind was formed in Massachusetts about fifteen years ago and had the satisfaction of seeing a woman-suffrage measure defeated by popular vote in 1895. The New York State Association opposed to the Extension of Suffrage to Women was formed in April, 1896, and now has a standing committee of more than one hundred women, twenty thousand members, and branches in some of the large cities. The Illinois association, formed in May, 1897, has issued a circular defining the position and motives of the women who have taken this stand, and answering some of the arguments that have been put forward in favor of woman suffrage. Exclusion from the franchise, the circular says, does not imply inferiority, but division of qualities. "A little reflection shows that the kind of intelligence which the lawmaker should possess, the knowledge of the practical things of the outside world, such as currency, banking, the franchises granted to corporations, the general control of vast commercial and manufacturing interests, with other details of practical life, not easily enumerated, are affairs which lie almost wholly within the domain of man, and which it would be a sad waste of energy for women in general to become familiarly acquainted with. . . . Does it therefore follow that women are on the whole inferior to men? By no means. In her own domain, which includes the most vital, the most spiritual, the most progressive elements of life, woman is as much man's superior as he is hers in outer and material things." Everywhere, the circular continues, intelligent women of good character are effective agents in good work, public as well as private. It is only the women who are without moral influence who lack this power; and to give them the ballot would not only be a mistake in itself, it would place in their hands the power utterly to nullify the moral influence of the more enlightened of their sex. The pure and educated women of the nation, non-voting, and thus unbiased by the selfish considerations which naturally sway political aspirants, should form the strongest and purest element of conservatism possible." The noblest and most useful work of woman has ever been and ever will be "in that domain in which man can never take her place, or become her peer or rival. . . . We believe that men do look to women, and it is our desire and prayer that they may never look in vain, for the maintenance of the home, the upholding of lofty, pure ideals of domestic and social life, the moral education and training of children. . . . It is the compensation which woman owes to the state for the protection which she enjoys in the home, and for immunity from public labor and service, that she should rear her children with right habits and instill into their minds true principles and noble ideals of life, and she can not do this while she is managing political machines and besieging legislatures."

MINOR PARAGRAPHS.

In a paper on oil-producing seeds, in the Yearbook of the Department of Agriculture, Mr. Gilbert H. Hicks estimates, supposing that two pounds of seed are produced for every pound of ginned cotton, nearly 4,000,000 tons of cotton seed were produced in the United States in 1894–'95. Deducting about one third of this, required for sowing, there would remain more than 2,500,000 tons of seed. Of this amount, about 1,500,000 tons were worked at the oil mills, each ton producing 45 gallons of crude cotton-seed oil and 800 pounds of cotton-seed cake. This estimate gives a total of 60,000,000 gallons of oil and 600,000 tons of oil cake produced in the United States in a single year. At 30 cents a gallon, this crude oil was worth $18,000,000, while the oil cake exceeds $12,000,000 in value. Of this annual production of oil, about 9,000,000 gallons are used in making "compound lard," etc., while the rest is exported or is mixed with drying oils or used in the manufacture of soap. Cotton-seed oil is also largely used for adulterating other oils.

A uranometry of the bright southern stars has been completed at the Arequipa station of Harvard College Observatory, each star having been compared by Argelander's method with adjacent stars slightly brighter and fainter than itself. Visual observations of the southern variables have been obtained every month as far as possible. Counts have been made of the number and distribution of stars in several clusters. The meteorological stations have been maintained at Mejia (elevation, 100 feet), La Joya (4,150), Arequipa (8,060), Alto de los Huerecos (13,300), Mont Blanc station on El Misti (15,600), El Misti (19,200), and Cuzco (1,100). Interference with the carefully formed plans of the Astrophotographic Congress being undesirable and duplication of work unadvisable, the plan of preparing and publishing a complete map of the sky by the aid of the Bruce telescope has been abandoned, in the belief that more useful work can be done with the instrument in other ways. Glass copies of negatives, of any part of the sky, will be furnished to astronomers who desire to study them. It is believed that most valuable work can be done by careful study of particular regions by means of such photographs. The library of the observatory contained, October 1, 1897, 8,635 volumes and 12,992 pamphlets. Special efforts are made to render the collections of meteorological as well as of astronomical publications as complete as possible.

The great power of adaptation of the lower and smaller animals has received the special attention of Prof. L. C. Miall, who remarks upon the readiness with which they assume new stages or drop old ones, and the bewildering variety of visible contrivances and changes of forms which they take on.

Worms that can hardly be classified, and larvæ which give no clew to their parentage, exhibit beyond other animals the tendency to multiply rapidly, and to break away from one another at an early stage—a tendency which is so strong in the microscopic protozoa as to enter into the definition of the group. Fission, budding, alternation of generations, and spore formation are ultimately due to the same tendency. Weak animals make up, by their invisibility and their ability to scatter and evade, for the lack of powers to resist. If one polyp of a hydrozoa colony is bitten off, others remain, so that no enemy can possibly devour all the medusæ liberated from one colony or all the planulæ liberated from one medusa. Some animals and plants multiply by being torn to pieces or chopped small. Small animals are usually short-lived; and those that last as long as a year are often driven, like annual plants, to adapt every detail of their existence to the changing seasons. The naturalist who explores the surface waters of the sea soon learns that the time of year determines the presence or absence of particular larvæ.

The importance and great expense of securing a pure water supply in large cities, and the carelessness with which the average householder handles his taps, have led many municipalities to consider the use of water meters. Such an attempt is now being made in Philadelphia, and is, it is stated, causing some dissatisfaction. There is no question that the water meter is a thing of the near future. The great care and expensive mechanism which are now coming to be considered necessary in securing a safe city water supply have added so much to its cost that wanton waste of it can not be tolerated; and, besides this, the small individual savings at each house, when added together in a large city, will go far toward furnishing a supply for various public sanitary purposes, such as daily flushing of the pavements, etc., and in this way also tend to improve the hygiene of the town.

The halibut fishery on the northwest coast of the United States has developed into an industry of considerable importance, and there are now, Mr. A. R. Alexander says, in a Bulletin of the Fish Commission, nearly double the number of vessels engaged in it that there were four years ago. The demand for this fish five years ago was mostly limited to local orders; now large shipments are made to all parts of the West, and important consignments have been sent to the Atlantic coast by Canadian fishermen. The American catch finds a market in the States west of the Mississippi River. When this fishery began on the Pacific coast Port Townsend was its center, but for the last few years Tacoma and Seattle have absorbed the business. Halibut on the northern coast banks are very erratic. In places where they are numerous one day, few will be found the next. It frequently happens that a vessel will have good success for several days, and in a few hours' time fish will become so scarce that it is useless to remain longer on the ground. Fishermen can give no cause for this sudden disappearance other than that the halibut are traveling in schools, going from one bank to another, and not stopping long at any one place. Halibut do not seem to be very particular as to their food.

It is stated in Industry and Iron that, after a series of tests which have proved satisfactory in every respect, the Prussian Railway Department has decided to introduce a mixture of acetylene and oil gas for train lighting on the state railways. It is said that by the admixture of one part of acetylene to three parts of oil gas the illuminating power of the latter is increased three hundred per cent. A flame consuming twenty-seven litres of the mixture per hour produces sixteen-candle power. The use of this mixture offers the great advantage that neither in manufacturing methods nor in the present oil-gas appliances in the carriages is any change necessary. As a pattern for the installation of the other gas plants to be erected on all the railway lines of the kingdom, the minister recommends the acetylene gas plant at Grünewald station, near Berlin. The present annual consumption of Pintsch oil gas on the Prussian railways is one hundred and twenty-seven million cubic feet.

The curious formations known as bezoars, of common occurrence in the stomach and intestines of ruminants, are simply masses of indigestible material which, either owing to excessive size or other cause, are not thrown off. They were formerly of great repute as alexipharmics (medicines supposed to neutralize infectious or other poisons). Two curious specimens of this formation—which is, when of vegetable origin, known as a phyto-bezoar—are described in a recent number of the Pharmaceutical Review. They were taken, along with fourteen others, from the stomach of a bull at the Hacienda de Cruzes in Mexico, were of a brown color, somewhat resembled felt or rubbed sole leather in appearance, and consisted of the barbed hairs of the *pulvini* of the platopuntias. To the barbs with which the hairs are covered is due their power of felting together. Concretions akin to bezoars are sometimes found in the human stomach.

NOTES.

The exploring yacht of Prince Albert I of Monaco, the Princess Alice, made its fourth cruise of scientific research in the summer of 1897 in the waters west of Morocco, around Madeira, and the regions of the Azores and the sea off Portugal. Weirs sent down to depths of nearly sixteen thousand feet brought up animals wholly unknown. Another net kept for twenty-four hours at a depth of about thirty-seven hundred feet, near the Azores, brought up twelve hundred animals, of which eleven hundred and ninety-eight were fish. Large cetaceans were often chased by the whale boats; and in some instances unknown animals, from forty-five to sixty-six feet long, yielded remnants of food which they had swallowed—fragments of gigantic devil fishes, which were carefully preserved.

The spore dust that is often seen on cereals promises to be available as a pigment. David Pearson reports, in Nature, that a rich amber color, sometimes approaching sepia in tone, is obtained from smutty oats, and that when applied as a water color it remains fast and unaltered in ordinary diffused daylight, and changes but little in direct sunlight after months of exposure.

Experiments have been made by M. Perchor, of the French Academy of Sciences, from which he is satisfied that the zenith point can be determined directly with astronomical instruments as accurately as the nadir is found by means of the mercurial bath.

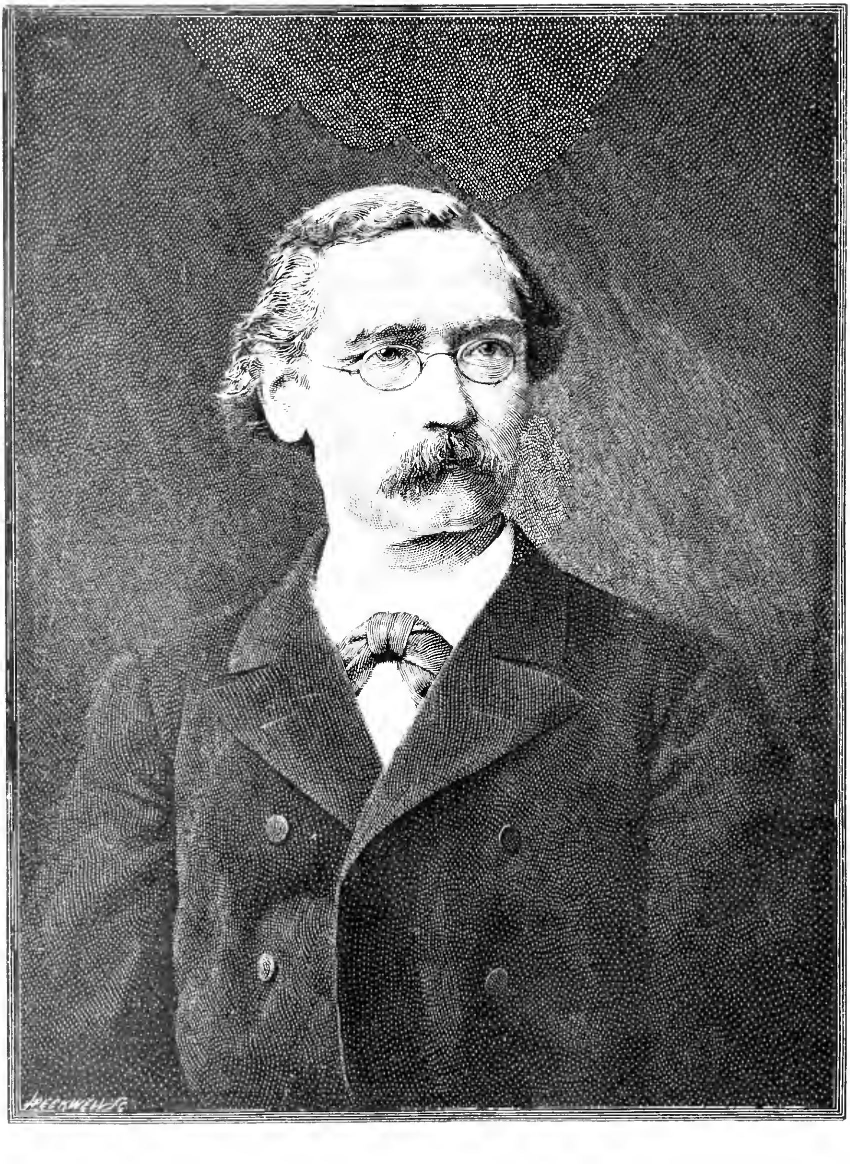
The investigations respecting the culture of the sugar beet made, by the Ohio experiment station, indicate that some parts of the State offer considerable encouragement to the industry. In three respects of temperature, soil, and rainfall they seem to offer all that is necessary for the best production. There still remains, however, much to be done before it can be positively asserted that beet sugar may be profitably produced in Ohio.

Toward the end of the year 1896 Mr. Spencer consented, at the request of a large number of distinguished men, to have his portrait painted by Mr. Herkomer. The portrait is now finished, and will be sent to the next exhibition of the Royal Academy. It is said to be the intention to finally offer the picture to the trustees of the National Portrait Gallery.

At a meeting of the New York Academy of Medicine, on February 17th, the following resolution was unanimously adopted: "*Resolved*, That the fellows of the New York Academy of Medicine do earnestly recommend the establishment of a bureau of health, with the power to administer, within constitutional limits, the sanitary needs of the United States."

The net earnings of the railways of the United States for the year ending June 30, 1897 (that is, the amount of gross earnings remaining after the deduction of the operating expenses of the railways), representing an operated mileage of 180,027.65 miles, were $369,050,856.

In the later death lists we find the names, among men associated with science and the arts, of Dr. Hermann Kämmerer, professor of chemistry at Nuremberg, April 12th, aged fifty-eight years; Dr. Samuel Gordon, president of the Royal Zoölogical Society of Dublin; M. Demontzey, correspondent of the French Academy of Sciences in the Section of Rural Economy; Dr. Hermann Schapira, professor of mathematics at the University of Heidelberg, May 9th, aged fifty-seven years; Maurice Hovelacque, secretary of the Geological Society of Paris; W. C. Lucy, an English naturalist of great activity and local fame, contributor of numerous papers to the proceedings of the Cotteswold Naturalists' Field Club, an observer whose name is familiar to readers of Nature; Dr. C. Herbert Hurst, formerly of the zoölogical department of Owens College, and later of the Royal College of Science, Dublin, author of many papers criticising modern biological theory; M. C. J. Souillart, professor of astronomy in the University of Lille, and author of several important papers on mathematical astronomy; D. S. Kellicott, professor of zoölogy at Ohio State University; Paul Henri Schneider, chief proprietor and director of the great iron works at Creusot, France, aged fifty-eight years; and Lord Lyon Playfair, at one time professor of chemistry in the University of Edinburgh, but who spent most of his active life in public or official positions in which the scientific function was highest in importance.



FELIX HOPPE-SEYLER

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PRINCIPLES OF TAXATION.

By DAVID A. WELLS, LL. D., D. C. L.,
CORRESPONDANT DE L'INSTITUT DE FRANCE, ETC.

XIX.—WHAT SHOULD BE TAXED, AND HOW IT SHOULD BE TAXED.

SOME years since (1873) a citizen of Tennessee, Mr. Enoch Ensley, making no pretense of scholastic learning or private interests, but earnestly desiring the material development of his section of the country (Tennessee), and that it should not be retarded by the adoption of an unsound system of State or municipal taxation, published in the form of a letter addressed to the Governor of the State a little pamphlet entitled What should be Taxed, and How it should be Taxed, which set forth certain fundamental propositions in respect to local taxation, and supported them with such homely and clear illustrations as to entitle the essay to a permanent place in economic and legal literature.

Mr. Ensley commences by proposing the following rule or maxim as the basis for a State (Tennessee), city, or county system of taxation:

"NEVER TAX ANYTHING THAT WOULD BE OF VALUE TO YOUR STATE, THAT COULD AND WOULD RUN AWAY, OR THAT COULD AND WOULD COME TO YOU."

Mr. Ensley then lays down the proposition that property naturally divides itself into *two* classes—*movable* and *immovable;* that the former, as its name implies, can be moved from one place to another as its owner chooses, while the latter is fixed and can not budge an inch, no matter what its owner chooses. "I hold it to be true that immovable property has no value till it is occupied or located upon, or brought to subsist or employ, movable property; and, as a rule, the more it employs or subsists, the more valuable it becomes; and the greater the inducements or attractions it offers movable property, the more it will have to locate upon it"; citing in proof and illustration the fact that the best acre of land in America is worth nothing till man goes upon it with his axe, horse, cow, etc., and puts it in cultivation and brings it to subsist himself, horse, cow, etc.; and from that moment it commences to have a value, by reason of the fact that it employs or subsists the man (who, if he can be called property at all, is certainly movable property) as well as the horse, cow, etc. And if this acre of ground for any cause should become attractive to and employ double the amount of movable property, it will as a general rule become doubly valuable; and so on, if it should become attractive to and employ profitably ten or a hundred or a thousand fold more movable property, it would become in like ratio more valuable, even up to the value of millions of dollars per acre, by reason of the fact that it offers attractions, and has employed upon it profitably five, ten, or fifteen millions of dollars' worth of movable property. Of course, when ground gets beyond a certain value it must be put to other uses than agriculture, and just this process acres of ground have doubtless passed through since the Dutch first landed on Manhattan Island.

There are exceptions to this rule—that immovable property is valuable as it has movable property employed directly on it—for it frequently has a greater value than movable property employed directly on it would warrant. It has a value reflected from the employment of movable property employed on immovable property near by, as in the case of residences in or near cities. For instance, the use of movable property on a Broadway lot gives a great value to the merchant's residence up town, by reason of the fact that it is sufficiently near and convenient for it to be in demand for the transaction of business daily at his store, all of which is attributable to the employment of movable property at the store.

The thrift or profit which immovable property offers to movable property helps to regulate its value. For instance, a man owns two pieces of property alike, say in different towns, rented out to merchants of equal capital; one is enabled to make seven per cent per annum only on his capital, for the reason that he has to pay three per cent tax on his capital, and the other makes ten per cent net, and pays no tax. The property paying ten per cent will be the most valuable, for it will pay the largest rent, because there will be more applicants for it than for the seven per cent; and the law of supply and demand governing, it must rent for more. It is, however, impossible, as a general thing, for these two merchants to remain of equal capital. The ten-per-cent man will soon have more capital, from his extra thrift; and the seven-per-cent man, seeing his prosperity, is apt to pull up stakes and quit his town, and move to the ten-per-cent town; and other merchants will perhaps do the same thing, until, by competition increasing in the one town by other merchants coming in, and decreasing in the other by their going out, profits may be made the same. This, however, is not apt to make profits the same in a country like ours, for there is generally new trade to be looked up to keep pace with the newcomers. So the result would be that the newcomers would continue to go to the ten-per-cent town from the seven-per-cent town and other places, till the one becomes a large and prosperous city, and the other a dilapidated, languishing town. It will be easy then to say which storehouse is the most valuable.

In this there is little of novelty; but in the homely, clear illustrations which Mr. Ensley employed for impressing his fellow-citizens with the truth of his propositions, novelty is not wanting. Thus, for example, he says:

"I hold that, of all men, the real estate, or fixed property man, is most interested in the rule or motto I have adopted. To illustrate, I will say that there is an acre of ground in the city of Memphis, Tennessee, say in front of the Overton Block, that is worth at the rate of two hundred thousand dollars per acre, while the writer has an acre six miles below the city, quite as good naturally, and even better than the Overton Block acre, because it will produce more corn, cotton, pumpkins, peas, potatoes, cabbage, etc., than the Overton acre will, or ever would, and my acre is not worth one hundred dollars per acre. Now why is it that the Overton acre is worth two hundred thousand dollars per acre, and mine not worth one hundred dollars? The reason is that there is employed on the Overton acre, profitably, two, three, four, or five hundred thousand dollars of movable property, while upon mine there is employed the sixteenth part of a negro, the sixteenth part of a mule, plow, hoe, etc. Now, if you will manage in any way, either by taxation or otherwise, to drive from this Overton acre the two, three, four, or five hundred thousand dollars, and affect the Overton acre so that this capital, or any part of it, can not be employed on it with a profit, it will not be worth more than my acre—in fact, not so much, for there is nothing so valueless as ground covered with houses, when there is no demand for said houses. And, further, if you do anything to make the two, three, four, or five hundred thousand dollars pay less profit, you will damage the ground, or lessen its value, more rapidly than you will decrease the profits—not in the same ratio, but more rapidly. Suppose, for instance, the profit has been ten per cent net on the capital employed, and the property is paying a rental on three hundred thousand dollars; if you reduce the profits permanently, in any way, to five per cent net, the property would not pay a rental on one hundred and fifty thousand; in fact, it would hardly pay any rent at all, for five per cent would be too small to induce a business at all in this country."

"Movable property always seeks and locates on immovable property where it thrives and multiplies most rapidly. A spot of ground, a city, a county, a State, or even a nation, that offers the greatest thrift, will be sought and located upon by the greatest quantity of it, and the greater the quantity the more value and thrift will the land have. Any tax levied upon it lessens its thrift, and consequently is in violation of the correct principle; though it may not be enough to perceptibly affect it, yet it will have some effect. Though it may not drive any away, yet it will, to some extent, keep other movable property from coming."

"It is said that it was the last feather that broke the camel's back, while the first had as much to do with it as the last. An oppressive tax, such as exists in some parts of our State, drives off a good deal of movable property, and absolutely forbids any more coming to such parts, unless it comes relying upon dodging or evading the law, which large capital never does. Men of small amounts of money, goods, etc., such as one can hide, may come; but men of large amounts of money, to go into open banking, or merchandising, on a scale that can not be hidden, or evade the law, will not come.

"Here I wish to state a truism which, perhaps, many owners of real estate may never have thought of. It is this, to wit: The renter or lessee of real estate must always prosper before the owner of the real estate can expect to prosper. This is certainly true as a rule, when taken for a series of years, in a country like ours, where land is abundant, and the people free to go where they please. This will apply to all real estate, whether farms, storehouses, shops, or other kinds of realty. I don't mean he must have greater prosperity, but that he must prosper first."

"Of course, all mankind, where they have lived for a time, form local and social ties, and will submit to some oppression, though their property be all movable, before they get their consent to move away; but with the millions of dollars of movable property we desire to attract to us, no such ties exist; and if we do not offer quite as much thrift as other localities, and even more, when the property may be already located, we need not expect to attract it to us. But it is just as certain as that the law of gravity will cause the apple to fall toward the earth when it leaves the tree instead of toward the sky; or as that water will run down an incline, if we (in Tennessee) do offer greater attractions than other localities we will attract it toward us, and the quantity and the rapidity with which it will come, can and will be measured by the amount of thrift that is offered. It is about as important to induce a man, with a given amount of capital, to come to us, as to retain one we already have in our midst, with the same amount." We can not expect to develop a State or build up large cities rapidly from their present population in their natural increase, but must invite others, with their capital, to come and settle among us.

"As I have said, any tax levied upon movable property lessens its thrift, and tends to drive and keep it away; consequently, it is incorrect in principle, while a heavy and oppressive tax is absolutely prohibitive and suicidal. Embraced in the rule I have presented in the beginning, never to tax anything that would be of value to your State, that could and would run away, or that could and would come to you, are two or three kinds of movable property which I regard as most important, and which I will mention—to wit, money, merchandise, and capital to be used in manufacturing. These pertain to cities mostly. There are many other kinds of property which, perhaps, would come under the rule, but for the present I will speak of these three, because through them great wealth generally enters the State.

"And here I desire to call your attention to the fact that the great bulk of the movable property generally enters a State or nation through its cities and towns—money and merchandise or trade always, and capital for manufacturing purposes most frequently; and from the cities and towns its beneficial effect is radiated throughout the State far and near, greater the nearer the city, but beneficial, to some extent, even to the utmost bounds of the State, particularly when we owe a common debt, as most of the States of the American Union do, and as our State of Tennessee certainly does, to the extent of over twenty million dollars. And here I wish to note the fact that there exists in Tennessee, in the minds of some of our farmers, or people living in the country, a prejudice against the cities. They imagine that the interest or prosperity of the cities is entirely separate from theirs, if not antagonistic; and again, the people of one part of our State imagine their interest to be separate from other parts of the State, which is incorrect *in toto*. This idea or feeling has, to a great extent, been manufactured by demagogues or ignorant politicians, and by newspapers actuated by incorrect motives or ignorance of the correct relations between cities and country, and the different parts of the State. This is all wrong, and the sooner the people turn a deaf ear to all such, the better it will be for all parties. There is no antagonism of interest between them; but, on the contrary, a unity of interest. For a city to grow large, rich, and prosperous within the borders of a State that owes a debt to be paid by all parts of the State in proportion to the wealth of the respective parts, of course can not be against the interest of any part of the State or country; and *vice versa*, for the country to become rich and prosperous, it can not well hurt the cities; for East Tennessee to flourish, can not hurt Middle and West Tennessee, and so on. But, on the contrary, the prosperity of one is, and must be, advantageous to the other, not only so far as paying the common debt is concerned, but in divers other ways, such as the country patronizing the trade and manufactories of the cities, etc., and the cities, in return, buying what they may consume of country products from the country, and offering a near and convenient market for many of their products that can not be shipped to more distant markets, besides shedding or radiating an increased value on their lands in every direction, for miles and miles. To attempt to enumerate the various reciprocal advantages is useless, for the mind once directed to the subject, they become apparent by the scores.

"And here I desire to call the attention of the farmer or countryman to a fact that many have never thought of, which may tend to abate their hostility toward the cities. It is this, to wit: While it is impossible for a rich and prosperous farming country to surround a city without contributing to the prosperity of said city, yet it is possible for a city to be located within the borders of a State and grow to be rich, prosperous, and large, and to add great value to the lands around and to the State, without receiving a corresponding value from the country of said State. In fact, such is always the case where the city is large. For instance, the great city of New York is not indebted to the country or farm lands of New York for one hundredth of her prosperity and wealth. She reaps her wealth not only from all the States of the Union, but from all the civilized parts of the world; yet she don't contribute a dollar to the payment of current expenses and State debt of any State in the Union, or any part of the world, except the State of New York. She gives in her immense wealth to be taxed solely for the State of New York, thereby relieving each and every farmer in the State. St. Louis reaps a majority of her prosperity from other States than Missouri. New Orleans reaps four fifths of her prosperity from other States than Louisiana, and of Memphis it can be said, she has reaped of whatever wealth and prosperity she has, from a half to two thirds of it from Arkansas, Mississippi, southern Missouri, and southern Kentucky; yet she does not contribute a dollar directly to the payment of current expenses or State debt of any of these States, but it is all taxed to supply the wants of the State of Tennessee alone. Nashville is similarly situated, to some extent, and perhaps Knoxville and Chattanooga, just to the extent that they may have prosperous trade beyond the State. Hence it will be seen that the farmers or country people should not be prejudiced against the cities located within their State, for they receive more aid from them than they give in return, and are consequently the gainers. So the practical operation of large cities seems to be to receive trade, and become rich out of it, from other States more than their own, and allow their own State alone to receive the full benefit, as far as her demands go. This, it strikes me, should not be objectionable to the farmer or countryman, or to the State or any part of the State. Consequently, by no means should they desire any law, of any kind, to exist in the land, whereby the cities are oppressed and kept from growing, when, by its repeal or modification, they would not be harmed a particle, but, on the contrary, be benefited.

"To undertake to enforce a very oppressive tax on money is ridiculous nonsense. It is impossible. The Maker of all things has forbidden it, in giving to all things their peculiar nature. He has forbidden an oppressive tax on money, by giving it such an easy mobility that it can go, in a fortnight, from Tennessee almost to the uttermost parts of the world. And just so, to some extent, with other kinds of movable property. It would be about as wise for the Legislature to pass a law enacting that, from and after this date, the great bulk of the water of the Mississippi River shall flow toward Cairo instead of toward New Orleans, as to enact that the great bulk of the money of Memphis shall pay four and a half per cent tax per annum. It is wise in man to deal with things as they are, and will be in spite of him, and not as he may think they should be. Don't kick against the pricks!

"Suppose that some city or town found it necessary, in order to pay current expenses, interest on debts, etc., to levy a tax of ten or fifteen per cent on all kinds of property, real, personal, and mixed, and that it was rigidly enforced. Does any one suppose that there would be any movable property there in twelve months to collect the tax from? No, sir; you would hardly be able to find a pocket handkerchief or a pound of coffee in either of these cities. But all the real estate, houses, etc., would be there still, but without tenants, and consequently, on account of the high tax and want of occupants, worth nothing. Suppose, again, it was possible to adopt a process to make the real estate worth something, could it be done by running the occupants off and receiving no rent whatever from it? No; it could only be done by adopting a process which would fill all of your houses with tenants, and secure to you a rental from them; and that could only be done by allowing movable property to thrive, and by attracting a sufficient amount of it to you to occupy additional ground, and to pay additional rental until your rental would be more than the tax.

"I find, in submitting my views to intelligent men, that at first they oppose me, and invariably say it is right and just for all kinds of property to be taxed alike; they all receive protection from the laws alike, and of course they ought to pay alike. Now, this would do very well, and be good reasoning, if we had a Chinese wall around a State; a wall that man could not scale to go out or come in, and no railroad could go under, through, or over; and then I would favor the tax of everything, for then it would all be fixed property; it couldn't run away or come to you; but until that kind of arrangement is made I am not in favor of it."

Commenting on a rate of tax of three per cent imposed on all property by various cities of the Southern States (at the time of his writing, 1873), Mr. Ensley points out as one result of such a policy that it offered "inducements to banks to carry on business with small capitals, and rely upon deposits for their capital; in other words, to undertake to do banking business without capital. A bank with five hundred thousand dollars capital pays fifteen thousand dollars to State, county, and city, being five times as much as a bank with one hundred thousand dollars capital, when the bank with five hundred thousand dollars capital does the State, county, and city, otherwise, five times as much good in the shape of assisting trade, manufactures, and developing the various industries."

Commenting also upon the tax rate of four and a half per cent imposed at that time in the city of Memphis, Mr. Ensley further adds: "If you will levy, enforce, and collect such a tax on the money, trade, etc., of the great city of New York, and charge no tax in Boston, Philadelphia, or Baltimore, I will guarantee to transfer, in a short time, hundreds of millions of the trade, money, etc., of New York to those cities; and, if she will continue it five or ten years, I will guarantee to show you, in either of these cities, more trade, more money, and more people than in New York. I will guarantee to depopulate her more effectually and more permanently than a plague ever did a city, and impoverish her more effectually than ever a war did. Yes, I will hurt her infinitely worse than a fire, that might burn every house from Castle Garden, from river to river, to Central Park. I will make it entirely safe for women and children to cross Broadway at City Park, Astor House, Wall Street, or elsewhere, without the protection of policemen. I will reduce the value of the real estate of Mr. Astor from one hundred million dollars (it is said to be worth one hundred million dollars) to twenty-five million dollars or ten million dollars, and perhaps even less, and the estate of every real estate or immovable property holder in the same ratio; but I can not say that I will greatly injure the movable property man, for he may go to Boston, Philadelphia, or Baltimore, and do quite as well as he did in New York city with his money, goods, etc. The truth is, it would entirely bankrupt the great city, for the demand for immovable property would not be sufficient to pay a rental sufficient to pay the interest on her city, county, and State debt. I do not think these assertions on the extreme, or the picture overdrawn. And if the picture is not overdrawn, and even say it is overdrawn by fifty per cent, who would be the injured party in New York by the enforcement of such a law? Would it be the great merchants who, for aught I know, rent their houses from Mr. Astor? Or would it be Mr. Astor, the great real estate owner of New York? In other words, would it be the movable property man, with his goods, money, etc., who can take it and go to Boston, Philadelphia, or elsewhere, and perhaps do quite as good a business as he did in New York, or would it be the immovable property or real estate man, who has to stay where he is and pay his city and county debt, without tenants or rental from his property? Hence, I say that, of all the men who should object to oppressive and, to follow the principle, I will say any taxation at all on money, merchandise, or trade, manufactories, etc., it is the man who owns the real estate or immovable property. His position should be this: He should say to the thousands of men in the civilized world, with their money in their pockets, looking out a favorable locality to go to banking, merchandising, manufacturing, or farming, etc.: 'Come, locate on me; I will not oppress you; come to me, for I can't go to you, and we must come together, or I am worth nothing; and knowing this, I will not tax you and oppress you. Other localities make you pay a tax; I will not, consequently I offer that advantage over other localities.' Heretofore it has been the merchant who has done the complaining about the tax levied on him; he is not the one to do it; it is the real estate man, and the writer being one of those men owning real estate almost entirely, and not owning a dollar's worth of merchandise of any kind for sale, and not being a lender of money, but, on the contrary, a borrower, and not being a manufacturer of any kind, and not being the owner of machinery, except a steam sawmill and a steam cotton-gin establishment, but being what is known as a plain farmer or planter by profession or occupation, thinking he sees his interest in the system he is advocating; consequently therein is to be found the moving cause of this letter.

"I contend that this system will lighten the burdens of taxation on real estate, and, after a very short time, the rate of taxation will really be less. To illustrate further, I will say what I said to a prominent real estate owner in a conversation on this subject. He said to me: Do you say that such merchants or bankers shall make from ten to sixteen per cent on their capital, and pay no tax, and I make only six or eight per cent on the houses they are occupying, and pay all the tax? Yes, says I. You seek to tax them, and that is the reason you get no larger per cent on your property. Says I: If they make one hundred per cent per annum on their capital, you should not want them to pay a copper of tax. Why? Because if they made one hundred per cent per annum, next year you would have forty applicants for the house they are doing business in, and if you should, you would certainly get a full rent for it, more than the extra tax, and as only one of the forty could get the house, and the other thirty-nine would be unaccommodated, and if your tenants should be making this large per cent, it is reasonable to presume that they would be making it, or something near it, all over town; consequently there would be near the same number of applicants for every house in town; but as only the present tenants or their number could be accommodated with houses, the result would be that you would not only get exorbitant rents for all the houses in town, but you would have demand for the hundreds and thousands of vacant lots throughout the city to build storehouses on; they would either buy them or offer you such enormous rents as would induce you to build them houses on lots that you have been paying taxes on for years, and received no rental from. Soon there would be houses going up all over the city, block after block. The brickmaker would have more than he could do; the lumberman would have more orders than he could fill; the carpenter, bricklayer, stone mason, foundryman, and all descriptions of mechanics and laborers would have more than they could do, so that the builders would have to send elsewhere for mechanics, and they would come in by the thousands. All these newcomers in turn would want residences for their families; and thus would bring into demand and make pay a rental thousands of lots that have never paid anything, and you give active employment to all the mechanics you have, and besides bring thousands of others from other places.

"Let us go a little further, and see how it affects all and everybody in the city. These newcomers get their houses, and then they want furniture, and they patronize your furniture man; they want a carriage or wagon for family uses, and they patronize your carriage man; and then horses, and patronize the horsemen; and then the blacksmith to shoe them; and then the retail dry-goods houses, mantuamakers, milliners, grocery-men, butchers, vegetable market men, and, in short, every kind of retail establishment throughout the city, thereby giving vigor, life, and thrift to all; and thus it would go on until, before you would be aware of it, you would have a city of hundreds of thousands of people, and be worth and pay a rental on hundreds of millions of dollars. Of course, no general trade would pay one hundred per cent per annum, but I have adopted this rate to illustrate the principle.

"The system of nontaxation of certain kinds of movable property, which I am advocating as the correct system, while it is the best to be adopted in every State, yet it will not make a rich State out of every State, nor will it build up evry town to be a large city, by any means. Thus, for instance, its application to a naturally poor State could not induce movable property sufficient to go there to make it a very rich State; still, if there is any way possible to develop such a State, this is the one.

"It think I have shown beyond question that it is not in harmony with the interests of any one in any State to tax money, trade, manufactures, etc., and that, of all others, the owners of fixed or immovable property should demand that the present system be changed—that they should say: Don't adopt any system that has a tendency to drive movable property from me; but, on the contrary, adopt a system that will attract it—for we are worth nothing without it, and the movable property man may go elsewhere and do quite as well."

SOME USES OF THE CAMERA IN ZOÖLOGY.

By R. W. SHUFELDT, M. D., C. M. Z. S.

PRACTICAL zoölogy in these days is realizing more and more the benefits it is receiving from the use of the photographic camera. These advantages are appreciated by naturalists, educators, and the reading public, and are seen to be advancing along a variety of lines; not the least important among these being the services accruing therefrom to the morphologist, the zoölogical artist and illustrator, and to the taxidermist. To the first named the assistance rendered by photography to his science has been some time established, having a number of years ago been placed upon a practical working basis. Its most successful operations are seen in the photomicrographs produced at the hands of the skilled laborers in such fields. Osteology is another department wherein distinct gains have resulted from photography. Bones and skeletons of every species of vertebrate are now illustrated in a manner that for beauty, accuracy, and permanency of the work, defies any character of illustration heretofore known, not even excepting the best grade of wood-cutting, and to it it is superior in the matter of accuracy. Time, labor, and expense are also largely saved by the scientific use of the camera. For example, in order to produce a figure of the skeleton of some such medium-sized mammal as a cat for an octavo work upon osteology, the reduction and draughting often occupied an artist several days; the cost, in addition to his time and labor expended, ranging all the way from ten to twenty-five dollars; whereas now, by the use of the camera, not only are greater accuracy and beauty insured, but the resulting half-tone obtained is at a very moderate pecuniary outlay. In the matter of illustrating sections of bones there is absolutely no comparison at all, for it is quite out of the question for any artist to copy the delicate internal cancellous tissue of the bone, while a photographic picture, occupying less than an hour to secure, will exhibit all this detail with the greatest sharpness and fidelity. Passing to another field in practical zoölogical pictography, we find the works upon natural history published during the latter part of the last decade, in many instances, filled with figures of mammals, birds, reptiles, and fish, to say nothing of those of the invertebrata and plants, where not only the specimens are malproportioned, drawn in impossible attitudes, characterless, but are even in some cases totally irrecognizable. Then these figures too, or the wretched class of them to which reference is made, had come to be a species of authors' heirlooms, passing from one work on to the pages of the next published one, and so on, till they found their way even into lexicons and text-books intended for the instruction of students in schools and colleges. All this is especially objectionable, for it is fraught with the danger of teaching erroneous ideas in the very important matter of the appreciation of correct form or morphological accuracy in natural objects, giving our youth false notions of the appearances of animals of all kinds and descriptions.

Let any one examine, for example, the figures in literature of such mammals as the walrus or the seals, published not longer ago than forty years, and my meaning will at once be made clear. Indeed, it is only in very recent time, comparatively, that we begin to see anything like correct pictures of the fur seal, and the camera has played a very important part in securing these. Among birds, and particularly among reptiles and fish, the same objectionable features are frequently noticeable, and of the charge of all this the present writer considers himself by no means guiltless, for before the photographic camera came to his aid not a few of his own published figures of vertebrates would without question have passed into the same category. Since the camera has come to his aid, however, these have been supplanted by a class of photographic pictures of living

Fig. 1.—Deer Mouse. Life size from living specimen. Reproduced from a photograph made by Dr. Shufeldt.

specimens, frequently taken in their natural haunts, that for accuracy and beauty defy criticism.

Upon the whole, the mixture of feelings is by no means pleasurable when he comes to examine, for instance, some of the drawings of mice he had the temerity to publish in a popular journal some dozen or more years ago, that came before the eyes of a very large constituency of readers and observers. Yet he can remember very well the time and labor that were expended in attempts to faithfully portray those beautiful little animals, so difficult of correct portrayal. Unsatisfactory in the extreme were the results, and disappointment the sole reward. How very differently does the camera do its work! Not so very long ago, having captured a fine living specimen of the common white-footed or deer mouse, the attempt was made to photograph this, one of the gentlest and prettiest little creatures in Nature. A result was obtained far exceeding the most sanguine expectations of the operator. Having placed an ear of ripe yellow corn, with husk and silk attached, the subject was induced to jump from the hand on to this as a perch. No sooner was this feat accomplished than he ran up and down it in a very excited, not to say interesting, manner. Already the ear of corn had been focused upon the ground glass of the camera box, and a holder armed with a very sensitive five-by-eight plate been duly placed in position. After having satisfied himself upon the state of things, my mouse suddenly paused and balanced himself to jump off, and if possible gain his liberty. In this attitude, and offering an opportunity not to be lost, an instantaneous exposure was made, and the plate removed to the dark room and developed.

This entire operation took no more than half an hour, and yet the outcome of the achievement was a picture of surpassing interest and accuracy, and one that even a rapid artist could not have produced in less time than a day, and then not have succeeded anything like as well. A reproduction of this picture is shown in Fig. 1, which for animation and fidelity to Nature would be hard to equal.

Similar and equally successful photographs have been produced by the writer of other species of mice, of young opossums, of the muskrat, and several other mammals. With respect to birds it may be said, by employing the same means in the same way, photographic pictures have been secured of upward of fifty species of those forms occurring in our United States avifauna. A certain proportion of these are of adult individuals, while many others are of nests containing young in various stages of development. Sometimes old birds, male and female, were secured together, in the most natural attitudes upon the same limb, as in the case of cedar birds, and a life-size picture of two young catbirds, large enough to fly, was similarly obtained. Others in the collection represent vultures, hawks, owls, many warblers, Carolina paroquet, woodpeckers, crows, thrushes, and those of various other families and genera.

One of the chief beauties of such pictures is that by the use of the instantaneous shutter the operator secures a result with the subject in some attitude that even the very best of zoölogical artists fail in.

Fig. 2.—Long-eared Owl. Subadult; about one third natural size. Reproduced from a photograph of the living specimen taken by Dr. Shufeldt.

This is well exemplified in such birds as owls, and it is a fact long known that such an accomplished ornithological artist as Wilson complained in his work of the difficulty he experienced in even depicting these in conventional attitudes. Not so with the camera, however, for with it the adroit manipulator of the instrument catches them upon the sensitive plate in almost any posture he pleases. Many of these taken by himself are to be found in the writer's collection. Last June Mr. Edward S. Schmid, the bird fancier of Washington, D. C., kindly loaned him a living specimen of a sub-adult long-eared owl, and this pugnacious bird soon proved himself to be a most capital subject from which to secure the more unusual attitudes so characteristic of the group. Having photographically pictured him in postures of rest, he was next teased to assume various ones of defiance, and these were secured with equal celerity and ease—not little, unrecognizable inch-high affairs either, but only a degree less than half natural size, capable of exhibiting all the external characters of the species. From the collection one of these is selected and offered to the reader in Fig. 2, and for a portrait of a defiant owl it is surely a very striking likeness.

Pictures as good as this one have been obtained by the writer of the screech owl, Aiken's owl (male and female in one print), the barred owl, and the barn owl, the last-named species being the most difficult subject of this famous family yet handled. Success was at last secured, however, where the specimen is shown (one third natural size) resting on one leg upon an old stump of a tree in a shady bit of woods. It has not at this writing yet been published.

Turtles, frogs, snakes, and lizards have been, to the extent of a score or more, taken with admirable success. My picture of the tree frogs has already appeared both in London and in New York, and the common bullfrog in Appletons' Popular Science Monthly. Forty or fifty have appeared in other places, and this is only noted here as proof of the practicability of illustrating zoölogical works by these methods, and in support of the fact of the way they are appreciated and utilized by naturalists.

Recently attention has been turned to the photography of fishes, a group of subjects presenting more difficulties to confront the artist and his camera than almost any other class. Nevertheless, success along these lines, too, is coming fast, and it is safe to predict that the photographic picture, in a vast number of instances, of ichthyological specimens will place the tediously produced pen-drawing in black and white in the background.

In July (1897) the Honorable United States Commissioner of Fish and Fisheries, J. J. Brice, Esq., at Washington, D. C., extended the writer unusual facilities to attempt some camera work in this direction at the aquaria of the Central Station. Without any special preparation this courtesy was almost at once availed of, and, although the circumstances were by no means the most favorable under which the first exposures were made upon the living fish in the aquaria tanks, yet some of the results were more or less gratifying, and certainly measured a standard of success sufficient to encourage other and more elaborate trials. Good photographic pictures

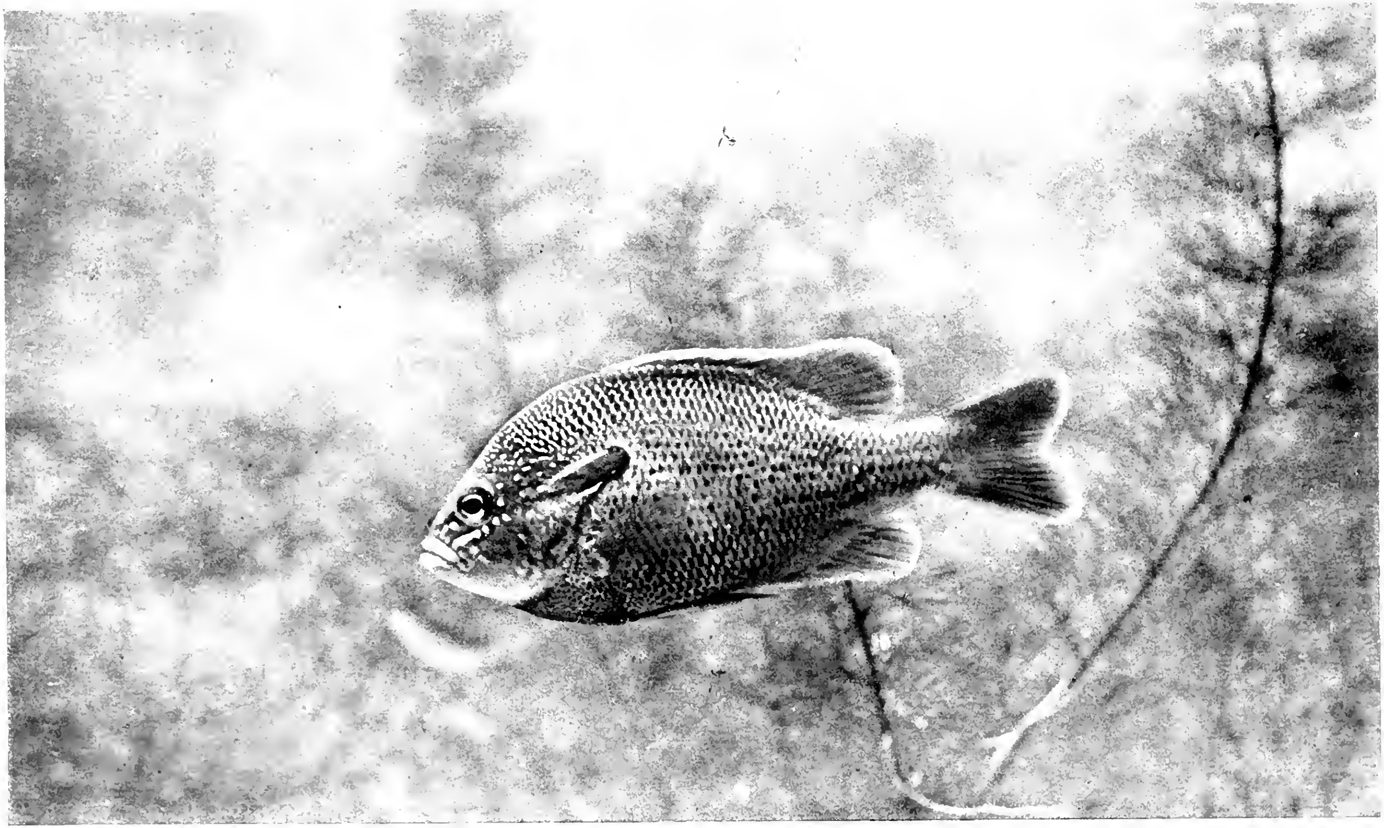

FIG. 3.—LONG-EARED SUNFISH (*Lepomis auritus*). One third natural size, from life. Reproduced from a photograph taken by Dr. Shufeldt at the United States Aquaria at Washington, D. C.

of sunfish (*Lepomis gibbosus* and *auritus*) were secured, as well as one of the common pike (*Esox lucius*). No less than twenty sunfish appear upon one plate, and in not a single fish is any movement discernible, the exposure having been made in less than a second. A very pretty result is seen in the male long-eared sunfish that was

FIG. 4.—PAPILIO TURNUS. Natural size, from life. Reproduced from a photograph taken by Dr. Shufeldt.

obtained, and this picture is here reproduced as a fair example of such success as attended the other attempts (Fig. 3). Where failures here were made, they were due to the insufficiency of light, the too rapid movements of the fish, and to reflections upon the glass of the aquaria. In a few cases all these difficulties conspired to defeat the hopes of the photographer.

Fortunately, however, each and every one of these drawbacks, save the second mentioned, can be overcome, and this the writer proposes to do in the near future.

Insects, again, make very instructive pictures as taken by means of the camera, though frequently they are secured with no little difficulty. Photographic pictures of this kind are in the writer's collection, showing beetles, spiders, butterflies, and the like, and a number of them have already been published. Great restlessness on the part of most of the subjects is here what chiefly has to be dealt with and overcome. The large black and yellow butterfly, taken life size, and shown in Fig. 4, occupied the best part of two hours to obtain. It was extremely restive, and declined over and over again to alight upon the day lily that had been selected for it as a perch. Still, indefatigable patience, the prime qualification for achievement in this field of art, in time won over the unintentional obstinacy on the part of this lovely insect, and victory finally crowned the long series of efforts made to secure its photograph. Nothing whatever can be gained here where harshness, haste, or lack of tact are allowed to come into play. On the contrary, one must not only be more or less familiar with the habits of the subject in Nature that he is trying to secure the picture of, but every act and movement on the part of the artist to accomplish this end must be characterized by extreme gentleness, patience, and perseverance, or else the desired goal will never be reached, and the science of zoölogy will forever remain ignorant of his power to produce portraits of living forms as they appear in Nature, by employing to that end such an instrument as the photographic camera.

Mr. C. Hose relates that one of the points of etiquette of the natives of the Baram district of Borneo forbids any man being called away from his meals; and it is even considered wrong to attack an enemy while he is eating. The people assume to converse with spirits and omen birds through the medium of fire. If a man hears the cry of a bird—which is a bad omen—he lights a fire and tells it to protect him. The fire is supposed to speak to the bird. The owner of fruit trees in fruit places round stones in cleft sticks near them, and utters a curse against any one who may attempt to steal the fruit, calling upon the stones to be his witnesses. If a friend passing by wishes to take some of the fruit, he lights a fire and tells the flame to explain matters to the stone, and that is supposed to make him safe. When a house is to be built, all the parts having been made ready to be put together and the omens having been consulted, every man, woman, and child in the neighborhood is called upon to help on a given day in erecting the structure; while a few small boys are sent out to beat gongs and keep up a din, in order that bad omens may not be heard after a good omen has been obtained.

THE EVOLUTION OF COLONIES.

By JAMES COLLIER.

II.—EMIGRATION.

EMIGRATION is a continual regenesis of colonies, and in its latest stages exhibits all the phenomena that belong to the beginnings of societies. It answers closely to the genesis of the individual organism in particulars not previously mentioned. It is a mere extension of the migrations of animals, which project light on it, as it reflects light on them. And it recapitulates the movements that peopled the countries whence it proceeds. Guided by this triple clew, let us explore its myriad facts. They may be conveniently distributed under the principal Aristotelian categories. Whence, by whom, and of what sort, when, why, how, and whither has emigration taken place? Which are the emigrating races? At what point in its history does a nation throw off a colony? What are the characteristics of the emigrating type? What are the classes, religions, and professions, and which chiefly the sex, that swell the stream? What are their motives for leaving the old and seeking a new country? Under what circumstances and by what agencies is emigration carried out, and in what direction does it move?—these are the questions to be answered.

I. It is the brilliant generalization of Weismann (with which his view of the intransmissibleness of acquired characters seems to have no necessary connection) that the substance of every species consists of a web of germinal protoplasm that is continuous from one generation to another—a warp whereon the lives of individuals are as patterns woven. We might similarly conceive the migrating (destined, when they reach the sea, to become the emigrating) *races* as forming a continuous emigrating chain or cable, unbroken from the departure of the first migratory band to the sailing of the last emigrant ship, splitting on this side and that into independent strands, but each containing the ferment of the movement that has carried civilization round the globe. The Carthaginians inherited a double portion of the Phœnician colonizing spirit. The Greek colonies gave birth to others which, like Massalia, Syracuse, Sybaris, Corcyra, and Andros, were more colonizing than themselves. England, the progenitor of a hundred peoples, is a Teutonic and Scandinavian colony. Massachusetts was the mother of a cluster of New England States, and Virginia of many of the Southern States. Two great colonies have sprung from the loins of New South Wales; two others from two New Zealand settlements; and both countries stretch out their hands toward New Guinea and the South Sea islands, while they flood distant newly discovered gold fields with immigrants.

It is the *masculine* races that emigrate. The earliest of the great colonizing peoples, the Phœnicians and Carthaginians, in addition to the "strenuous ferocity" that marked the Semites, possessed an "individual impulse and energy" which (in Grote's opinion) put them greatly above the Egyptians, Assyrians, and Hindus. The Greeks were flexible and many-sided, and, being fractured into a hundred independent communities, had a self-organizing faculty which promoted emigration in many directions and diversified colonization. The manliest of ancient races, the Romans, overflowed equally in colonization and conquest. The now emasculated Spaniards and Portuguese were, in the fifteenth and sixteenth centuries, the most robust of European nations. In the sixteenth and seventeenth centuries the French were aggressive and conquering. The long struggle with Spain made Holland a nation of heroes. The English, Germans, and Scandinavians are Bismarck's masculine peoples. The Celtic Irish, the Italians, and other feminine nationalities have emigrated in profusion since emigration has been made easy.

The emigrating impulse is by no means diffused equally over the emigrating races; there are emigrating *sections* of these races. The migrating Aryans, whether starting from "somewhere in Asia" (as Max Müller still maintains) or from southern Russia (as Schrader contends), spread into every European country, and forming a fringe along the coast, where they remained as sea rovers, or crowding to its centers, where they became its rulers and its aristocracy, were the progenitors of the migrating bands which left these countries in after years or are leaving them now. "The cells in which the original germ plasm most predominates become the reproductive cells." Thus the early colonies of Spain and Portugal were settled by Biscayan and Guipuzcoan mariners and by the flower of chivalry at the seats of military enterprise at Cadiz and Seville. Breton and Norman seamen and merchants of Saint-Malo planted the first French colonies. Devonshire gentlemen and sailors led and manned the buccaneering and exploring expeditions that were the parents of the American colonies; Devonshire and the adjacent counties contributed one sixth to the Puritan exodus and, only half a century ago, founded a colony in the South Seas. Two thirds of that exodus were made up of the descendants of Norse sea rovers on the Lincolnshire seaboard. It points likewise in the direction of a continuous migrating element in stationary masses that emigrants are drawn unequally from the different races of the mother country. Thus the masterful Scottish nationality, once so vagabond, has left a "broad and permanent impress" on the middle belt of the United States; has more than its share of population and power in Canada, where it pioneered the Northwest; in Australia, where the Queensland sugar planters and most of the large landholders are said to be Scots; and in South Africa.

II. The masculine races colonize and emigrate at a *point of time* after the attainment of national manhood. National puberty manifests itself in the feverish excitement of provincial rivalries and civil wars. National manhood shows itself in a nation's becoming master in its own house. Spain expelled the alien, unassimilable races of Jews and Moors. The French monarchy subjugated the provinces. The English brought the civil wars to an end. The Dutch threw off the Spanish yoke. Germany annexed the German portion of Denmark, extruded the heterogeneous Austrian domination, and, emerging victor from the struggle with France, unified the empire. Aggressive action ensues, as when a new professional man measures himself with rivals; if a nation can invent a new weapon, as a young business man a new process, the chances of success are multiplied. The Phocæans, the boldest of Greek mariners, conducted their trading voyages in armed penteconters, and, gaining a naval victory over the Carthaginians, established the colony of Massalia in what might almost be termed Carthaginian waters. The Corinthians invented the trireme and colonized. Their own colonists, the Corcyreans, were soon able to cope with the mother city on the sea, and then *they* colonized. The Greeks supplanted the Carthaginians. The Romans swept both from the sea, and recolonized the colonies they had abandoned. The Dutch, Spaniards, and French have lost many colonies to victorious rivals.

The surplus energy of a young nation will overflow in conquest or colonization, according to the time. It was after the struggle with the Moors, when Spanish chivalry was set free for new exploits, that Spanish ardor poured itself upon distant colonies. Surplus soldiers in England under the pacific James I, in Scotland after the plundering Borderers found their occupation gone with the Union, and in the same country after 1745, became colonists.

Colonization is precipitated by the maritime character of a country. Phœnicia, Greece, and England are notable examples. Colbert estimated that in 1669 the Dutch possessed a commercial fleet of fifteen or sixteen thousand sail, while populous France had five or six hundred ships at the most. The English and Dutch had a larger naval experience and markets over sea which they had frequented for a century. The Germans have few ports, and till lately have had neither merchant ships nor navy; Germans have accordingly emigrated in English vessels, and there are still few

German colonies. There must be surplus capital, as there was in Holland in the seventeenth century. Scotland had to strip itself of half its savings to equip the Darien expedition. Colonies that arise from the outflow of masculine vigor in these several forms might be called energy colonies.

Stud cattle are kept rather under condition, lean women have most children, and the number of the offspring depends mainly on the fertility of the female. As the feminine elements in a country reach maturity, as there are order within and peace without, the size of families increases, and the population presses on the means of subsistence. Hence statistics show that emigration is greatest in least prosperous years. Periodically, the pressure reaches the point of famine, due to the failure of a crop, or to devastation, or war, or changes in the mode of cultivation. The Greek colonies of Cyrene and Rhegium, those of the Sicilian Mamertines, of Virginia, and of the (English) Cape of Good Hope had this origin, and might be called distress colonies. The emigration after the Thirty Years' War, the long European war of 1793 to 1815, the Irish famine of 1845, and the Sutherlandizing of parts of Scotland, was distress emigration. Normal emigration is determined by the surplus birth rate. With one hundred and seventy-one births to one hundred deaths the United Kingdom is the most emigrating of all peoples, past or present; Germany, with a surplus of sixty-one, has been long the chief emigrant nation of the European continent; while poor France, with her one surplus birth, is in no position to colonize the territories she feverishly annexes. If the foundation of colonies is a consequence of military or naval power, the settlement of them is, therefore, a "function" of the excess of population.

The power to reproduce itself declines in a nation with age, as it does in an individual. Were there space enough, it would be easy to show how all the other signs of old age are traceable in the senile peoples that have ceased to colonize.

III. The *type* of successful emigrant repeats that of the mother country at an earlier stage. In the trappers, hunters, and traders of old Canada and new Oregon—often coarse, audacious, unscrupulous, but possessing endurance, courage, sagacity, and resource—Parkman finds realized "that wild and daring spirit . . . which marked our barbarous ancestors of Germany and Norway." The same type, its good and evil qualities softened by time and a less harsh environment, is still to be met with in colonies of recent foundation. 1. The emigrant must be physically robust. It is the brute forces that are most required when the resistance encountered is often that of Nature herself. Sometimes it is recorded on a tombstone that he who lies below was originally of "iron constitution," broken by the toils of a pioneer existence, and many a silent heroine, the worthy mate of such a settler, has sunk under its privations. 2. The moral attribute most needed is forcefulness of character. Determination and tenacity, often rising (as lately in Rhodesia) into "splendid self-reliance" and devotedness, are the notes of the successful colonist now as ever. Will and not intellect is his *differentia*. 3. Yet high intellect always springs up to meet the demand when new molds of social life are to be framed, and disappears or flows into other channels when the necessity for it vanishes. The group of statesmen who drafted the Constitution of the United States, and the politicians who nursed the Australasian colonies through the perils of infancy, have had few equals.

IV. A polyp will reproduce itself, however small the fragment, if it have within it samples of all the different kinds of cells. A nation, in order to be fully reproduced, must likewise send out representatives of all its essential *classes*. 1. Many princes have migrated to ascend a throne, and two have emigrated—a Braganza to Brazil and a Hapsburg to Mexico. 2. Miltiades colonized Thrace, and one of the Bacchiadæ colonized Ortygia. Counts of the empire settled Davos and other mountain districts in German Switzerland. Hidalgos and other members of the royal household joined the second expedition of Columbus, and many of the members of the third colony sent out in his time belonged to the best families in the kingdom. Rich nobles sold their estates, as their ancestors had done in the time of the Crusades, to follow Cortez to Mexico and Pizarro to Peru. These two waves spent, the inferior nobility alone henceforward emigrated. Representatives of the lesser French nobility, like the Barons Poutrincourt and Castin, with Gascon and Norman cadets, were leading or degenerate colonists in Canada, where also many noble ladies contributed their fortunes or spent their lives in mission work among the Indians. In the seventeenth century a Scottish nobleman (the Earl of Stirling) endeavored to colonize Nova Scotia, and early in the nineteenth another (the Earl of Selkirk) led a colony of fur traders to Red River, having previously made a settlement in Prince Edward Island. Sir T. Temple ruined himself by generous efforts to build up a colony in Nova Scotia, and the story of the gentlemen adventurers in Acadia is long and interesting. Some of them, like La Tour, remained in the colony and left descendants. The so-called "nobility" of Carolina toward the end of the seventeenth century was a mere upper class. Even the Virginians, who have boasted of being descendants of the Cavaliers, are stated by Bancroft to have belonged to the middle class. Yet many of the loyal nobility fled from England after the execution of Charles, and these settled in the Southern States. Penn and Baltimore for a time personally administered the colonies they led. When a genuine enthusiasm excites a whole people, the nobles share in it, and three hundred of the twelve hundred who formed the first expedition to Darien were of the best Scottish families, while some members of the second were Highland chieftains. Several baronets and sons of peers took part in colonizing New Zealand, and a baronet led the Jamieson raid. Only a few years ago an ancient English earldom threatened to become extinct in South Africa through miscegenation. 3. The great middle class, seat of the solid qualities in every country, was long the chief fountain of emigration. It alone, or it chiefly, had the means to emigrate, and the intellectual and moral energy to make the emigrant's life a success. "The immense majority of American families," Bancroft tells us, in both New England and the South, belonged to this class. Far the larger proportion of unassisted emigrants to British colonies during the present century has had the same origin. 4. Now that emigration is comparatively easy, the greater number of emigrants are artisans, laborers, and domestic servants, who thus assimilate colonies to the ratios of the mother countries.

V. Priestcraft did not emigrate, says Bancroft of the North American colonies generally. Yet, when a colonizing enthusiasm takes possession of a community, especially if the settlement is to be formed on church principles, *clergymen* often make great sacrifices to participate. The colonies of New England, Canterbury, and Otago were well supplied. A minister was sent out with the Darien colonists. In ordinary emigrations they are apt to be in defect. A bounty was offered in Virginia to immigrating clergymen. The hard country, the poor pay, the cavalier treatment, and the rough life deter even a "stickit minister." Those who succeed as emigrants are therefore of tough fiber, and possess the hardihood of character needed to hold their own with an untender race. As the colony develops, the more average members of the profession find their way out, and to a late stage in its history the majority in all the professions are of home birth or education.

The author of the Scarlet Letter ascribes the lack of *physicians* in New England to the undoubted materialism of the profession, which prevented them from sharing the impulse to emigrate. But the scarcity was not peculiar to the medical profession, nor was it confined to New England. Surgeons were as rare in French Canada, where "there was not a man who could set a bone." They are equally lacking in young colonies at the present day. The colonists are too few, too scattered, too poor, and too healthy to require or to be able to pay for them. Many a colonial township has starved out a succession of would-be medical residents. Those who thrive are of the rough-and-ready type still to be met with in English country districts—men who have picked up their knowledge in the course of practice, and are better qualified to treat the diseases prevalent in simple than in more advanced communities.

VI. The "male cells are always more anarchic, usually mature before the female elements, and even in plants, and in such passive animals as a sponge or a hydra, burst from the organism, while the female cells remain *in situ*." * It is in accordance with all organic evolution that the male leads and the female follows. Male birds earlier migrate. The first Greek emigrations were exclusively of the male *sex*. Even the organized colonization of Cyrene was womenless. The northern invaders, having fighting to do, were solely men. No women went out with the first expeditions to New Spain. There were few women in early Virginia. There were few in New France for long, nuns excepted. The two colonies sent out to Darien consisted respectively of twelve hundred and thirteen hundred men. It is males that are wanted in a new country. Only men could fight the battle the early colonists have to fight; hampered by women, they would fight it worse or not at all. Heroines like the wives of La Tour, Dupleix, and many an unknown settler are equal to men, but women of a softer stamp suffer greatly and eventually succumb. Nor are they imperatively required; there are native women for the first immigrants, who are not as a rule squeamish. As the conditions assimilate to those of older countries, the proportions change. In a newly settled pastoral country the males are as ten to one. In older pastoral countries complicated with newly discovered mines, like West Australia, they are still as two to one. The emigration to New South Wales in 1831–'37 was of one hundred males to thirty females. The emigration from Great Britain at this day continues predominantly male, but only in the proportion of ten to seven.

VII. The *age* of the reproductive cells must be left in the obscurity in which it lies. Parent birds migrate before the young, but it is probably the more active and the less old of these that are the first to leave. The law remains operative to the last. The first emigrants are fighting or toiling men at their best. As colonial life grows easier, older and younger members of families join the stream. In rare cases an aged father and mother are brought out by a son who has thriven. Still (if observation may be trusted), nine tenths of emigrants are under forty-five, and two thirds of them are under thirty-five. Manhood in its prime and womanhood in its bloom form the core of all emigration. White heads are singular in youthful communities.

* Geddes and Thomson. Evolution of Sex, p. 241.

VIII. The dominant *religion* of emigrants is that of young and aggressive sects. Heretical Paulicians and Waldenses, independent Puritans, self-illuminated Quakers, spiritually minded Moravians, rebel Huguenots and Covenanters, disrupting Free-Church Presbyterians, and High Churchmen advancing to the conquest of the Church of England, have been the successful colonizers. The story of individual emigration has the same purport. Two thirds of the population of Carolina were Dissenters. The Methodists and Presbyterians, and these probably the last hived-off sects of the one and the schismatic denominations of the other, have each emigrated to Canada more numerously than the Anglicans. Australia is predominantly Anglican and (thanks to recklessly administered state aid) largely Catholic, but the Presbyterians and Methodists, Congregationalists and Baptists have all emigrated in higher proportions than exist in England. Of the United States it is needless to write. Within the last fifty years there has indeed been a copious immigration of the oldest of churches, but that from Ireland has been motived by political rebellion and that from Italy by social discontent; while there is probably not a European sect, community, or craze that has not sought a home in the wide, free spaces of the West.

IX. "Hunger is a dominant characteristic of living matter," and the lifelong hunger of the individual protoplasm is repeated in the social protoplasm. Birds and quadrupeds migrate for food, sunshine, and warmth. In a troop of horses or wild cattle a young stallion or bull gathers together a few heifers or young mares, possibly fights a battle with the old chief, then leaves the herd and seeks new pastures. The same thing is said of apes, and might probably be said of all polygamous animals. Monogamous groups drift apart by the mere law of growth. Finally, animals may be driven from their habitats by persecution or violence. All *motives* of human migrations and emigrations are reducible to these five—hunger, cold, lust of dominion, love of freedom, and public or private oppression.

1. Persons of all degrees of competence, from the capitalist who disembarks at Hobart with £25,000 to the quarryman who lands at Brisbane with fivepence, are continually seeking to better themselves. The craving is seen in its crudest form in the gold hunger. "I have come not to till the soil," said Cortez in Mexico, where he was offered a tract of land, "but to find gold." It is more reputable, but is not a whit more honorable, in high financial circles: the Grotes and Goschens, Barings and Rothschilds, who migrate from Holland and Germany to England, are governed by precisely the same motive as the gold digger. The earth hunger ought to be a shade less repellent, and yet the land sharks who infest young colonies are at once less honest and more avaricious. Higher wages and more continuous

employment will at any time attract emigrants. The less successful members of the professions naturally look to new emigration fields. Just fifty years ago a young engineer who was crowded out of his profession had resolved to settle in New Zealand, but, receiving a small apppointment, stayed on in England to become the most eminent philosopher of his age. An ex-Lord Chancellor relates that he and another briefless barrister, the present Speaker of the House of Commons, were at one time on the point of emigrating to "the colonies." Some have their career prepared for them before they start: bishops, professors, certain officials and experts generally, the flower of a nation's culture and of late growth, are regularly exported from England to her colonies, and even to the United States.

2. Human beings are less free to travel than swallows or lemmings, and they can temper a northern winter by warmer clothing, shelter, and fire. But even so there are many English families and still more individuals who regularly or occasionally hibernate in the Riviera, Algiers, and Egypt. Others expatriate themselves for a time or for life. The Brownings made a home in Florence till the lady's death, and Aristophanic Frere endured lifelong banishment in sun-baked Malta. It is usually to warmer latitudes that migrants move who are "ordered south," but Symonds found health in the snow-clad solitudes of the Engadine. Those who emigrate from such motives are more remarkable for quality than number. The statesmanlike organizer of a New Zealand province was a consumptive. Consumption sent Richard Proctor to observe the "larger constellations burning" in the "happy skies" of Florida, and thither also bilingual Edmund Montgomery; to Queensland it dispatched Clement Wragge to found Australasian meteorology. The literary worker whose strength has given way rejoices to have escaped from the fogs and darkness, the cold and wet of a London winter, and feels his sense of well-being heightened in the light air and unfailing sunshine of New South Wales. Not invalids only, but almost all, gain by southing. The Sutherlandizing of the north and west of Scotland excited indignation, and the inflamed imagination of the sentimentalist saw "the heather on fire"; but the Highland crofter who barters his miserable patch in the rainy Hebrides for a farm in Natal or Otago makes a blessed exchange. Whole peoples move southward with the slow, resistless motion of the glacier. The pine tree longs for the palm tree, in Heine's song, and the Russian advance toward Constantinople is doubtless accelerated by the snow and ice of the declivity.

3. Ambition is an old motive for emigration. The Andræmon or Androclus who led a Greek colony to the shores of Asia Minor intended to remain as its *tyrannus;* and so have most of the leaders

of modern colonies, from Columbus to Cargill. Even "celestial minds" are sometimes governed by the primary passion of the male animal in its most spiritual form. Pythagoras, unable to gain hearers or found a school in Samos, emigrated to Croton, where he established the Jesuit order of the ancient world. Xenophanes emigrated from Colophon and finally settled at Elea, which thence gave its name to the loftiest of Greek philosophic sects. The motive is operative everywhere and everywhen. It impelled Aquinas and Scotus from Italy and England to France; urged Niebuhr, Bernstorff, and Moltke from Denmark to Prussia; attracted Rossi, Scherer, and Cherbuliez from Geneva to Paris; and led Boyesen to New York. The fact that an immigrant to the United States may rise to any position save that of President is known to be in the minds of young Germans who seek a freer country than their own. The consciousness or the conceit of ability makes many a youth restless in the narrow environment of a Scottish or English country town, and, learning that push and volubility, as well as genuine talent, may carry a man to high political office in a British colony, he emigrates to become (what some have been styled) a "colonial Gambetta."

4. Freedom is as alluring as power. The artisan who is constantly being involved in strikes of which he disapproves emigrates to a country where trades-unionism is in its infancy. The independence of the colonial workman excites the envy of his English rivals. Staid elderly men look back with regret on the free life of the gold fields. Protestant Irish farmers, of Scottish extraction, emigrated last century to become freeholders in the United States. Frenchmen who have returned to France go back to New Zealand, unable to bear the constraint of overcivilization. The same passion for freedom in higher things carried Puritan and Moravian, Puseyite and Free-Churchman oversea for liberty to worship God in their own way. Enthusiasm for political liberty took Forster, Paine, and a crowd of dupes to France after 1789. The same feeling sometimes makes men retire from the world. Ulysses hoped to "touch the Happy Isles." Hamilcar Barca longed to escape from the turmoil of Carthage and sail for the fabled islands of Atlantis. Shelley, Tennyson, Mrs. Browning, and many plainer folk have cherished the same lotus-eater's dream. The disillusioned ex-governor who returns to spend the evening of his days in a Pacific paradise within the waters of the colony he once ruled is a type of the few who realize it. Do they always find the peace they seek?

5. Public and private oppression has made many migrate or emigrate. The Ionians and Syracusans who were driven westward by subjugation or sedition had no choice. The conquest of their

country before and after the fall of Byzantium in 1453 scattered educated Greeks over Italy and so cross-fertilized modern Europe. "The vices of European governments colonized North America." The revolutions of 1848 sent Follen to the United States and Foscolo to England. The *coup d'état* of 1851 had similar effects. "The great silence of the empire," as Zola calls it, which made it hard for liberals to earn a living, diverted Jules Simon into publicism and politics, and drove another eclectic, his friend Amédée Jacques, to seek death in South America. The conscious oppressiveness of an aristocratic system of government made Goldwin Smith a Canadian. Private persecution, which pursued Byron to Venice, chased the younger Arago to South America. Disappointment sent an unappreciated poet, Charles Wells, to lifelong exile in France, took George Brandes to Berlin, and has taken many to the colonies. Defeated men used to retire to the cloister. They now migrate or emigrate.

X. The earliest *mode* of emigration—that of roving adventurers on the seas—might be assimilated to the spawning of fish or the effusion of the male element generally. It is exclusively masculine, and retains this quality to the last in the person of every emigrant who embarks for a new country at his own expense, there to make a living in ways of his own. It soon takes on a partially assisted character in the equipping of the ship by home merchants. These develop into commercial or colonizing companies, which acquire (or seize) colonial lands from the natives, and then send out emigrants who buy land from the company, together with artisans and laborers whose passages are paid for them. Such emigration might be described as mixed masculine and feminine, and this form long continues. There is a third stage where (as in England after 1830) philanthropic associations dispatch pauper or partially assisted emigrants. The third is supplemented or superseded by a fourth stage, when a colony sends for immigrants, wholly or partly defrays their passage, and provides for them on their arrival. This least independent method of emigration, as the antithesis of the earliest masculine mode, may be considered exclusively feminine.

Emigration, like the migrations of animals, is *collective*. Though the vast Aryan migrations, so ingeniously charted by Pictet, may prove mythical as well as legendary, authenticated mass movements occur all through history. The earliest emigrations were of small accidental aggregations without adhesion. The next were great organized bodies. The emigration in our own days, of individuals and families who go out to kindred or friends, is really group movement of a highly organized character.

Like the lower migrations, emigration is rhythmical. The burst of Greek colonizing activity which peopled Italy and Sicily was followed by a pause of forty years. After the Puritan exodus there was no emigration to New England for nearly a century. The rush to the Australian gold fields more than doubled the population in ten years, and then fell permanently to half. An eloquent propaganda sent a tidal wave of emigration to New South Wales in 1861–'63, only to sink in just the same space of time to its former level.

Migration and emigration are alike *periodic*. Swiss cowherd and Lapland deerherd, French workman and British invalid migrate only for the season. Fishermen emigrate for the season. Most of the first emigrants to new colonies intended to return, and many of them did and do return, but ever fewer with successive years. They compensate for this ascent above the animals by being migratory within their new area. Americans and Australians, New-Zealanders and South Africans have no homes.

There is a heightened temperature in plants before flowering, in lower organisms before budding or fission, in the lower animals at pairing, and in human beings during courtship. So is there among peoples at great colonizing periods. A "fever of emigration" partially depopulated Spain after the discoveries of Columbus and again of Balboa. The settlement of New England and Pennsylvania was preceded by growing and widespread, if subdued, excitement. Three successive waves of colonizing enthusiasm swept over England and Scotland in the forties. The gold rushes to California and Australia in 1847–'51, and the milder sensations of Kimberley and the Transvaal, Coolgardie, and Klondike, partook of the same character. And still, in some remote Swedish village, an emigrant to the United States or Australia will create a "fever" by the tidings he sends home of success or better days. Then it gets into the blood, and they can not stay. A "colonizing fever" is admitted by observers like the Duc de Broglie to reign at present in France, and is alleged to exist with equal intensity in Germany and Italy, while it is said to be redoubled in England, where it is normal and in the temperament.

At efflorescence, fission, budding, and parturition there is a "disruptive climax." So is there in colonization and emigration. Esquiros has given a pathetic account of a visit to an emigrant ship at the London docks. William Black has described, and some artist has painted, the departing Highland emigrants as they sing Lochaber No More. As the white or the dark cliffs fade, the lump rises in the throat, the eyes fill with unwonted tears, and those who are gifted that way break into verse. Byron's wild Good Night!, Edward Bliss Emerson's melancholy Last Farewell, Hugo's vicarious Sea Song of the Exiles, and Australian Gordon's Exile's Farewell give moving expression to universal feelings. It is, in truth, a "terrific wrench." To leave (forever, as it may seem) the happy scenes of childhood and youth, associated with all the sentiments of the prime—its golden dreams and first love, the growing passion for knowledge, the dawn of religious faith, visions of wider horizons, the stirrings of ambition and the hopes of future usefulness—and to settle in a new, strange land, perhaps half inhabited by savages and but partially cleared, with incredible wooden houses and many things still in the rough, is a unique experience. The psychologist in search of fresh material for his much too impersonal science might be (but is not) advised to cultivate the sensations of the immigrant who lands at the antipodes and doubts whether he is rightly perpendicular. A cry of joy leaps from him as he first hears and then sees the skylark mount, and feels that, after all, he can not be far from home. But it is long ere he is thoroughly acclimatized, and if he has emigrated late there is to the last a consciousness of "something wanting."

XI. Animal and human migrants follow the southing sun. Swallow, lemming, bear, and wolf are forerunners of the Auvergnese, Switzer, and Laplander who descend from mountain to plain as winter approaches, and of the invalid who seeks the sunny Riviera or the rainless Nile. The first Spanish and Portuguese colonies were planted on the same southerly slope. Then Europe spread its wings for a bolder flight, and the drift of emigration has since, as it mainly had ever, been toward the setting sun. Yet the *direction* is by no means uniform. The Hellenic migrations poured downward through Greece and, overflowing into the Ægæan islands, colonized Asia Minor. The Hellenization of Asia by Alexander was a movement toward the east and south. The Gauls marched eastward to Galatia. A regression of the Teutonic race under Charlemagne in the eighth century founded the two great German dynasties of the present day. The Crusaders, Venetians, and Genoese conquered and colonized eastward. The largest wave after the American has taken a southeasterly course to Australia. Smaller streams of French, Italians, and Spaniards flow to Algeria and Tunis, and a mixture of nationalities to Madagascar, while East Indians pursue nearly the orthodox line to Guiana and Mauritius, or diverge to the Straits Settlements and Fiji. An increasing volume of emigration is being directed south and southeast to South Africa or due east to China. But these will prove only eddies and backwaters in the steadily westing current. It will be by America that the European nations will return to their fabled birthplace.

While the drift is apparently overmastering, the exact direction is often, as with birds, a matter of accident. Tyrians were driven to Cadiz, and Greeks to Libya and Sicily, by stress of weather. Columbus struck Hispaniola on his imagined way to India. Hudson embarked on a Saul's voyage in search of a northwest passage and found New York. Fishermen were blown south to the Canaries and west to Newfoundland. The settling of Plymouth was an accident of the weather, and of Virginia and Botany Bay an accident of discovery.

Yet accident plays its Darwinian game within narrow limits. Deep affinities and irresistible magnetisms mark out the paths of emigration. 1. Colonization follows discovery at unequal intervals. It followed that of South America instantaneously; more or less successful attempts at it in North America were at no great distance. The Cape of Good Hope was colonized by its discoverers, the Portuguese. Dampier discovered Australia in 1688, but it had to be rediscovered and explored by Cook eighty years afterward before it was settled in 1788. The colonization of New Zealand took place half a century after its discovery. 2. Distance is the primary factor in determining the order of colonization. That South America was settled before New England was partly an accident of discovery, but, once it began, the stream of emigration flowed and still flows in far greater volume to the nearer colonies. Out-of-the-way South Africa has not until lately allured emigrants, and the remoteness of Australia and New Zealand has all along deterred them. 3. Attractions and repulsions, the grosser they are, govern the quantity of emigration and, as they rise in the scale, determine its quality. (1) The precious metals have been the loadstone of more immigrants than all other causes put together, and the attraction is independent of climate, distance, or accessibility. (2) The virgin soil of one colony, which yields eighty bushels of wheat to the acre, is a potent inducement to the solid agricultural class, while the infertile land and almost rainless skies of another have barred settlement. (3) The aspect and climate of Delaware were painted to the Scandinavian imagination as a "terrestrial Canaan," and this is still a stock-topic with emigration lecturers. (4) The savagery of the indigenes long checked emigration to North America and South Africa, and dispersed one New Zealand colony. (5) Leaders like Cortez and Rhodes draw crowds, and Puritan congregations followed their ministers across the Atlantic. (6) Cruel laws made Virginia unpopular in the eighteenth century, feudal exactions drove immigrants from New York, and the "peculiar institution" has at all times repelled them from the Southern States. (7) Personal, political, and religious liberties invite the best and the worst—Roger Williams and Hayraddin Maugrabin. (8) The prosperity of a colony and (9) the greatness of a country, like that achieved by the United States in the War of 1812, constrain immigration. 4. Not accident, but deep affinities, have guided the northern Europeans to North America, Australasia, and South Africa, the southern Europeans to South America and North Africa. In these *officinæ gentium* new types will be generated by the fusion of allied varieties. And, finally, it may be that, in the primeval seats of mankind (if such there were), these new types will be themselves reblended into the one original race from which they sprang, but now immeasurably stronger, wiser, happier, and better.

Emigration is thus at first exclusively, and to the last predominantly, masculine in all its aspects. It is conducted by the heroic strand of humanity, the manlier races and their most vigorous sections; by these at the emergence of national manhood; by individuals of a strenuous type by the masculine classes and professions, aggressive religions, the male sex, and at the age of maturity; they are long actuated by the motives that govern the male animal; the earliest agencies are the spiritualization of the male mode of propagation, and the direction is at the beginning that of greatest attractiveness (as of a bride) and latterly the line of least resistance (as if toward a bridegroom). The feminine races, ranks, professions, sects, and sex—feminine elements along the whole sociological scale—join one by one in the fugue, and make at length of each colony a complete reproduction, yet with new attributes, of the mother country.

Secretary Langley, of the Smithsonian Institution, reports that while the bison has been decreasing in the somewhat unfavorable locality of the Yellowstone Park, some increase has occurred in other parts of the country. A part of the great northern herd has been isolated near Ronan, Montana, and a remnant of the southern herd continues to be maintained in the Pan Handle of Texas. The secretary observes that Texas contains many animals that would be of advantage in our national zoölogical collection. Several of the Mexican species of deer range in this country, and many distinctively Mexican animals, such as the peccary and the jaguar, occur, while on the plains are found wild horses; and there are even a few camels running wild in some of the more inaccessible parts of the country, relics of a herd imported many years ago.

In a paper on "Popularizing Astronomy," read at the eighth annual meeting of the Astronomical and Physical Society of Toronto, Mrs. George Craig dealt with the subject of establishing an observatory which would, under certain regulations, be open to the public, and be used for general observations of the beauties of the heavens rather than for special study of particular objects. She thought it would be comparatively easy to obtain money for such a purpose. Her scheme was considered decidedly opportune, and the society decided to take up the matter during 1898, and make special effort toward carrying it out.

THE AURORA.

By W. FARRAND FELCH.

"Low on the horizon, beyond Durdham Down, were streaks of white light, wavering spokes and flaring lines and streamers, flushing into faint rose pink. Could the buried sunlight still be felt so late into a night of May? Soon, by quiverings and motions in these signs—for the west darkened, and flames burst forth among the topmost stars, and toward the east ran swords, stealthily creeping across the heavenly spaces—I knew that this was an aurora borealis. The pageant rapidly developed, and culminated with dramatic vividness. At the very zenith, curving downward to the Great Bear, there shone a nebulous semicircle—phosphorescent, with stars tangled in it. From this crescent of light were effused to north and west and east rays, bands, foam-flakes, belts, spears, shafts of changeful hues, now rosy red, now brightening into amethyst, now green, now pale as ashes. The whole was in slow and solemn movement, like lightning congealed, which has not ceased to throb. As glaciers are to running water, so were these auroral flames to the quiverings of lightning. In the midst of all the glow and glory sparkled Ursa Major, calm and frosty. Other stars seemed to wander in the haze, as I have seen them in a comet's tail. The most wonderful point in the pageant was when the crescent flamed into intensely brilliant violet. Then it faded; the whole heaven for a few moments flushed with diffused rose; but the show was over. That supreme flash recalled the pulsing and rutilant coruscations with which Tintoretto spheres his celestial messengers. I could have fancied the crescent and its meteoric emanations to have been the shield of an archangel."—*In the Key of Blue, by* JOHN ADDINGTON SYMONDS.

I.

THE public was startled the other day by the announcement that Tesla had discovered a means and manner of telegraphing through space without wires, and that he had, by eight-foot flashes, so influenced the electricity of the earth that it would be felt all over the globe. This is an important discovery, if true—a revelation, now, that will be a revolution in the world of ideas. It may not be out of place to study these tremendous earth currents in their only visible form—the aurora. The subject certainly merits more than a transient treatment.

One of the latest issues of The International Scientific Series, which has now grown to seventy-five or eighty volumes, is entitled The Aurora, and is written by M. Alfred Angot, honorary meteorologist to the central meteorological office of France.

If one wishes an accurate account of the vicissitudes of starting and supporting this splendid series, and of educating the American public to receive and appreciate it, one has only to read John Fiske's admirable biography of the late E. L. Youmans, the pioneer of the movement not only in this country but abroad. To him are we thus indebted for an introduction to the works of Darwin, Huxley, Spencer, Tyndall, Bain, Balfour Stewart, Maudsley, Jevons, Lockyer, Quatrefages, Luys, Vignoli, Lubbock, Romanes, Ribot, and many others in this country; as the editor of the Popular Science Monthly for years Mr. Youmans was entitled to no small commendation for his capable work; but, more than all, to greater credit for the good he has accomplished in this series than has ever been tendered him.

In the present work we have one of these inimitable special *brochures*, which appeals to a small circle of readers, but it proves none the less interesting for the general reader. The author begins with the history of the aurora borealis—so called in contradistinction to the aurora australis of the south pole—and cites mentions of it by Aristotle, Cicero, Pliny the naturalist, Seneca, and Gregory of Tours. It is shown by these writers to have been an object of superstitious

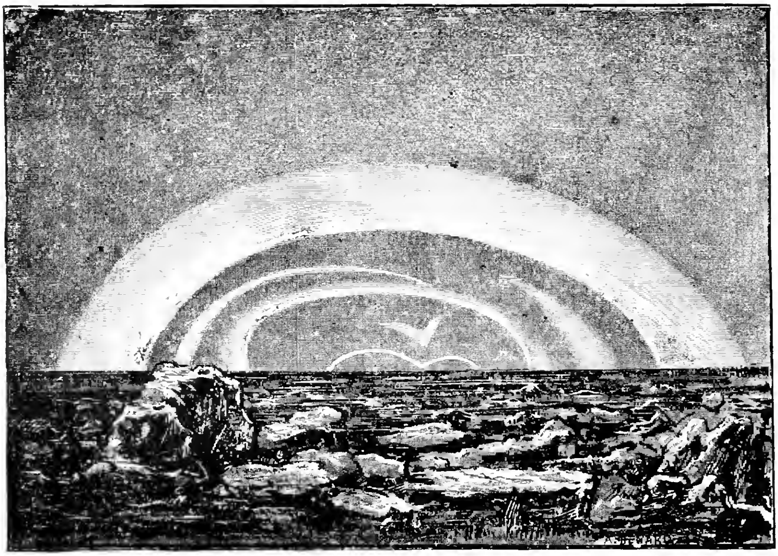

Fig. 1.—Wintering of the "Vega." Elliptical Arcs.

dread and terror, even down to the seventeenth century, no one being capable of understanding the nocturnal miracle then. For that matter, only the educated few understand it now. But it is no longer a dragon, a harbinger of woe, a pet terror for homilists and prophets, the Valkyrie of the Norse Eddas, nor a reflection of fire that surrounds the north pole or emanates from a polar cavity or from the interior of the earth at that point—which Nansen possibly just escaped, and Andrée is probably now experiencing! One Danish writer, who called it "the King's Mirror," and wrote a work with that title in 1250, thought the aurora was "produced by the ice which radiates at night the light which it has absorbed by day." Since 1621 it has been called aurora borealis by scientists, or in popular parlance "the northern lights" or "streamers." It is "*nordlicht*" in German, "*nordljus*" in Swedish, and "*nordlys*" in Danish, all meaning northern lights.

The aurora in its most varied and interesting forms is either motionless or rapidly and incessantly scintillating. Of the first class there are three forms: (1) Faint lights without very defined form; (2) more distinct, in patches or clouds; (3) clearly defined arcs touching the horizon at either end. Of the second or moving class there are: (4) irregular arcs, formed of intermittent rays; (5) rays isolated from each other at a greater or less distance, converging to a fixed point in the sky, and sometimes forming around this center a crown or glory; (6) non-homogeneous bands, formed of rays pressed close together, which have not all the same degree of brilliancy; sometimes these bands fold over on themselves, becoming draped auroras, the most beautiful of their manifestations, aside from the boreal crown.

It sometimes happens that these arcs, instead of being circular, are distinctly elliptical; the two curves which form the upper and lower edge of the arc may or may not be parallel; sometimes, instead of a single circular arc, there are two, three, or four arcs, all perfectly concentric. Multiple striped arcs are not uncommon. Stars have been discerned through the rays, as also through the arcs, proving their extremely diaphanous character.

The chief characteristic of the auroral rays is their extreme variability. They are subject to two kinds of movements: the lateral or sidewise, and the longitudinal or upward; both movements are very rapid. A ray in twenty-seven seconds covered a distance of ninety degrees, or half the heaven, in one instance. At times a ray remaining nearly in the same place is seen at the upper extremity to dart toward the zenith or lengthen itself upward. At other times it rises and falls alternately, vibrating, and it is then said to dance. By sixteenth-century writers these rays were called "leaping goats" and "flying fires"; such rays are still known in Canada as "marionettes," and in the Shetlands as "merry dancers."

The direction of all the rays passes, as a rule, close to the magnetic zenith of the locality, or may radiate therefrom, as we have seen, forming a crown; the center of this crown may be either luminous or obscure. At certain moments the rays which compose this crown or glory enter into rapid movement, become very brilliant, and take on, instead of the usual yellowish-white color, vivid tints of red and green. This is one of the finest auroral effects, if not the finest. When one of these crowns forms in the midst of an already existing aurora, all the other lights of the aurora pale, to reappear when the crown is dissipated.

So much for the forms of the aurora. Now as to the colors. The slow-moving forms are white, lined with yellow, milky and difficult to define. Rose carmine is the next most noticeable color. In the rapid-moving arcs, crowns, wreaths and draperies, the center is usually yellowish, one extremity red, the other green. The red is almost always toward the lower part and also in the direction to which the ray moves, while the green is above and behind. For instance, if a ray darts down from a crown, the lower end will be red, the upper green. These colors will be very brilliant; when the red is very brilliant, the green is as intense. The red remains longest and fades last, when fog obliterates the aurora finally.

Our author, it will be seen, is a close observer, and furnishes reasons for all his deductions. He has discovered that the brilliance

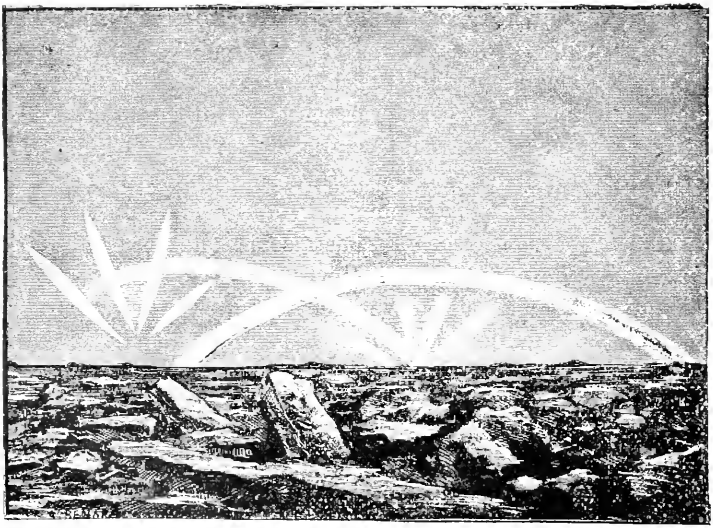

Fig. 2.—Wintering of the "Vega." Multiple Arcs with Different Centers.

of the colors bears a definite relation to the state of the atmosphere. In high latitudes, Sir John Franklin, McClintock, Weyprecht, and others aver that the coloring of the aurora was less strong when the air was very pure, and increased when it became foggy. The fine drapery forms are generally seen where seas are open in winter, free from ice, hence subject to fogs, as in Norway, Spitzbergen, and Newfoundland.

The light from auroras is very feeble; only a few lines of print can be read; while by the light of the full moon this is easy. The intensity of the aurora rarely exceeds the light of the moon in her first quarter, even in the arctic regions; this is corroborated by Parry, Kane, Hayes, Nordenskiold, and others. Auroras are less frequent in the full of the moon, paling in her effulgence, which drowns the auroral display; but some of the brightest have been seen at full moon. Some have said that auroras could be seen in daylight, but this sounds like a ghost story.

It has been almost impossible to photograph the aurora, although in the winter of 1882–'83 a Swede at Spitzbergen claimed to have secured a faint image in eight minutes and a half. This was done before access was had to the orthochromatic plates, color screens, or lightning emulsions of to-day.

Some observers claim that the stars scintillate less when seen through an aurora; but this is caused, according to Montigny, by the presence of fog. On the contrary, it is clearly proved that the scintillation increases during any magnetic disturbance, even when the latter is not accompanied by an aurora.

As to the study of the nature of the light of an aurora there are two methods: by the polariscope and by the spectroscope. By the former it is easy to recognize whether it is a natural light emanating from a self-luminous body, or whether it reaches the eye after undergoing one or more refractions or reflections. Biot, in 1817, in the Shetlands, could not discover the smallest trace of polarization; this has been confirmed by Macquorn, Rankine, and Nordenskiold, and proves that the light of the aurora is not, like that of rainbows and halos, the result of reflection or refraction, but is itself luminous.

This important discovery is confirmed by the spectroscope. If the light emanating from a solid or liquid incandescent body is passed through the spectroscope, the resulting spectrum is continuous; if, on the contrary, the source of the light is gaseous, the spectrum is composed of a certain number of bright lines or stripes separated from each other by dark intervals. The number, the position, and the brilliancy of these bright lines depend upon the chemical constitution of the glowing gaseous body. The spectrum of the aurora was studied by Angstroem, in 1866, for the first time, and is essentially a spectrum of lines, hence gaseous by nature; it can not, therefore, be due to a reflection of the light of the sun, as has been supposed. The spectrum of the aurora runs the gamut from red to yellow, green, blue, and even violet, the last line of the spectrum having been seen but once, by Lemstroem in Lapland. Some of the lines are very similar in position to the spectrum of the electric spark or of lightning. The fourth line has not been found in any known body, and Angstroem attributes it to phosphorescence or fluorescence. For instance, oxygen is phosphorescent, and there is an abundance of ozone created by the aurora. A drop of sulphate of quinine has been made luminous by the action of the rays of the aurora, and so also has the double cyanide of platinum and potassium.

But, although we are getting nearer to the truth as to the nature of the auroral light, it is not yet clearly known. There is also as much dispute as to whether any sound accompanies the aurora. The northern nations believe in the existence of this sound, like the rus-

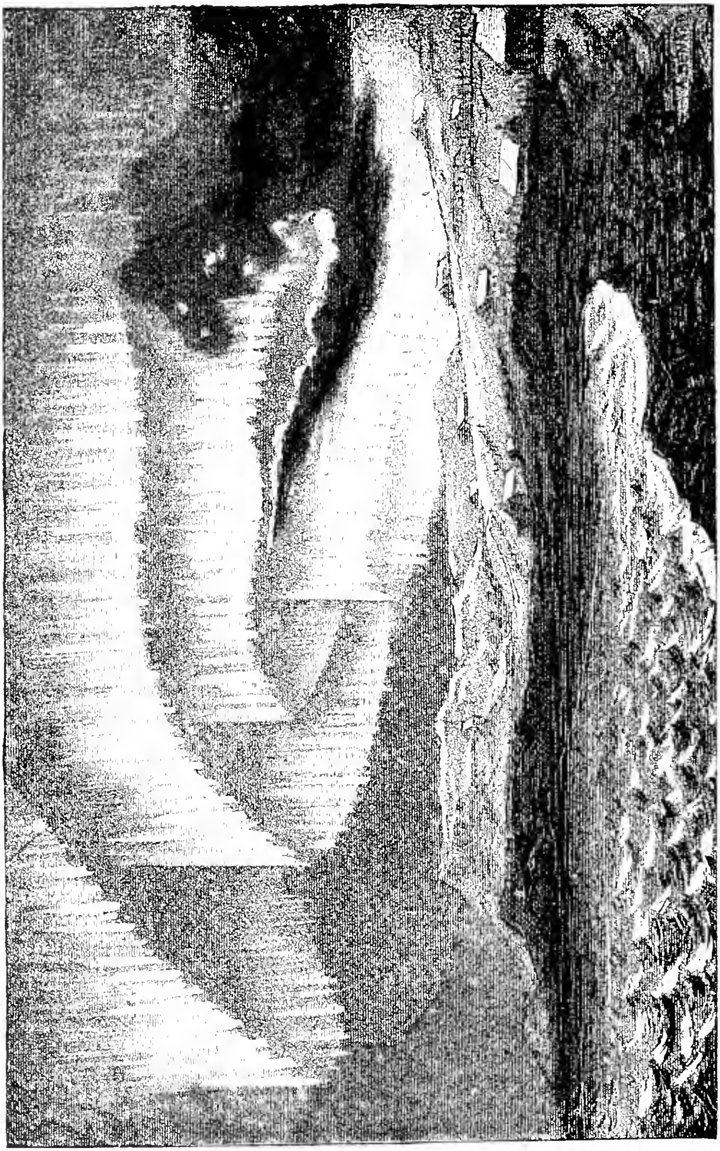

Fig. 3.—Bossekop. Draped Aurora.

tling of silk or of straws, a "crackling" coinciding with the darting of the rays. This also is not well proved. In arctic regions it is probably confounded with the incessant crackling of fields of snow and the faint clicking of small needles of ice in the process of their formation. In 1870, the aëronaut Rollier, escaping from besieged Paris in a balloon, landed in Norway, and he claims to have heard a persistent sound the whole time he was in a certain cloud, accompanied by a strong odor like ozone, very irritating to the bronchial tubes. A fine aurora was observed at precisely that time. Bergmann compared this odor to that of sulphur, and Trevelyan to that of electricity (?).

It is not necessary, at this juncture, to enter into a discussion of the extent, position, or periodicity of auroras, nor their relation to sun spots. But some new facts may be added that are valuable. There is a close resemblance between certain effects of the aurora and cirro-cumulus and cirro-stratus clouds, which are the highest clouds; so that it is difficult to tell whether a given effect is due to real auroral light or to these high clouds lit up by reflected light. Sometimes these bands of clouds stretch out in long parallel lines; again, they are due north and south and lie parallel to the needle of the compass, and are then called "polar bands." It has been discovered that when these polar bands occur during the day an aurora follows that night.

As long ago as 1580 and 1590, Tycho Brahe observed that the appearance of these polar bands and halos coincided with the presence of spots on the sun. Klein, in our own day, comparing twenty-five years of observations made with the greatest care at Cologne by Dr. Garthe, has confirmed the fact that these high cirrus clouds and polar bands follow as to their frequency the same laws as the spots on the sun; they succeed each other or even coexist. Many observers of the aurora are of the opinion that the appearance of the aurora depends on the presence of these clouds in the sky, which are in turn due to magnetic disturbances of the earth's photosphere originating in the sun spots. There are other evidences that the aurora is intimately connected with material particles in the atmosphere, like clouds and fog; for instance, when two or more rays in an aurora cross, the light is augmented, or when an aurora makes a fold on itself as in drapery forms, showing that there are two material "thicknesses" of the substance; moreover, the wind also acts on the aurora, which is torn after a tempest, showing that the wind has acted upon luminous clouds which are part of the aurora; finally, the presence of clouds seems to favor the formation and development of auroras. So there is an intimate relation between them.

II.

The rare phenomenon, St. Elmo's fire (balls of fire alighting on ship masts and spars), is frequent during auroras, but this is about the only form of electric disturbance of the atmosphere occurring during auroras. Andrée, in 1882–'83, at Spitzbergen, with a Mascart electrometer, found that before an aurora appeared the positive electric potential of the air diminished rapidly, and even became negative, as usually happens when it rains; but as soon as the aurora appears the potential takes as before a high positive value. But it must be remembered that the electric potential of the atmosphere, especially at a short distance from the earth, varies constantly in an abrupt and irregular manner; so that it would be imprudent to assume any coincidence, even during an aurora.

Auroras seem to depend for their form and position in space on the distribution of magnetism on the surface of the globe. The appearances of auroras coincide in the majority of cases with magnetic disturbances on the earth's surface. The auroral arc generally has its summit near the magnetic meridian, where the compass needle points. The force which governs the auroras appears to be the same which the magnetic needle obeys. In general, the point where the rays converge in auroral crowns, the center of the crown, is near the magnetic zenith. The variation, in fact, in such instances is but one degree, which may be allowed as the amount of probable error in observations.

The conclusion is, therefore, that the earth's magnetic forces certainly play the most important part in the auroral display. The arcs or "bands" are nearly perpendicular to the magnetic meridian, and the direction of the rays parallel to the magnetic needle. The deviations from these rules are due to atmospheric conditions of temperature and humidity. The electric discharges which constitute the aurora borealis encounter all sorts of conditions of the atmospheric strata which are unequally conductive; hence lack of symmetry in the auroral displays. Meteorological conditions very likely influence not the production of the aurora, but its form and position. There is an intimate relation, as we have already pointed out, between the weather and these magnetic disturbances.

The magnetic needle sometimes begins to be agitated an hour before the appearance of an aurora. The magnetic disturbances last a long while, often for twenty-four hours. Motionless arcs and faint auroras do not affect the magnetic needle sensibly, while, during an active aurora, which is apparently nearer, the needle is greatly agitated, especially when the great red and green rays flash suddenly like lightning.

Arago has shown that if the aurora seems to be absent during magnetic disturbances, it is often because it is too distant, or below our horizon, and visible only in more northern latitudes. In the arctic and antarctic regions there is small deviation of the magnetic needle, but this is considered due to the great height of these auroras, while local auroras are nearer the earth, of small extent, and due to local disturbances.

Telluric currents, passing along telegraphic wires, communicating with the earth at both ends, are visibly and often violently affected

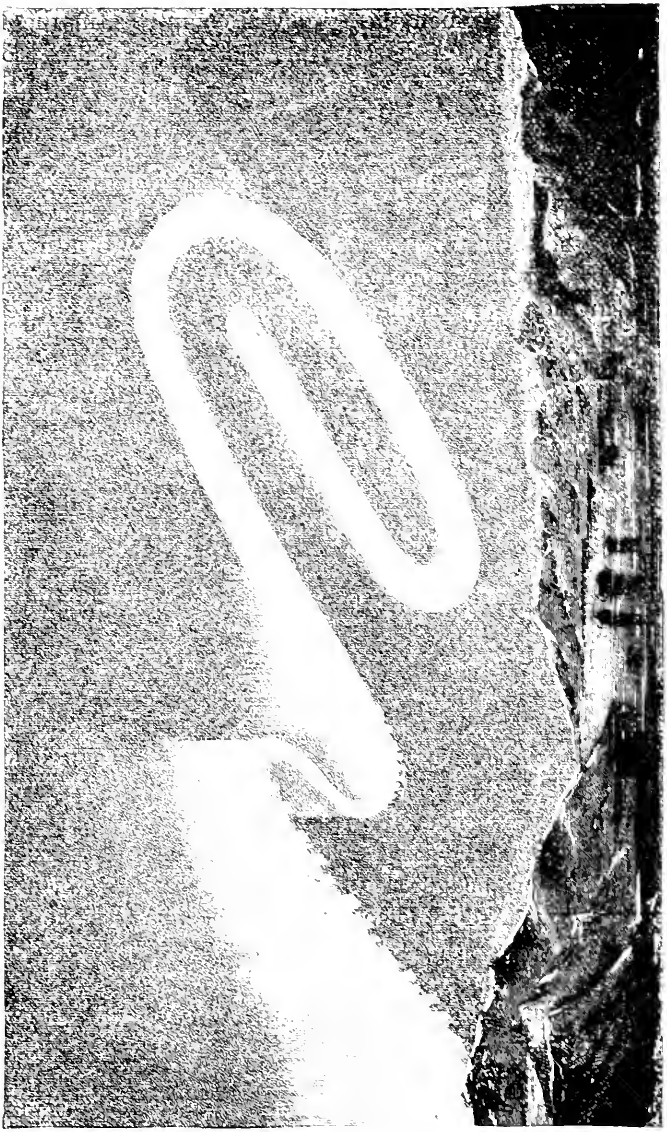

Fig. 4.—Bosselkop. Draped Aurora with Hook.

during an aurora, setting electric call-bells ringing, preventing the transmission of messages by throwing the mechanism out of gear, and often proving a source of positive danger. This is not due to, or during, a storm. The telluric currents cease when one end of the line is isolated; they are only manifested in single lines which have their return to the earth, but they may affect submarine cables, and they vary in direct ratio with the length of the line.

Balfour Stewart, in 1869, compared the earth to the center of a Ruhmkorff's coil, of which the circuit is completed in the higher strata of the atmosphere. Electric movements are hence produced in these higher strata when terrestrial magnetism or the telluric currents undergo rapid variations.

The aurora is supposed to be a purely terrestrial phenomenon, without regard to outside influences. The position of the earth in its orbit has no influence on the movements of the aurora. The movement of the earth from east to west is not the prevailing one of the aurora; the inverse movement is more frequent.

The magnetic theory of the aurora must now yield to the electric theory of its cause. We hope to show in a future paper the intimate relation of magnetism and electricity, but the subject is too vast at this juncture to examine. Halley, in 1716, thought the aurora due to luminous magnetic vapors, but electro-magnetism was then unknown. Dalton, in 1793, and Biot, in 1820, thought it was produced by ferruginous particles in the air, the dust of volcanoes, like that which caused the "red sunsets" several years ago from a volcanic eruption in Java. Van Baumhauer, in 1840, thought auroras due to the fall of cosmic dust, becoming incandescent when it entered the earth's atmosphere, as in the case of meteors and falling stars. Toeppler, as late as 1872, supported this idea, and even supposed the halo around the moon due to the same cause.

The electric theory seems destined to supersede the cosmic, optic, and magnetic theories. Canton, as early as 1753, pointed out the close analogy between auroras and the light of electric discharges produced in very rarefied air; he recognized also the fact that a tube of such air becomes luminous when moved about near a charged conducting body. In his view the aurora was but the form which storms take in polar regions. So far he was very nearly correct.

The ideas of Canton were adopted by Priestley, Eberhard, Frisi, Pontoppidan, Benjamin Franklin, and others, but without making much progress. A very similar opinion was adopted by Fischer in 1834, whose theory was that auroras were caused by electric discharges due to the positive electrization of the atmosphere; these discharges being produced at the moment when the electric equilibrium is re-established between the atmosphere and the earth, by the intermediary of particles of ice floating in the air. This was followed by the theories of Dove, de la Rive, Lemstroem, and others, the latter producing on a Holtz machine electric discharges which electrified rarefied air in Geissler tubes.

Another theory, proposed a few years ago by Edlund, seems nearer the truth than any yet propounded. He began with the phenomena of unipolar induction, discovered by Weber. This is the name given to those currents which arise in each half of a metallic sheath which surrounds a magnet when the sheath is rapidly revolved around the magnet. It is known that the general phenomena of magnetism can be satisfactorily explained on the hypothesis that the earth is a magnet with two poles. The earth rotating on its axis is similar to the sheath, and unipolar action is induced.

Edlund shows that a molecule charged with positive electricity, taken on the surface of the earth, is subjected to two forces: one, from below, driving it upward into the air; the other force, perpendicular to the first, drawing it toward the nearest pole. The first movement is in full force at the equator and nil at the poles; the other is nil at the equator, increases with the latitude, and is again nil at the poles. The tendency is then for the electrified molecule to rise in the atmosphere, thereby accumulating a store of electricity in the higher atmosphere, the movements thence tending toward the poles. As rarefied air and gases are good conductors, being like a vacuum, the electricity will find little resistance at the poles, in returning to the earth. It can either return in disruptive discharges like storms, or in slow discharges in the form of continuous currents, as in the polar aurora. The vertical force is here nil. The electricity of the atmosphere generally re-enters the earth before it reaches the poles, producing local auroras. In polar regions the tension or attraction is much stronger, the flow downward more rapid, having only to overcome the resistance of the air, hence producing greater displays.

Edlund's theory satisfactorily accounts for (1) the direction of the rays of the aurora; (2) the frequency of auroral crowns; (3) the zone of greatest frequency being in polar regions; (4) the deviation of the summit of the auroral arcs from the magnetic meridian (which does not coincide with the geographical meridian); (5) the accidental deviations caused by atmospheric conditions, clouds, humidity, and temperature, that cause curtains, draperies, cirrus effects, etc. This theory seems of all others the most tenable and credible, and should be retained, at any rate for the present, until a more plausible and satisfactory one can scientifically be adopted. It explains clearly the occurrence of polar auroras which are simple, and less reasonably the auroras of immense extent covering two thirds of the globe. These are always accompanied, as we have seen, by marked magnetic disturbance and telluric phenomena, which are probably more active as causes than the Edlund currents. It is natural to suppose that any variation of the earth's electrical equilibrium or potential would tend to draw down the atmospheric currents. Here would come in the action of the electrical currents which coincide

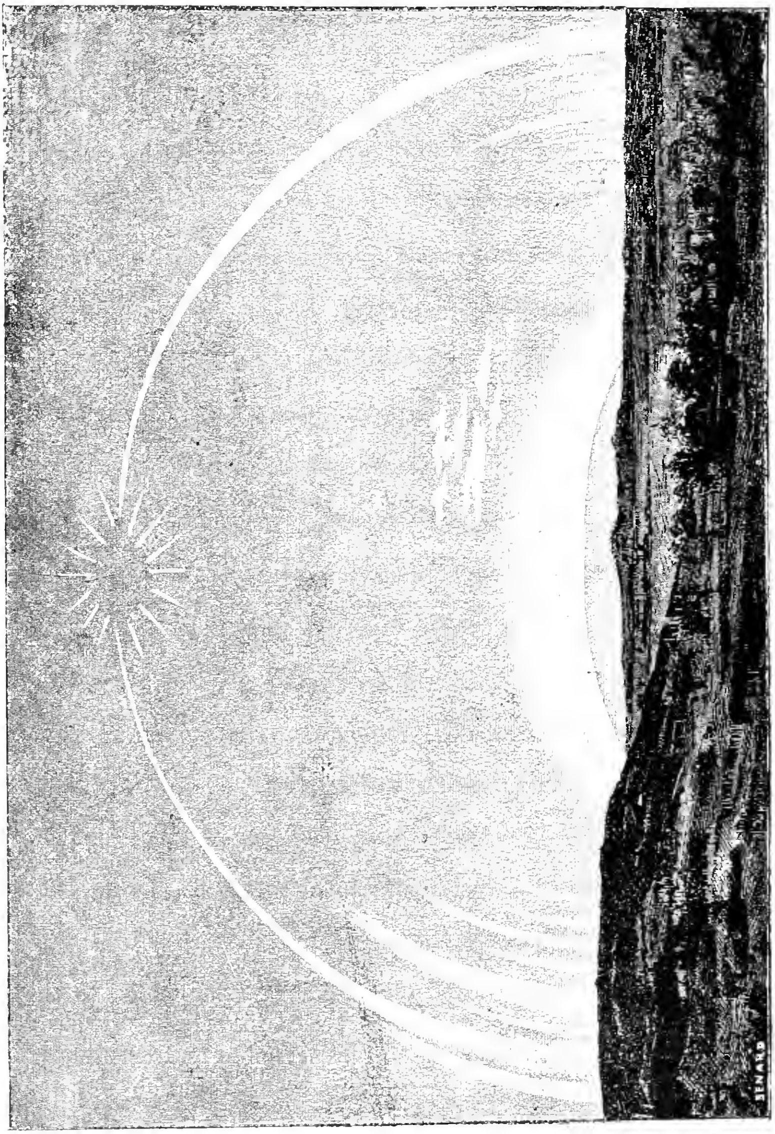

Fig. 5.—Melbourne. Aurora with Arcs and Corona Australis.

with sun spots, and which undoubtedly produce electric storms in summer and auroras in winter. Magnetic disturbances and telluric currents have a known relation to sun spots; so also must the aurora in its secondary widespread form.

This theory accounts for nearly all the points on which there is now any uncertainty. There only remains the spectroscopic side of the subject, as intimated, to account for all the lines in the spectrum of the aurora. The yellowish-green line (the fourth in the spectrum) to which we have referred is only found in the "zodiacal light" which travels along the zodiac at certain times of our year. But while there is otherwise no identity between the two forms of light, this would indicate an intrastellar or supermundane source of both lights. So it is very probable that cosmic causes, foreign to our globe, may determine on our globe the production of the aurora. We have dwelt in other papers on the influence of the sun spots, so it is not necessary to revert to them, except to confirm our previous theory and impressions. These phenomena all appear to obey the successive phases of solar activity, and the electric theory of the aurora fully accounts for their relation to each other. If sun spots can cause a widespread action of the aurora in polar regions, why can they not induce magnetic disturbances, electric storms, and all the fury of tempests in temperate regions, acting along exactly the same lines of current, only deflected sooner to the earth than the rays of force which reach the earth nearer the poles? It is a very simple question, and the answer self-evident.

Laboratory study of electric discharges in rarefied air and gases has not yet reached a point where the spectrum of the aurora borealis can be artificially produced. A study of the zodiacal light, and of the influence of magnetism on light, will be necessary to reveal this factor of the problem. This opens an immense field of further research in which scientists must still delve.

In the Baram district of Borneo, according to Mr. C. Hose, it is customary, when a dispute arises, concerning the ownership of a fruit tree, for example, for the parties to take their positions, in the presence of the witnesses and a throng of spectators, in about four feet of water, each asseverating that he is the rightful owner, and praying that the water and the birds and animals may bear him witness. Two sets of cross-sticks have been driven into the mud at the bottom of the river. At a given signal, each disputant puts his head under his cross-stick and keeps it in the water as long as he can, a friend holding his legs in order to detect the first signs of fainting and pull him out on their appearance. The man who can keep his head under water the longer time is declared to be the winner, and the loser is not allowed to make any further claim. Men recovering from serious illness often change their names, hoping that the evil spirit that caused their illness may lose trace of them. When this is done, the former name is never mentioned again. The most precious articles of clothing and weapons are deposited in the graves, because the friends wish the spirit of the deceased to appear to advantage on his arrival in the other world.

TOPOGRAPHIC FEATURES DUE TO LANDSLIDES.*

By ISRAEL C. RUSSELL.

IT is well known that masses of rock sometimes break away from steep slopes and descend as avalanches or landslides into adjacent depressions.

The topography of a region where landslides occur is changed in two ways—i. e., by the removal and by the accumulation of material. The contours of a mountain, plateau, or other land form that stands in relief, are altered by the removal of material; as, for example, when a portion of the border of a plateau falls away, a re-entering angle or curve is produced; or, when a rock avalanche occurs on a mountain side, a high-grade gorge or depression may result. The material composing a landslide comes to rest in ridges and piles which have certain characteristic shapes. The most noticeable feature in such instances is the backward slope of the surface of the displaced material after it comes to rest. The surface of a landslide, whether composed mainly of a single block or of a heterogeneous mass of loose material, slopes toward the cliff from which it came. This backward slope tends to the formation of basins in which water accumulates, and lakes and swamps result. The backward slope referred to appears to be due to friction between the moving mass and the rocks beneath, which retards the progress of the material at the bottom and in front, so as to allow the material which comes later and at a higher level to slide over it. In a heterogeneous mass of fallen rocks there appear to be several planes of shear along which differential motion has taken place.

The changes produced by landslides are usually considered, even by geologists, I believe, as of a local character and of minor importance in the topography of most regions. Recent studies by the writer of the geography of the lava-covered region of Oregon, Washington, and Idaho, however, have shown that the phenomena referred to furnish an explanation of the origin of a class of topographic forms which occur not only on mountain sides and plateau margins, and among the hills at the bases of such elevations, but in certain instances in the minor features of broad and approximately level plains.

The landslides or avalanches which sometimes rush down the sides of mountains are frequently, and probably in most instances, composed of loose rock and soil. The most frequent condition leading to such catastrophes is the saturation of the material with water. Landslides usually follow heavy rains. The famous Willey land-

* Published by permission of the Director of the United States Geological Survey.

slide in the White Mountains in 1826, and the still greater one which descended into Biraki Ganga River, near Golma, India, in 1893, and gave origin to Golma Lake, are instances of this nature. A large number of landslides, however, are due to geological rather than climatic causes, and it is to this class that I wish to invite attention.

It frequently happens that a layer of hard rock rests on softer or more easily soluble beds. When steep escarpments are formed of two strata having this arrangement, conditions are produced which favor the breaking off of masses of the hard upper layer and their descent to the foot of the escarpment in landslides. There are other conditions, such as the thickness of the hard layers and the manner in which they are jointed, and the consistence of the soft beds—whether slippery clays, loose volcanic *lapilli*, etc.—which modify the process. The main or controlling conditions referred to are furnished at hundreds of localities in the region occupied by what is known as the Columbia lava, and drained by Columbia River. In that region sheets of basalt, ranging from two to five hundred feet and more in thickness, alternate with or overlie sheets of clay, shale, volcanic tuff, etc., which in many instances are hundreds of feet thick. The basalt was poured out in a molten condition and spread over the land in horizontal sheets. On cooling, these sheets acquired a columnar structure due to joints, usually at right angles to the top and bottom surfaces. This columnar structure facilitated the breaking away of great masses of basalt, when, for various reasons, portions of the sheets form the summits of bold escarpment.

In part, the Columbia lava, and the softer beds interleaved with it, have remained undisturbed, and are now practically horizontal over thousands of square miles. In adjacent areas of a great extent the beds have been broken by extensive fractures and the blocks thus formed variously tilted. Over still other extensive regions, particularly in the Cascade Mountains, the originally horizontal sheets, aggregating several thousand feet in thickness, have been raised into dome-shaped uplifts, at least one of which is nearly circular, while others are more nearly elliptical, the major being several times as long as the minor axis. Some of these domes, if unaffected by erosion, would have an altitude above their immediate bases of from five to eight thousand feet.

Where the Columbia lava is still essentially horizontal, as in southeastern Washington, it has been dissected by streams which now flow in magnificent cañons with clifflike walls from a thousand to four thousand feet high. In the region referred to as having been extensively fractured, cliffs have been produced by the tilting of the blocks thus produced. The dome-shaped uplifts have been broken by weathering and by the work of streams in such a manner as to remove their more elevated portions, and leave their truncated bases as a series of cliffs facing inward toward the center of the uplift. Thus, in many ways, and owing to still other conditions noted in part below, the region of the Columbia lava has become a land of great escarpments.

The fact that the escarpments referred to are formed of the edges of layers of hard basalt, which are traversed by joints at right angles to the planes of bedding, and also the occurrence of layers of soft rocks beneath the hard, cliff-forming layers, furnish conditions unusually favorable for landslides. In fact, *landslide topography*, as it may be termed, is nearly as characteristic of the Columbia lava region as are its magnificent cliffs. The topographic features due directly to landslides themselves are probably seldom recognized, while the long lines of frowning escarpments obtrude themselves on the attention of even the least observant. The fact is, however, that the cliffs in many instances have resulted from the breaking away of large rock masses, and will in time be destroyed by the same process.

The alternation of lava sheets and of lacustral sediments, etc., is not a marked feature of the entire country occupied by the Columbia lava, and for this reasan great variations occur in the extent to which the escarpments of that region have been affected by landslides. In southeastern Washington, for instance, sedimentary or other soft layers between the lava sheets are relatively unimportant, and throughout scores and even hundreds of miles of cañon walls appear to beabsent. In this portion of the field the evidences of former landslides have not been noted.

In striking contrast with the region just referred to is the great dome from which the Wenatchee Mountains have been sculptured. (The Wenatchee Mountains are situated in the central portion of Washington, and on the eastern flank of the still vaster and much elongated Cascade dome. Mount Stuart and a number of associated peaks composed of dense granite form the center of the Wenatchee dome, and now stand in bold relief, owing to the removal of softer beds from about them.) In this instance the central portion of a dome fully fifty miles in diameter, has been removed and the truncated edges of the hard layers composing it left in prominent escarpments which sweep about the central core of granite in vast irregular curves. At least four sheets of Columbia lava, varying in thickness from three to four or five hundred feet, formerly extended over a large portion and possibly covered the entire region where the Wenatchee dome was upraised, but have been eroded away from its central portion. The uncovering of the region referred to, embracing fully one thousand square miles, has been accomplished by the slow recession of inward-facing cliffs, due principally to their having fallen from time to time in landslides, and the gradual decay and removal of the fallen blocks by streams and percolating waters. This process is till in progress, and a series of topographic changes from fresh landslides to rolling, prairielike lands with deep, rich soils and features characteristic of old land surfaces, can be easily traced. The reader must not infer, however, that the entire area from which the successive sheets of Columbia lava have been removed has a low relief. The streams have cut deeply into the rocks beneath the lowest lava sheet, and produced a markedly different series of land forms, in which sharp ridges and deep, narrow valleys are conspicuous elements. A belt of country marked by landslide topography which was gradually smoothed out, owing to the decay and erosion of the fallen blocks of basalt, receded with the slow retreat of the encircling cliffs and was replaced by exceedingly rugged topography.

The nature of the changes produced by landslides and the subsequent decay of the fallen masses and their melting down, as it were, into an undulating plain with undrained basins, is graphically displayed at many localities adjacent to the still receding escarpments. Favorable localities for this study are furnished by Table and Lookout Mountain, to the northward of Ellensburg, Washington, or on the southeastern margin of the truncated Wenatchee dome. Standing on Lookout Mountain, for instance, one beholds toward the southeast a gently sloping table-land which rises toward his station. The surface of this inclined table is formed of a sheet of Columbia lava, but not the older sheet, which dips southeast at an angle of four or five degrees. On its northwestern margin this table-land breaks off so as to form a precipice from a thousand to twelve hundred feet high. In many places this escarpment is vertical, but its lower slopes are masked by talus. Below this palisadelike escarpment are many others of a similar character, but of less height and seldom over half a mile in length. The lower escarpments are formed of the edges of blocks of lava which have broken away from the main escarpment from time to time and plowed their way down into the valley. The fallen blocks are inclined at angles of ten to fifteen degrees toward the cliffs from which they fell. At the base of the main escarpment there is a series of irregular depressions or basins, which connect one with another more or less perfectly, and are bounded on their northwest margins by the backward-sloping blocks. In three of these basins at the present time there are small lakes without visible outlets. Each lake is four or five acres in area, and, except where the basins have become partially filled with talus from the overshadowing cliffs to the eastward, are deepest on that side. The western edges of the fallen blocks rise some two or three hun-

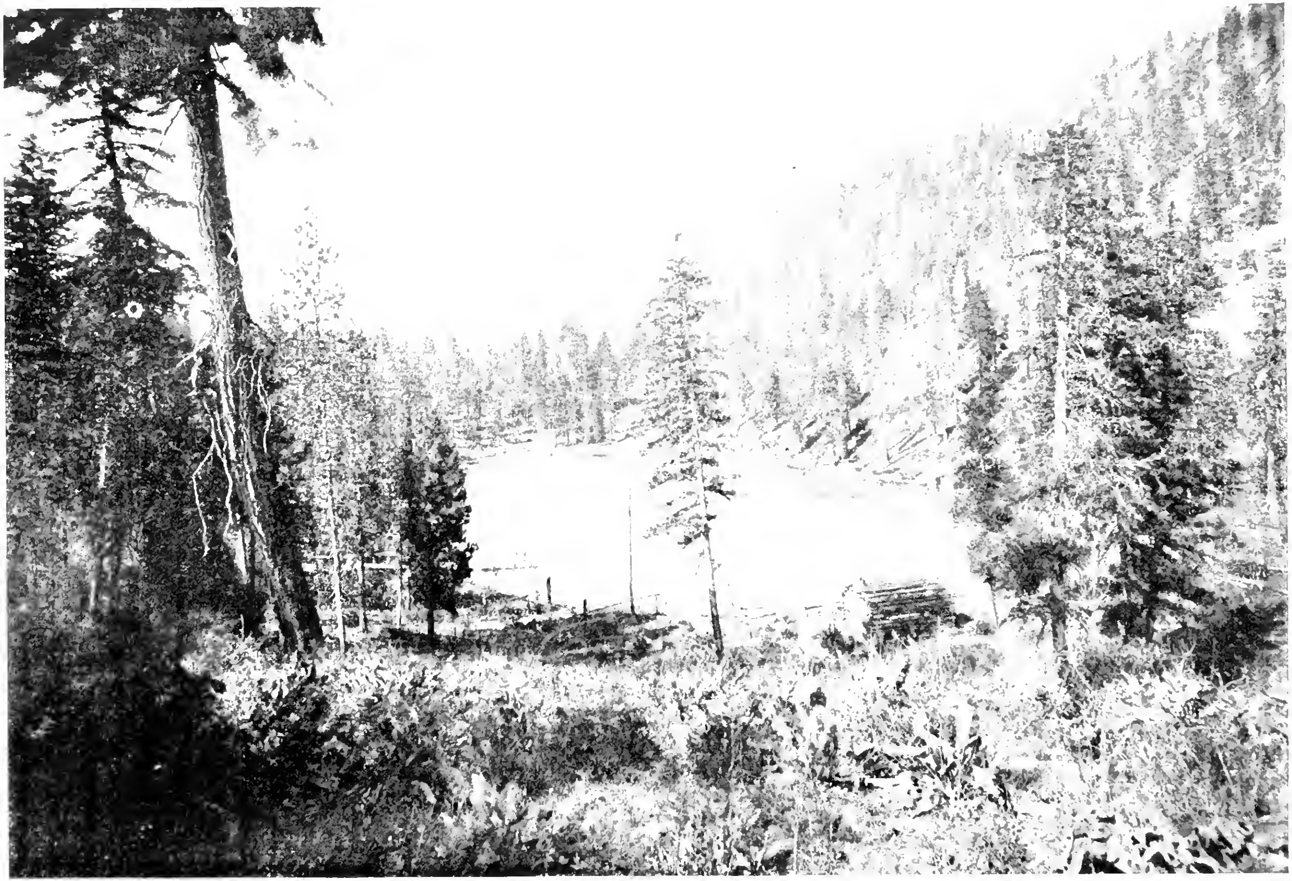

Fig. 1.—Cabin Lake at the West Base of Lookout Mountain; an Example of a Lake occupying a Landslide Basin.

dred feet above the surfaces of the lakes, situated on their depressed borders. A view of one of these interesting lakes is given in Fig. 1.

To the northwest of the basins holding lakes, just referred to, there is a series of ridges and hills inclosing undrained basins, which extends about two miles from the base of the main escarpment and gradually decreases in height at the same time that the minor features in their relief become more and more subdued. This belt of ridges and basins finally merges by insensible gradations into a tract of undulating, prairielike land, two to three miles broad. The edges of the more recent of the fallen blocks stand out as sharp-crested ridges, with gentle slopes toward the great cliffs from which they fell, but present precipitous escarpments of bare rock toward the valley. As one descends the series of ridges and hills, the cliffs become less and less sharply defined and soon give place to rounded swells. Old lake basins change to swampy areas, and at a still greater distance become grassy dells.

As already stated, there is a gradual transition from the still hilly region to the undulating plain, at the northwest base of Lookout Mountain, where the relief has been smoothed out and only gentle, flowing outlines attract the eye. On the margin of the plain adjacent to the lower hills there are obscure ridges, on which there are many rounded and much-weathered bowlders of basalt, but a mile farther westward the soil is exceedingly fine and homogeneous, and scarcely a stone can be found. Such pebbles as do occur are of basalt, rounded by decay. A characteristic feature of the plain, now cleared of the scattered groves of pine that formerly covered it, and sown with wheat, is the presence of shallow, undrained basins, with low, gently swelling hills between them. This tract of country, eight or ten square miles in area, lies between Teanaway River and Swauk Creek, but is entirely without stream channels. The scanty rain is absorbed by the deep, porous soil.

The undulating, prairielike lands just described have resulted from the slow disintegration and decay of blocks of basalt which fell as landslides during the slow recession of the thick lava sheet and of the soft volcanic tuff beneath, which once covered the region. The undulating surface of the wheat lands, with undrained basins, illustrates the old age of landslide topography. A view of this undulating plain is reproduced in Fig. 2. The hills seen in the distance owe their origin to another sheet of Columbia lava, the lowest of the series, which slopes toward the observer, and breaks off in steep slopes to the northward.

An ideal section through the margin of Lookout Mountain is

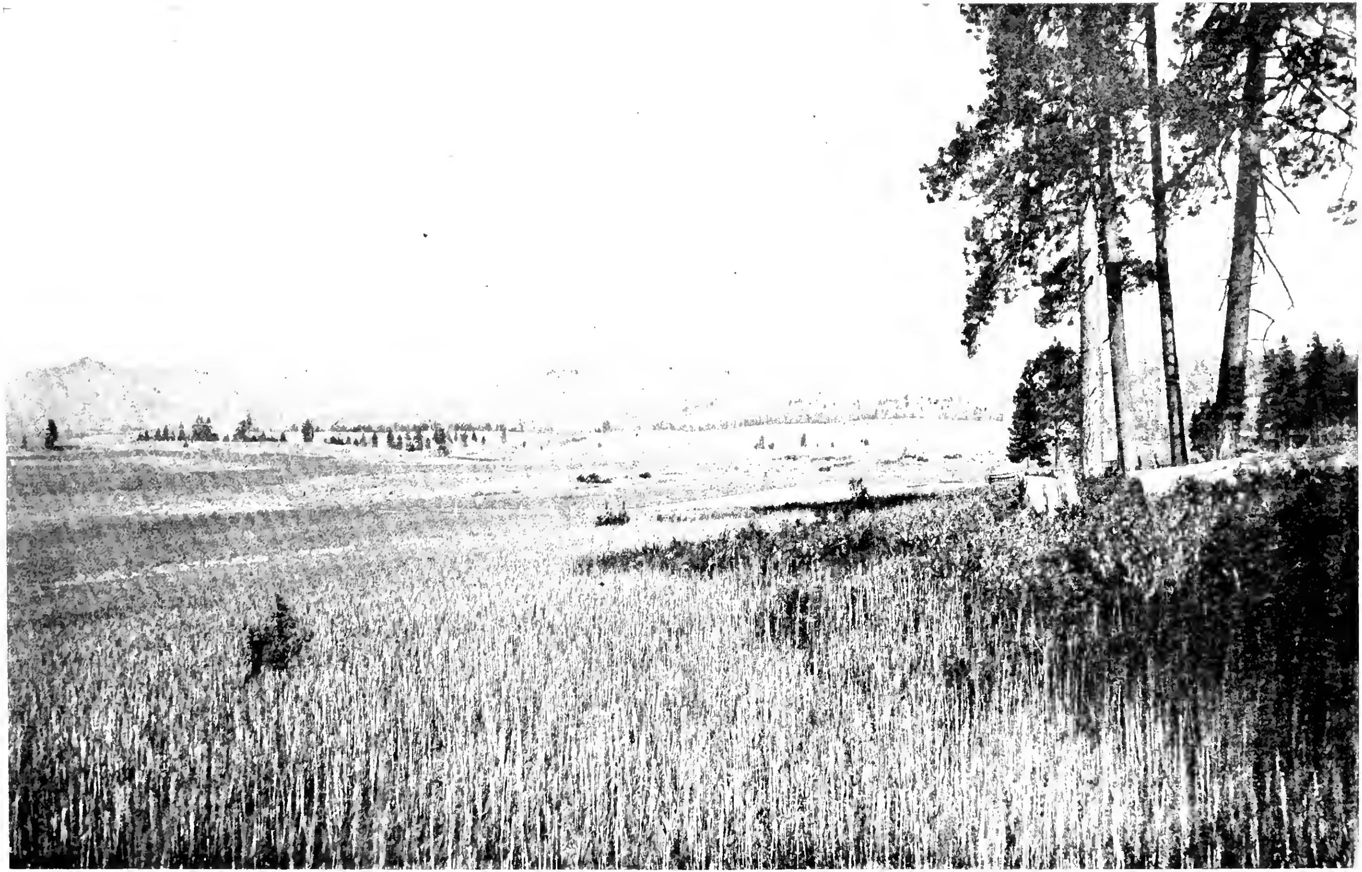

Fig. 2.—Uplands to the West of Lookout Mountain, Washington, illustrating Old Landslide Topography.

shown below. The section crosses one of the lake basins at the base of the mountain, and is continued northwestward through the belt of hills and basins to the plain into which they merge. In this diagram an attempt has been made to indicate the breaking down and rounding of the fallen blocks, and their gradual change to an undulating plain.

In some instances a landslide plows its way out into a valley for a mile or more from the base of the cliffs from which it came, and

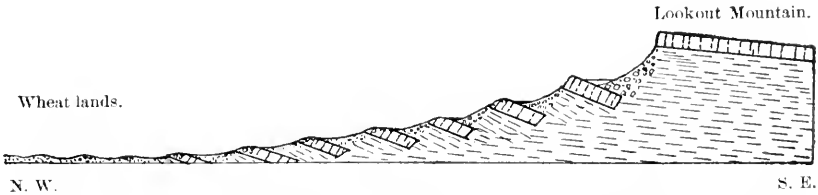

FIG. 3.—IDEAL SECTION THROUGH LOOKOUT MOUNTAIN, WASHINGTON, SHOWING LANDSLIDES.

forces up a series of ridges and mounds about its margin. These ridges have a striking resemblance to terminal moraines left by the recession of glaciers, but the scars on the adjacent escarpment or mountain sides and the associated hills and basins plainly show their origin.

The sequence of topographic changes described above, so well illustrated at Lookout Mountain, is typically and characteristically displayed at hundreds of other localities in the same general region, but is not confined to the basin of the Columbia. With minor modifications due to local conditions, it may be recognized in many lands where bold escarpments occur. Where a humid climate prevails, however, and streams occupy the valleys, the old age of landslide topography is seldom reached.

The Columbia lava, it will be remembered, was spread out during a series of inundations of molten rock and has an area of approximately two hundred and fifty thousand square miles. Previous to the opening of the tens of thousands of fissures through which the molten rock reached the surface, the country had a rugged topography due to erosion. The lava covered the plains and entered the valleys in the mountains so as to give them level floors. Hills, ridges, and mountains were in some instances partially or wholly surrounded by the fiery flood and became capes and islands. Isolated eminences of the old land rise through the sheets of lava which cooled and hardened about them, in much the same manner that *nunatakas* break the monotony of the borders of the Greenland ice fields. When these islands in the sea of lava are of resistant rocks, like quartzite, which withstand the attacks of the destructive agencies of the air better than the encircling basalt. they still remain in bold relief, as is illustrated by Steptoe and Kamiack buttes, described elsewhere by the present writer.*

When, however, the projecting portions of the nearly submerged peaks and ridges were of granite, volcanic tuff, limestone, etc., which weather more rapidly than the surrounding lava, they have wasted away so as to give origin to basins, valleys, and cañons, with boundary walls of basalt. The sheets of basalt in these escarpments in many instances rest on less resistant rocks, and a recession of the cliffs due to the breaking away and falling of large masses of their capping layers takes place. The fallen blocks disintegrate and waste away in the manner described above, and the cañons and valleys increase in size. The ground plans of the depressions originating and enlarging in this manner, vary according to the shapes of the islandlike rock masses which have been removed; some of the depressions are nearly circular, others are greatly elongated, and now have the characteristics of flat-bottomed cañons with vertical walls.

The remarkable circular valley surrounded by an almost continuous palisade in eastern Oregon, known as Grande Ronde Valley, from which a river of the same name flows northward to join the Snake, is an illustration of the class of topographic forms produced in the manner described above. I can not testify from personal observation as to the nature of the soft rocks beneath the lava in the walls of Grande Ronde Valley, but other similar valleys, less regular in outline, near at hand, have resulted from the removal of islandlike masses of soft volcanic tuff.

Another unique feature in the topography of the region drained by the Columbia is the Grande Coulée in what is known as the Great Plain of the Columbia, or more familiarly as the "Big Bend country," in central Washington.. The Grande Coulée is a flat-bottomed cañon some thirty miles long and varying in width from two to four miles. In its vertical walls, usually about three hundred and fifty feet high, the edges of several sheets of Columbia lava are exposed. This great trench through the but little disturbed plain of lava was in existence previous to the Glacial epoch, and furnished an avenue of escape for Columbia River which was dammed by a glacier. At the southern end of the Grande Coulée, as can be seen from Coulée City, the lava sheets on its eastern side dip gently eastward, while the beds comprising its western wall are apparently horizontal. This fact led me to infer that the Grande Coulée, like several other similar but smaller cañons in the lava, is due to stream erosion along a line of

* A Reconnoissance in Southeastern Washington. Water Supply and Irrigation Papers of the United States Geological Survey, No. 4, 1897, pp. 37–40.

fracture.* At the northern end of the cañon, however, granitic rocks form a portion of its walls, and stand as isolated towerlike masses within it. Some of these towers are capped with horizontal lava sheets. When the lava was poured out it surrounded a granite ridge having the position of the Grande Coulée, but probably not extending as far south as the depression since formed. The weathering and removal of the granite gave origin to a trenchlike depression with vertical walls, composed of basalt above and granite below. The more rapid crumbling of the granite led to the breaking away of the jointed basalt resting on it, and the widening of the depression in the manner already noticed.

From the brief and inadequate description I have given of certain of the more striking features of Washington and Oregon it will be seen that landslides have modified the topography of the region occupied by the Columbia lava in several ways. There are yet other changes in the geography of that most interesting and instructive land due to the same causes. Chief among them are the obstructions to the streams formed by landslides, and the production of lakes and rapids. At several localities in the upper Columbia masses of rock which have fallen from the cliffs bordering the stream obstruct its course. There are now no lakes along the course of the river due to this cause, but terraces above rocky rapids, show where such water bodies previously existed.

Perhaps the most interesting fact brought out by the study of landslide topography is that certain broad, nearly level areas, now covered with deep, rich soil, and in the autumn golden with the sheen of ripened grain, owe the minor features in their relief to ancient landslides. The hills, with broadly rounded summits, and the shallow undrained basins between, in such regions are an inheritance from a time when long, precipitous escarpments, by their slow recession, left the land covered with a rugged, confused mass of fallen blocks. A review of the facts concerning the minor features in the relief of the broad wheat lands of southeastern Washington,† in the light of the conclusions here presented, leads to the suggestion that some of the ridges and basins of that region may be due to the recession of cliffs produced by stream erosion. Many portions of the deeply decayed surface of the basaltic plateau of southeastern Washington resemble closely the old landslide topography in the valley to the northwest of Lookout Mountain, shown in the accompanying illustration.

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* A Geological Reconnoissance in Central Washington. By Israel C. Russell. United States Geological Survey Bulletin, No. 108, 1893, pp. 90–92.

† A Reconnoissance in Southeastern Washington. By Israel C. Russell. Water Supply and Irrigation Papers of the United States Geological Survey, No. 4, 1887, pp. 58–69.

THE PHILOSOPHY OF MANUAL TRAINING.

By C. HANFORD HENDERSON,
LECTURER IN HARVARD UNIVERSITY.

III.—THE MANUAL TRAINING SCHOOL.

THE educational sequence in America is not yet an established order. The amount of schooling that a boy or girl is supposed to need is not the same in the Carolinas that it is in Massachusetts. In the more highly evolved communities the pressure is all in the direction of an elaborate educational process. The gap between the minimum and the maximum requirements is very great. It would be unfortunate, however, to believe that virtue lies at either extreme. It is quite possible to have an educational process so meager as to be utterly inadequate to the needs of modern evolved living. And this extreme is apt to be found in communities where either Nature is too bountiful in her offer of a living, or where the invitations to action are too strong to be resisted. It is difficult to imagine the educational process as too comprehensive in Florida and Louisiana, or at the present time in gold-smitten Alaska. But it is also quite possible for the educational process to be so elaborate, so exacting, so time-consuming, that it takes the juice quite out of life, and gives us weakness instead of strength. The friends of action have, I think, quite as just cause for complaint in the devitalized and unattractive specimens of manhood and womanhood that the schoolmen are apt to send them, as the friends of thought have in the crude and ignorant youth who turn out of a holiday.

It is impossible to overeducate, but it is very possible to overschool.

In my own experience I have found that I could accomplish more with the boys who had been least in school. I have had boys graduate at a high school whom I could not induce to take a college course. They had been under instruction eleven long years—for remember that in childhood the years *are* long—and they were simply tired out. I could not blame them for wanting a change, though I did feel very strongly that they had put in their time at the wrong end of the sequence, and were giving up the far better part. And I have talked with clever young fellows in high school and college and have asked them if they could remember anything useful that they learned below the high-school grade. They have replied that they could not, or else they have mentioned something so trivial that when balanced against six or eight years of human life it seemed absolutely pitiful. I should be sorry to use a false standard in estimating the value of these schools. Their work is to be judged not by the specific useful facts that the children remember in after years, but by the general influence upon their lives. You perhaps remember that incident of Garfield. He relates that he once heard Emerson lecture, and that it was for him the beginning of a new life. Yet all he could remember of the lecture was one of those bullet sentences of Emerson's—"Men are as lazy as they dare to be." It is quite possible to fire the imagination of men and women, and have them clean forget whether it was by an electric spark or a tallow candle—or neither.

But when we look at our educational structure, and note what tremendously extended foundations it has, what an almost unending vista is presented by the lower schools, and then see how palpably it shrinks in rising upward to the high school and college, what a very low pyramid it forms after all, I can not but feel that the influence of these schools in arousing children to the higher life has been quite as weak as has been their informational capacity.

I do feel that in failing to impart abounding life and health, in failing to arouse a keen interest in the many beautiful sides of life, these schools are partly responsible for the apathy and *ennui* that you read in the faces of middle-age and middle-class America.

The wise sequence does not lie at either extreme—either seven weeks a year for three or four years, or ten months a year for a score or more of years. The present sequence in our older communities runs somewhat as follows: the kindergarten up to six years; the elementary school for about eight years; the high school, four years; the college, four years; the graduate, technical, or professional course, from three to six years. The educational process begins with very tender baby flesh, and ends with pretty solid men and women. It is not one day too long if it lead irresistibly to the radiant life. It is many years too long if it lead to ill health, to apathy, to hopelessness, if it lead to loss of initiatory power, to pedantry, to conventionality, to cowardice. It is a question of the *quality* of the results. Even this elaborate process, however, is not yet correlated and continuous. The lower schools and the high schools have been brought into pretty close relations, since both are commonly under public administration, but even here, in many of our cities, a remnant of the old apartness remains in the entrance examination to which the children are obliged to submit at the doors of the high school. Curiously, the public administration is not willing to accept its own stamp of approval or blame as set by the lower schools. But between the high schools and the colleges there is a very noticeable gap. The two are under different administrations, and in our less enlightened communities they are not infrequently antagonistic. There are now, however, associations throughout the country that have for their express purpose the bringing about of a more complete understanding between the high schools and the colleges, and the mutual adjustment of the curriculum of the high school and the entrance requirement of the college. It is more and more coming to be felt that the best education should be the one leading to college and should be the one for all.

Now, into this somewhat vexed state of affairs the manual training school has come and must be given due place, and brought into relation with the rest. Coming as it did with its technical side uppermost, it was decided at once to be too strong meat for babes and was graded as a high school. This determined its relation to the lower schools, and there was no difficulty on that score. The children from the lower schools pass the same entrance examinations, whether they elect the manual training or the English or Latin high school. In some of our cities, and notably in those of the middle West, manual training has been incorporated into the regular high schools, and consequently has introduced no new problems, at least as far as the educational sequence is concerned. But the older typical manual training school is a distinct institution, one of recognized high-school grade, but differing from the older high schools in having a three years' course in place of four years.

If I have at all succeeded in making clear to you the philosophy and methods of manual training, you will easily see that as a scheme of education manual training is equally applicable to all grades, the lowest as well as the highest. It is only that the work would have to be adapted to the age of the children. We should not expect babies to make steam engines any more than we should expect them to learn to read out of Shakespeare. From the artisan point of view it is limited to the upper grades, for little children can scarcely gain enough industrial skill to make it worth while. There are, however, only a few elementary manual training schools in this country. There is a public one in Philadelphia in the slum district, and there are several conducted by charitable organizations there and in New York and other cities. It is most encouraging to note, however, that manual training is rapidly making its way into the regular elementary schools. In New York city alone two hundred thousand children in the lower schools are having manual training, and it is making its way into nearly every progressive grammar school in the larger cities either as a required or elective study. But in the main, when we speak of a manual training school, we mean a high school having a three years' course, and it is to such a school that I want to call attention in this paper. Furthermore, I am sorry to say, a typical manual training school of the older sort means a school for boys only. But with the growth of the educational idea, manual training is rapidly being extended to the girls too. In the West they are much ahead of us in this respect. In Denver, for example, they have a fine manual training high school, with a very liberal course of study, and open, as it should be, to both girls and boys. In Kansas City, the new Manual Training High School has just opened with an initial enrollment of seven hundred and thirty-six children—three hundred and forty-nine boys and three hundred and eighty-seven girls. In San Francisco, the Polytechnic High School is open to boys and girls alike. And this represents the general spirit throughout the West. I am very glad to see it, and I am the more sorry that our older and representative manual training schools in Baltimore, Philadelphia, St. Louis, Chicago, Brooklyn, and Boston do not unlock their doors to girls in the same open-minded fashion.

The material that comes to a manual training school has always interested me. It does not come from any one class in society. On the contrary, it is a very composite group. News of the movement naturally reached the most advanced people of the community first. In the early days in Philadelphia—that is, something over a decade ago—it seemed to me that nearly all the boys in the training school were unusual. Their parents for the most part were come-outers of some sort, liberals, people interested in social and religious reform, very wide-awake people. As time went on, the groups became less marked. The industrial side of manual training got noised abroad, and for a time many boys were sent to the school merely because they were not fond of study, and the school was mistaken as a place for busy hands and sluggish brains. Boss mechanics, with no great faith in education, but with a strong desire to have their sons get on in the world, compromised the matter and sent them to the training school. From the very start, too, there was a large influx of Jewish children, whose parents were actuated, I think, not so much by that text in the Talmud which bids every man have a trade, as by the broader feeling that the children of Israel as a people were suffering from their too long and too exclusive devotion to commerce. The Jewish charitable organizations have since established a number of free manual training schools in the different cities, and are especially working among the poorer Russian Jews. There were also a number of colored boys, but these seldom remained to graduate.

Now that the schools are better known, and have taken their place alongside of the regular high schools, the choice has largely passed from the parents to the boys themselves. They come to the training schools, sometimes for good and sufficient reasons, because they have a taste along mechanical and scientific lines rather than linguistic lines, but often the reason is quite capricious. They come because some chum of theirs happens to come, or they don't come because some girl friend sticks up her nose at the dirt and the aprons, and calls the boys mechanics. And I should like to say in passing that I think we do not sufficiently realize the importance of having girls entertain high ideals of boyhood, and boys entertain high ideals of girlhood, for sooner or later each sex is bound to be what the other sex wants it to be. When I hear men running down women, or women running down men, I always feel very sorry, but I feel disposed to say: My friend, this may be so, but if so, it is partly your fault.

The average age of this composite group I should place at something over fourteen. The boys may enter at thirteen, and I am told that in New England they commonly do so, but the work as at present arranged is better suited to older boys.

The curriculum is divided into five departments:

1. The Humanistic, or Language Group. This includes English language and literature; French, German, Spanish, or Latin; history, civics, and economics.

2. The Mathematical Group. This covers advanced arithmetic, plane and solid geometry, algebra, plane trigonometry, elementary surveying, and bookkeeping.

3. The Science Group. This includes physical geography, biology, physics, chemistry, and an introduction to steam and electrical engineering.

4. The Drawing. This is both mechanical and free hand, and includes instruction in clay modeling, in plant analysis for decorative purposes, and somewhat of the history and practice of architecture.

5. The Manual Training. This is the most distinctive part of the curriculum, and includes wood work—joinery, pattern making, turning, and carving; vise work—chipping, filing, and fitting; smithing; sheet-metal work; ornamental iron work, and finally the machine-tool practice in constructive work.

This is a very full curriculum. The studies are all useful, and in the main well selected, but the amount of time that may be given to each is somewhat limited. The principal criticism to which the curriculum is open is indeed right here. It is not possible to offer the full equivalent of the four-year course in three years, and give so much of the time to the manual occupations. Let us look more closely at the disposition of the day. It is commonly divided into six periods of from forty-five to fifty minutes each. As there is no school on Saturday or Sunday, this gives thirty periods a week in which the curriculum must express itself. In the first and second years of the course, half of each day is given to manual work—that is, to tool work and to drawing; and the other half is given to the academic work, generally one period each to language, science, and mathematics. In the third year, the disposition of the time is somewhat different. About six hours per week, sometimes more, are given to manual training proper, four to drawing, and from four to six to the physical and chemical laboratories. Counting all this work as manual, however, the division of the day practically remains much the same as in the lower classes—that is, half the day to manual and half the day to academic work. Although half the curriculum bears so close a resemblance to customary high-school work, it is hardly practicable to consider the curriculum except as a whole, for in the best schools the course is distinctly a unit course, and the manual training does not form a bit of unrelated work apart from the rest. There is, of course, a tendency in such schools for the faculty to separate into two distinct parties, the academic and the manual, and the more so since the academic men are college-bred, while the manual men are mostly artisans taken directly from their shops, and devoid of even a high-school training. But such a separation is most unfortunate, for it makes the best results impossible. Where there is sufficient perception to see that the one problem is shared by all, and sufficient tact to co-operate in both spirit and letter, it becomes possible to realize the broad purpose of manual training. I confess that the demands made upon human nature by such a scheme are tolerably large, but I think that if you will go among the training schools of the country you will see that these demands are met here and there, and that the schools where they are met are animated by a singularly fine spirit of helpfulness and high purpose. The particular difficulty in the way of manual training just now is in finding men and women wise enough and skillful enough to carry it out. This is especially the case in the manual department. The supply up to this time has been drawn almost exclusively from the artisan class. Some of these men have shown themselves quite equal to the occasion, and have demonstrated anew that teachers are born, not made. But the majority are not satisfactory. The deficiency in general education is a serious drawback to the work of the academic departments, for it inevitably lowers the standard of the school. Particularly is this the case in the matter of language. The English is not the king's. Nor does it seem to me desirable that boys should come under the influence of the artisan view of life. It is bound to be narrow from the very nature of the case, for the artisan life is narrow, and a stream can not rise above its source. A serious objection, too, is that the artisan view of manual training, as I have tried to show, is a relatively poor one. It must suffer a complete change of heart before it can serve the purposes of education, and this is too much to expect from men whose very proficiency has been gained at the expense of their youth. You remember that when Harvey demonstrated the circulation of the blood, not a single physician in England, older than forty, accepted the new view. Darwin's theory of the origin of species fell for the most part on deaf ears except among the younger naturalists. It is unpsychological to expect men of a certain turn of mind and a certain way of life, and withal no longer young, to suddenly emerge out of their old selves.

The best work of the world is done without pay, the sacred work that asks no pay—the work of the mother, the work of the enlightened ones—but where the work *is* paid for, the rate of pay is a pretty sure gauge of the estimate that is placed upon the work. Now, in some of the manual training schools, the salaries in the manual departments are notably less, I should say about twenty per cent less, than the salaries in the academic departments. This seems to me a grave mistake. If manual training is to be put forward as a serious educational scheme, the teachers of manual training should be men and women quite as carefully educated, quite as acceptable in their language, quite as broad in their sympathies, quite as elevated in their morals—in a word, in every way quite as cultivated as the teachers of language and science and mathematics. And the first practical step in bringing about this equality of requirement would be to inaugurate an equality of pay. The manual teachers should get precisely what the academic teachers get.

In describing the manual training school, I am assuming that it is one in which this unity of purpose prevails, just as, in developing the philosophy of manual training, I assumed the educational view. And if, at times, it should seem that I am describing an ideal rather than an actual school, bear in mind, please, that the picture has at least been suggested by a reality. Let us glance, then, at the several departments in succession.

The humanistic group is weak, especially in English, and this constitutes the gravest weakness of the manual training school as now organized. Adequate results can not be obtained in the time allotted to the studies. In the first year, only five periods a week are commonly given to the entire group, three to English literature and rhetoric, and two to a foreign language, and this, when you consider the importance of the studies, is a mere drop in the bucket. The children are not even well grounded in the bare structure of English. They come up from the so-called grammar schools, where it has seemed to me they learn the rules of grammar all morning, and break them all afternoon. We need really an excess of English, for the poor English heard in the manual departments, and bound, I fear, to be heard for some time to come, ought to be effectively offset, or these schools will never take their place as true culture schools. There is in Europe, and notably in Germany, a strong nationalistic element in current educational thought. We have a national spirit here in America, but it is apt to take a bad form, a form well expressed in that street cry familiar to you all—"America for Americans"—a cry, by the way, that is commonly uttered with either a brogue or an accent. But the national spirit that we want to cultivate is something quite different. We do not want national pride so much as we want national interest. This can be done by concentrating attention upon the national life, the national problems, the national literature. Furthermore, by this means we could hope to truly nationalize our very heterogeneous population, and weld it into one nation; not one as against the rest of the world, which is the spirit of the cry "America for Americans," but one nation strong enough and alive enough and good enough to work sturdily *with* the rest of the world toward that federation of the nations which is the dream of every lover of humanity.

The three hours a week are given to the study of obvious solecisms and crudities, and to the reading of American authors—Burroughs, Emerson, Thoreau, and others. The instruction fails in not giving the boys a command of the mother tongue, and in not arousing them to a sincere national life. It makes a brave attempt to do this, and it only fails for lack of time.

In the matter of foreign languages, much the same thing must be said. At first only modern languages were taught, and many of the schools adhere to that practice. In Baltimore, only German is offered; in Boston, only French; in Philadelphia, it is German *or* French; in Brooklyn, German *or* Latin, with a chance for some French later; in St. Louis and in Denver, Latin, German, and French are electives; in Chicago, only Latin is offered, with French the third year; in San Francisco, German, French, and Spanish are elective; and so on. I am quoting at such length from these representative schools both to show how variable the practice is, and also to point out that in the more progressive Western schools the studies are largely elective. The customary thirty periods a week are required, for either three or four years, but each student makes out his own roster, subject to the approval of the head master. Here, again, I think they are much ahead of us. In the older Eastern manual training schools the boys take their German or French but twice a week during the first and second years, and three times a week during the third year, and I am afraid that they come out of the school unable to read or write or speak the language with any degree of practical fluency. The time is too short and too scattered.

In the second year history appears in the curriculum—ancient, mediæval, and modern European history—and with the literature forms a unit course. English as a study does not appear, or else history and English are each given half time, and run through both years.

In the third year three periods are given to United States history, civics, and economics, and two to literature and theme writing. The nationalistic work here is commonly of high grade, but the English is weak, and the whole structure rests upon insufficient foundations.

It remains for me to suggest how the manual training idea, that of learning by doing, is applied to studies apparently so abstract, for undoubtedly the idea does permeate the entire English work. The one effort is to give reality to the instruction and to make it arouse the self-activity of the boys, to have it creative rather than merely assimilative. To carry out this idea, the composition work of the first year is limited to subjects in which the material can not be had from books, but must result from direct personal observation and experience. In the second year the history and the literature are closely correlated, and each lends an interest and reality to the other. For example, when ancient history is being studied, the literature will belong to that period—Plutarch's Lives, or portions of the Iliad, or some of the excellent translations of Greek plays, the Alcestis of Euripides, or the Antigone of Sophocles. Boys are thought not to care for literature, but really they take a keen delight in the more full-blooded sort. They may not care for subtleties of thought, but they do care for action, and they sympathize with the strong primitive passions of the Greek heroes. And it seems to me very wholesome in these cold northern winters of ours to have the boys plunge into the open sunshine, the pure animality, the sincere passion of the Greek world, and return warm and invigorated. Ivanhoe, or Men of Iron, is good collateral reading for mediæval history. I have known a non-book-loving boy to read Men of Iron three times in less than a fortnight. Kingsley's Water Babies is a good breath of the modern spirit. The American work, if I may so call the history, civics, and economics of the third year, is made strong and real by the use of original documents, by local illustrations, and by the study of current social problems. Here, again, it all depends on the man. In the hands of the unimaginative, economics is apt to become a mere effort to formulate social abuses with the idea of justifying them, and the boys get little inspiration out of such dreary work. The English work is still formal. The boys read Shakespeare and other middle English authors, works that I have come to believe had much better be left until the boys come to them privately and of their own accord.

Let us look now for a moment at the work in mathematics. In the main, it is quite satisfactory, though the bookkeeping seems to me to have little educational value. In the first year, five periods a week, and in the second and third, an average of four, allow a reasonable though not a generous amount of time for what is attempted. The mathematical sequence is not the same in all the schools. The most typical is probably still the older scheme—advanced arithmetic, algebra to quadratics, geometry, advanced algebra, trigonometry, surveying, and bookkeeping. A partial inversion of this scheme would seem to me a better sequence, and I have carried it out in part, with results that confirm this opinion. There are three terms a year, so that we have in all nine terms of thirteen weeks each. I would suggest, then, plane geometry, two terms; elementary algebra, one term; solid geometry, two terms; elementary algebra and advanced arithmetic, one term; algebra, one term; plane trigonometry, one term; and surveying, one term. I would omit the bookkeeping. This sequence is, I think, logically defensible. The main idea in having geometry precede algebra is that the geometry is much more graphic and makes a far more direct appeal to the senses. The geometry may be made the means of the most excellent mental gymnastics if the chalk diagrams are for a time dispensed with and mental diagrams made to take their place. This was suggested, you know, by Herbert Spencer's father. We made the experiment at the Northeast School, and again at Chestnut Hill, and the results were very gratifying. While the putting of arithmetic after geometry and algebra may excite the greater surprise, it is practically the most defensible part of the whole inversion. The most important processes of advanced arithmetic are only explainable on algebraic or geometric grounds. Take, for example, the process of extracting the square or cube root of a number. I do not know of any simple arithmetical explanation of the process. There is only an empirical rule, and this has no educational value. It is a very simple matter, however, when the binomial theorem has been mastered, or it is a very simple problem in solid geometry. The surveying is practical, and is of course limited to the most elementary problems. There are few boys who do not enjoy it, however, and who do not get something of real educational value out of it.

The science work is good, and the sequence has been pretty carefully worked out. It is all laboratory and lecture work, and is made just as practical as possible. Indeed, it might almost be called a department of manual training, so strong is the desire to have the boys learn by doing, and through their own self-activity. During the first year, five periods a week are given to science, the work being in biology and physiography. This part of the work is, however, open to improvement. The present course is logical, and appeals to older minds as an admirable scheme. But boys of fourteen are not logical, and in science they are in too new and untried a field to appreciate the fact that the simple organisms and tissues they study under the microscope are the basis of a more interesting life. A philosophy with coherent, dependent, and interrelated parts, which you remember Mr. Frederic Harrison charged Arnold with lacking, does not make a very far-reaching impression on boys of this age. I believe the important thing is not to attempt to give the children a systematic knowledge of any part of natural history, but rather to arouse in them a keen and affectionate interest in the study of Nature. First impressions count for so much. The boys are just beginning the serious study of science, and it is so important that they should be fired by it, and not for a moment repelled. The cut-and-dried and systematic have their place, but not, I think, in secondary science work. And so I am advocating the seemingly illogical process of beginning at the end instead of at the beginning—of making, in truth, a very open bid for the boyish interest, and starting out with dogs and cats and horses and chickens and pigeons; with trees and flowers and vegetables, in place of lower and, from the childish point of view, less interesting organisms. In the same way, rocks and minerals and ores have more to teach than the more abstract chemical elements. Later, it may be, the work can lead back to the simple forms, and build up a world logical enough to suit Mill. But at present the boy is interested in the big things that he finds in his world, and would much prefer to investigate them. I believe that he is right, and that our elementary science work wants to be more thoroughly superficial, and less superficially thorough. I am not ashamed to recommend a return to the surface of things.

The second year's work in science is devoted to physics—to mechanics, heat, light, and sound. The work here is rich in possibilities, and is limited only by the ingenuity and skill of the teacher. It is work, too, that can be brought into the closest relation with the manual departments. Any number of projects in the way of physical apparatus can be made in wood and metal. The more of the apparatus is home-made and home-devised, the more truly practical and educational is the work. There is also a danger here that the instruction will run too much to measurement, and not enough to the experimental and phenomenal. I put in this word of caution because the teachers are mostly college men, as we want them to be, but men who have been so deeply drilled in laboratory methods of work and thought that they may have come to look upon the entire phenomenal world as somewhat of a divine concession to the vulgar mind. This attitude, I think, is unfortunate educationally.

The third year's work in science is particularly strong. From three to six periods a week in the older schools are given to chemistry, a practical laboratory course in inorganic; and three periods to physics, to the special study of steam and electricity. The tendency at one time was to make the electrical work almost too practical. It grew to be weak from a lack of fundamental instruction. But this tendency is now being corrected, and the work put on a much sounder basis. There are, however, plenty of chances for practical work. The schools all have their own steam engines and dynamos, switchboards and installations of electric lights and bells. There is plenty to be done in running the engine and dynamo, and in repairing and renewing the several installations, as well as in the more strictly quantitative work of the laboratory proper. To an active boy the attractions of electricity are simply irresistible, and this department, which in the early days was known by the too ambitious name of the electrical engineering department, has not only been a source of lively interest, but in no small measure a determining factor in the future career of many of the manual training graduates.

The work in drawing in nearly all the manual training schools is admirable. It continues throughout the three years; five periods a week during the first and second years, and four periods during the third. A little more than half the time is given to mechanical drawing, or, as we prefer to call it, constructive drawing, and the work is in the closest possible relation with the manual departments. The practice is not uniform. In some schools the boys make the drawings for all the articles that they afterward construct in the workshops. This has the manifest advantage of giving reality to the work, and making it continuous and practical. On the other hand, one can draw much faster than one can construct in wood and metal, and many of the projects, being somewhat similar from the draughtsman point of view, do not offer sufficient range of experience to form an ideal course. In many of the schools, therefore, it is growing to be the custom to modify the drawing, giving only a few selected exercises of the manual departments and the special projects, and adding an independent course of drawings chosen because they involve useful problems in draughting, and require the original working out of details. The steam engine is naturally a prolific source of such problems. By giving an outline dimensioned drawing, and then assigning to different boys a specific position of the piston, it is possible to teach not a little mechanics along with the drawing. In the same way the development of curved surfaces in the drawings for the tinsmithing work involves a helpful amount of applied geometry. As a rule, the manual training schools turn out very good draughtsmen. I think this is because the work is so real. Few of the later drawings are mere copies. They have enough in them that is original to require that they shall be understood before they can be made. The free-hand work is no less important. From an evolutionary point of view it is even more important, for it requires greater power and greater concentration, and in developing the æsthetic faculty it makes an even more substantial contribution to life as a fine art. The work is similar to the elementary work of the art schools. It is in touch with the shops in supplying all the designs for the ornamental iron work and for the wood carving, and it includes, on the constructive side, an important part of manual training, and one that I hope to see still more developed in the future, the work in clay modeling.

I have purposely left the consideration of the strictly manual training part of the curriculum—that is, the tool work—to the last, and I have done this that I might make it very clear that the humanistic studies, and the mathematics, and the science, and the drawing are quite as essential a part of the school as the tool work; and also that I might make it very clear, beyond all peradventure and even perhaps at the expense of repetition, that manual training is a scheme of education, a deliberate attempt to shape evolution toward definite social and moral and æsthetic ends, and is very far from being a mere system of hand training. At its best, the school is a practical as well as a philosophic unit. It has one purpose and one method.

The instruction in tool work occupies about one third of the entire time—that is, ten periods a week. In the first year, at the older schools, this is equally divided between wood and metal. In the disposition of the time, the different schools are pretty much agreed. In the details of the work no two schools are alike. All the manual training work is still fluid and experimental; but, to hear some of us talk, you might think that there was something quite fixed and sacred about it all. You have perhaps remarked the very solemn and knowing air that the tailor takes on when he assures you that a certain coat or gown is or is not in style. I never quite believe him; but, nevertheless, I am always impressed that any one should even pretend to have such inscrutable knowledge. It is a little bit the same here.

The wood work during the first year may consist of two terms of joinery and one of turning. It is very attractive work. There is something fresh and sweet about the smell of the wood. It conjures up all sorts of pleasant pictures of sawmills and logging camps, and, though it is a passing pain to remember that the tree has been cut down, if you happen to be a lover of trees, still the wood never seems quite a dead thing. The feeling grows very strong, as you stand in the wood shop, that you would like to stop there and go to work yourself. You remember, perhaps, that Jesus was a carpenter. You recall good Adam Bede and Dinah Morris. You see again the touching little wooden saints and angels on the stalls of the Antwerp Cathedral, and quite before you know it the occupations of the woodworker have become idealized and have passed from labor into joy. It is pleasant, too, to go again from day to day, and, as one term melts into another, to note the growing skill, the quickened intelligence, the greater aliveness on the part of the little workers. At first they are so awkward and helpless; they seem to have so small control over their organisms, and they are half ashamed of their pitiful little efforts. But all this changes. There comes not only skill, but a sense of skill, and a sturdy self-reliance that amuses while it pleases you. They seem to be passing into control of themselves and to know it. They are delightfully unconscious of you, and quite regardless, too, of your criticism, unless indeed it coincide with their own. They soon come to know whether a piece of work is good or not, and are as generous in praising the skill of a neighboring worker as they are frank in ridiculing his failures. I should like to give you an instance of this sturdiness: I had once a very solemn little boy in my science classes, whose delight it was to read Forney's Catechism of the Locomotive. He kept a little notebook in which he entered his difficulties in the form of questions. When he had a sufficient cargo of these, perhaps ten or a dozen, he would come sailing into the lecture room after school and present them one by one. I had answered seven or eight of such questions one afternoon, when we came to some detail of the steam cut-off. I could only answer on general principles, and told him that the answer was a partial one. He looked at me very solemnly and said: "I will take this question to Mr. Whitaker. I think he can answer it better than you can." I was immensely pleased.

But, as I say, the first impression on going into these workshops is not with the work, but with the workers, and I think it is high commendation when in any school you are more taken up with the children than with the process.

The work in joinery mainly involves the use of the saw, plane, chisel, and rule. Hammer and nails, sandpaper, glue, and shellac are taken for granted. The sandpaper and shellac are secondary, and are quite discountenanced if used to cover up defects. The term joinery is well chosen. The work covers all sorts of joints and frames, and joinable and fittable things. The wood turning, I think, is less valuable than the stricter hand work, though it does undoubtedly cultivate an accuracy and delicacy of touch, combined with quickness that might not result from slower operations. It is also possible that the inartistic forms produced by our turning mills and displayed with such prodigality in the construction of cheaper houses does something to prejudice one against the lathe. The forms turned out in the schools are not all beautiful, but they might be. They consist of rings, balls, vases, tumblers, balustrades, dumb-bells, Indian clubs, and the like, and are very sound and true in the matter of workmanship.

The manual work for girls during the first year usually includes joinery and sewing. The homely arts of mending and darning are taught, and also the more scientific processes of draughting patterns and cutting out garments.

The second year's work in wood may cover two terms in pattern making and one in carving. The main tools are the saw, plane, chisel, gouge, lathe, sandpaper, and gluepot. The work in pattern making is wonderfully nice and exact, and makes other wood work seem rough by contrast. Pattern makers as a class know this, and show a becoming appreciation of their own work. They quite look down on less exact workers. I have often wondered that, with their immense skill in wood and varnish, they do not turn to some more profitable and artistic work—such, perhaps, as violin making. The art of Stradivarius and Guarneri and Amati might prove recoverable. The present work in pattern making is very technical, and can not be other than an industrial abstraction, since the patterns are only used for forming the molds into which the molten lead and iron are afterward to be cast.

The wood carving is more human and more artistic. It used to be very elaborate and in very high relief; but this meant that the teacher had to do too much of it. It is now less ambitious and truer. The articles are smaller, and the carving is in lower relief. The so-called chip carving, borrowed from sloyd, has been introduced with advantage. It is effective artistically and is well within the boys' capacity. The regular wood work ends with the second year. In sloyd schools, wood is the material most used, and I think that it will occupy a larger place in the manual training school proper as the educational idea prevails.

The girls, meanwhile, during this second year, have also been taking wood carving, and have been extending their knowledge of sewing by fitting garments as well as cutting them out, by using the machine, and by instruction in the selection of materials.

The work in metal is limited, of course, to the boys. It is more varied and elaborate, and from an indusrtial point of view also more important. It is not, however, so attractive as the wood work. The noises are more trying—the anvil chorus is only one out of many possible sounds. Nor are the odors of the metals agreeable. The pictures of mine and furnace that they bring up are not pleasant.

Back of them stand the begrimed and impoverished workmen. Tubal-Cain was doubtless a strong man, but he does not greatly touch the imagination. You may think it a fancy, but I can not help believing that the hard and glittering surfaces of the metal exercises have a less humanizing effect than the other manual work. These influences of sound, color, texture, odor, and touch are very subtle, but they are not to be neglected, and particularly in the case of young children. I should therefore like to see the metal work somewhat reduced in amount, and thrown toward the end of the course. Its place could well be taken by work in wood and clay. I am glad to see that this is now being done in the majority of manual training schools, and that no metal work is introduced in the first year. In the early days, the poor little first-year boys used to have three solid terms of vise work, and it was somewhat dreary. Where the elementary metal work is still distributed over the first and second years, care is now taken to make it less monotonous. There may be one or two terms of vise work, one of sheet-metal work, one of molding and casting, one or two of smithing, and one of ornamental iron work. This is still the sequence in Philadelphia, but elsewhere the tendency is to throw the joinery and carving and part of the turning in the first year; the pattern making, molding, and smithing in the second; and to leave the vise work until the last year.

The most interesting and important of the metal work is undoubtedly that of the third year, the machine-tool practice and the construction of finished articles in the way of apparatus and machines. In the hands of a scientific man this department can be made to yield very rich results. The instruction may include so much to arouse and awaken a boy and bring reality into life and thought. Here he can learn to interpret mechanical drawings—a large training for the imagination; he can learn the niceties of mechanical construction, and by means of vise work, lathe, drill, planer, and shaper can turn his designs into solid facts in three dimensions; here he can embody scientific principles in suitable forms; can test new plans by carefully constructed models; he can do a hundred things that are useful and helpful, and will bring him into possession of himself. The work does not always take this broad turn, for it requires a very broad man to give it such a turn, but in estimating it, it is proper, I think, to value it for what it may become as well as for what it is.

Meanwhile, the girls have not been idle. They have been deep in the mysteries of cookery and domestic economy—mysteries so deep that I had better leave them to your imagination, for they would require of themselves a long chapter. But it is to be remarked that the occupations of the girls have nearly all of them a distinct practical end rather than a direct educational purpose. But they are defensible, I think, on the same broad grounds that the occupations of the farmer are defensible, that they contribute directly and essentially to the maintenance of life, and, like his, they may be made artistically excellent. Well-dressed men, women, and children, well-fed men, women, and children are ethical realities still far in the future. When you remember that we are dressed during the whole period of our social life and that we eat three times every day, eleven hundred times a year (allowing an occasional late supper), it is astonishing that these very human arts have not been brought to greater perfection. So I would not disparage the practical turn that is being given to the girls' education any more than I would disparage the practical arts which minister to distinctly human ends in the culture of the boys. But I do insist, quite as uncompromisingly for the girls as for the boys, that the arts of life are secondary, that the major end is life itself. And I hope to see manual training for girls given such a human and æsthetic turn that it will mean not only more accomplished home makers, but in even a deeper sense more perfect and more charming women.

I have tried to present an adequate picture of the manual training school. One will get a better picture if one will supplement this criticism by a day spent in the school itself.

WOMEN IN SCIENCE.

By HENRIETTA IRVING BOLTON.

A GREAT deal has been written of late years in regard to the "new woman"; a somewhat vague term expressing the contrast between the clinging, fainting, willowy heroine, dear to the hearts of our grandmothers, and the alert, athletic, breezy woman who rules the world to-day. According as the phrase is used, it becomes a title of honor, or a term of reproach; but in either case we are apt to look upon the "new woman" as a *fin-de-siècle* production. The "sweet girl graduate with her golden hair," who

"Knows the great-uncle of Moses
And the dates of the war of the roses,
And the reasons for things—
Why the Indians wore rings
In their red aboriginal noses,"

we regard as an outcome of this century, and we have only just become accustomed to the idea of women physicians.

That women should hold professors' chairs in the great female colleges seems quite right and proper; but think of the thrill of surprise and dismay which would fill the breasts of the mothers of this land should a lady, young and attractive, be appointed to train the masculine mind at Yale or Harvard!

On women lawyers we still look askance, at least in the Eastern States, and despite the attractions of some of the female divines, it will be "long after to-day" before women clergymen, a strangely contradictory term, win any large or enthusiastic following.

The fact remains that, with all our boasted progress and enlightenment, our age is much behind the past, and for a perfect type of the "new woman" we must go back to Miriam, the sister of Moses. She was no shrinking creature, hiding her light under a bushel; an accomplished musician and a poetess, she dared to assert herself, and to lead the Israelites with timbrels and with dances in their song of triumph upon the overthrow of Pharaoh and his horsemen in the Red Sea. She was also, so says tradition, learned in the sciences, and invented the *bain-Marie*, the double boiler of our kitchens, which still bears her name. She was an authoress as well, and wrote a practical treatise on alchemy which is still extant. She was a true woman in her love of gossip, and was most severely punished for "evil speaking, lying, and slandering," when she and Aaron expressed their opinion of their sister-in-law, the Ethiopian wife of Moses.

In 1894, Monsieur Rebière, a French mathematician, delivered a lecture entitled *Les Femmes dans la Science*, which was published in a small pamphlet of eighty-seven pages; this *brochure* he recently enlarged into a work of three hundred and fifty-nine pages, including more than six hundred names of women more or less distinguished in scientific pursuits. It is true that in order to swell the number the writer has included some names on insufficient grounds, and others about which he has no definite information; but the greater part of the book consists of short, well-written biographies, giving interesting and valuable insight into the lives of the women of all ages and countries who have made useful discoveries or profound studies in the various branches of science.

Although M. Rebière has omitted Miriam from his long list, we find sufficient dètails concerning women of ancient and mediæval times to convince us that the wearing of blue stockings is by no means a modern fashion. Nor are those who adopt the azure hose always the unattractive and elderly; on the contrary, their portraits show them to have been very fair to look upon. Indeed, so lovely was the beautiful Novella d'Andrea, the daughter of a professor of law at the University of Bologna in the fourteenth century, that when she took her father's classes she was obliged to lecture behind a curtain, in order to prevent the students, one and all, falling victims to her charms.

Among the ancients, mention is made of Athyrta, sister of Sesostris, who is said to have been an astronomer; Berenice, wife of Ptolemy III, King of Egypt, whose hair has given name to one of the constellations; Agnodice, the first female medical practitioner, who lived three hundred years before Christ; and the great Cleopatra, who is credited with possessing medical and chemical knowledge, besides occult powers.

At a later period we read of Hypatia, the romance of whose short and brilliant life is well known through the pen of one of England's most popular writers. She has obtained a place in the history of science by her extraordinary knowledge of mathematics; she taught geometry, algebra, and astronomy, and is said to have invented astronomical and chemical instruments. It is a remarkable fact that the story of the pagan maiden, murdered by Christian hatred, should have become transposed into the world-wide legend of St. Katherine of Alexandria, the beautiful, young, and learned martyr-queen.

Among the learned women we find St. Hildegarde, foundress of the Monastery of St. Ruppert on the banks of the Rhine, whose great work *De Physica* contains many personal observations of Nature. It treats of the rivers of Germany, of the nature and properties of metals, of vegetables, fruit and flowers, fish, birds, and quadrupeds. She seems to have been acquainted with the circulation of the blood, the physical phenomena of the tides, and with many other wonders of Nature. "The naturalist," says a recent writer, "finds in Hildegarde the germs of many modern discoveries." St. Hildegarde, who died at a great age in 1180, is a patron saint of physicians, and is often represented in art with a book or a pen in her hand.

The ancient universities of Italy early recognized the intellectual abilities of women, giving them every opportunity of gaining and imparting knowledge, and for several successive centuries numbered women among their most honored professors.

During the eighteenth century, three distinguished women were at one time occupants of chairs in the University of Bologna, one of the oldest and most important seats of learning in Italy: Maria Agnesi, Laura Bassi, and Anna Manzolini. Of the three, Laura Bassi was a few years the senior, having been born in 1711; she was a precocious child, and was early considered a prodigy of learning, being proficient in mathematics, Greek, and philosophy. While still quite young, she attracted the notice of Cardinal Lambertini, afterward Pope Benedict IV, and when only twenty-one was given the chair of philosophy in the university, a position which she held for twenty-eight years. In 1738 she married a physician,

J. J. Veratti, and became the mother of twelve children. She is spoken of as an excellent housekeeper, a judicious mother, charitable and most earnest in good works. Two years before her death she was appointed professor of physics at the university. Her personal appearance is thus described by a contemporary writer: "Laura Bassi has a countenance slightly marked by smallpox, but of a sweet and tranquil expression; her black eyes are sparkling, and she is serious and composed in manner without affectation or vanity."

Even more remarkable seem to have been the attainments of Maria Agnesi, born in 1718. She was one of the twenty-three children of a rich citizen, who must have needed all his wealth to bring up such a family. One of her sisters was noted as a musician, and was the author of three operas. Maria has been called the oracle of seven languages, speaking French fluently at the age of four, and early becoming proficient in Hebrew, Greek, and Latin, as well as German and Spanish. After spending her youth in the study of philosophy and philology, at the desire of her father, she devoted herself to mathematics, in which she attained such celebrity that she was complimented by Pope Benedict IV, who nominated her as professor of mathematics in the University of Bologna, a position she held for several years. At the death of her father she abandoned her chair and her studies to fulfill a long-felt desire for a religious life. She entered the Blue Sisterhood of Bologna, and spent the remainder of her long life in works of mercy and charity, gaining the name of the "servant of the poor." Her portrait and the contemporary accounts of her appearance show her to have possessed much beauty; in character she is said to have been modest, gentle, and almost timid.

Less gifted than these two women, but equally renowned, and whose knowledge has been of far greater practical value, was Anna Moranda Manzolini, a woman of humble origin, and the wife of a poor maker of anatomical models. Beginning as an assistant to her husband, she soon surpassed him in knowledge of his profession, and being encouraged by a friendly physician, she began to give lectures on anatomy. So great was her skill in dissection, and so clear were her demonstrations, that she soon acquired a European reputation, and her lecture room was thronged with students of all nationalities. After the death of her husband she accepted the professorship of anatomy at the University of Bologna, where her collection of anatomical models still bears silent testimony to her remarkable skill and accurate knowledge of the human frame.

Turning to France, we find at this period the Marquise de Châtelet, the friend of Voltaire, a woman "without faith, without manners, and without modesty," but deservedly famous as a mathematician, the author of many books, and the translator into French of the works of Newton; the beautiful Mademoiselle Delaunay, student of astronomy, geometry, physics, and anatomy; and others less distinguished.

A little later we read of Madame Lavoisier, who assisted her husband in his chemical experiments, learning English and German in order to translate for him the scientific works written in those languages, as well as engraving, in order to be able to illustrate his writings; the plates in his treatise of Elementary Chemistry all bear her signature. Madame Lavoisier was very beautiful, and her face is familiar to all through the celebrated portrait by David, which represents her standing behind her husband as he sits at his worktable. After the death of Lavoisier, who perished on the guillotine, his widow married Count Rumford, and lived to a great age.

Sophie Germain, born in 1776, is another French woman noted as a mathematician; she has been called one of the creators of mathematical physics. Her tomb at Père-la-Chaise is still often decked with fresh flowers. A high school for girls and a street in Paris have been named in her honor.

The recently published memoirs of Sophie Kowalevski have shown the difficulties which a Russian woman has to overcome in order to obtain the higher education, and they are also most pathetic, showing that neither science and learning nor the honors they bring can satisfy the deepest longing of a woman's heart. Full as are the pages of the record of her intellectual achievements, and the brilliant success of her genius, they are none the less the record of an unsatisfied and empty life.

Monsieur Rebière does full justice to the fame of Caroline Herschel, Mary Somerville, and our own Maria Mitchell, whose names and achievements are too well known to need mention here, and he also gives short biographies of many women now engaged in scientific pursuits in England and America: among them Miss Agnes Mary Clerke, author of many important works on astronomy; Miss Charlotte Angas Scot, one of the great living mathematicians, born in England, and now professor of mathematics at Bryn Mawr; Mrs. Ladd-Franklin, a graduate of Johns Hopkins University, not only noted as a mathematician, but as a student of logic and physiology; and others. An interesting account is given of Miss Dorothea Klumpke, born in San Francisco, and to-day "one of the foremost astronomers of France," where she is on the staff of the Observatory of Paris.

In studying the lives of those women who have been distinguished in science we are forced to the conclusion that their genius has but a limited field; while many have obtained fame through their knowledge of mathematics and its application to astronomy, they show but little aptitude for the natural sciences, and rarely exhibit any inventive faculty.

That a learned woman *can* be a happy wife and good mother such lives as Mary Somerville's and Laura Bassi's show us; that learning alone does not satisfy we learn from Sophie Kowalevsky.

Perhaps those women who have found the greatest happiness in their studies are those who, like Madame Lavoisier and Caroline Herschel, have been able to assist some loved one to perfect his researches. As a general rule the scientific woman must be strong enough to stand alone, able to bear the often unjust sarcasm and dislike of men who are jealous of seeing what they consider their own field invaded. This masculine attitude has been summarized by De Goncourt, who writes: "There are no women of genius; when they become geniuses they are men."

THE ROMANCE OF RACE.

By GRANT ALLEN.

LET us begin, like a wise preacher, with a personal anecdote. It happened to me once, many years since, to be taking a class in logic in a West Indian college. The author of our text-book had just learnedly explained to us that personal proper names had no real connotation. "Nevertheless," he went on, "they may sometimes enable us to draw certain true inferences. For example, if we meet a man of the name of John Smith, we shall at least be justified in concluding that he is a Teuton." Now, as it happened, that class contained a John Smith; and as I read those words aloud, he looked up in my face with the expansive smile of no Teutonic forefathers: for *this* John Smith was a pure-blooded negro. So much for the pitfalls of ethnological generalization!

Nevertheless, similar conclusions on a very large scale are often drawn on grounds as palpably insufficient as those of my logician. Facts of language and facts of race are mixed up with one another in most admired disorder. If people happen to speak an "Aryan" tongue, we dub them Aryans. We take it for granted one man is a Scot merely because he is called Macpherson or Gillespie; we take it for granted another is an Irishman on no better evidence than because his name is Paddy O'Sulivan. Yet a survey of some such delusive examples will suffice to show that all is not Celtic that speaks with a brogue, nor all Chinese that wears a pigtail.

Some familiar instances of outlying linguistic or ethnical islands, so to speak—little oases of one speech or blood or religion in the desert of another—will serve to lead up to the curious romances of ethnology and philology which I mean to huddle loosely together in this article. Everybody is familiar, of course, with such stories as that of the mutineers of the Bounty, who founded the colony on Pitcairn's Island, where a little community, about one quarter British and three quarters Polynesian, preserved the English language and the Christian religion for many years, without the slightest intercourse with the outer world. Equally significant in their way are the belated islands of Celticism in America, such as the Highlanders of Glengarry, in Canada, who migrated in a mass, and who still speak no tongue but Gaelic; or the Glamorganshire Welsh of the Pennsylvanian mining districts, who inhabit whole villages where Cymric is now the universal language. Again, we may take as typical examples of such insulation in the matter of religion the Abyssinian Christians, almost entirely cut off for centuries from the rest of Christendom by the intrusive belt of Nubian and Egyptian Islam. Who does not know, once more, that strange outlying church, the Christians of St. Thomas, whom the early Portuguese navigators found still surviving on the Malabar coast in India? Though believing themselves to derive their Christianity from the preaching of St. Thomas, these native sectaries are really a branch of the Nestorian Church of Persia—a distant scion of the Patriarchate of Babylon. Founded in the sixth century, their sect was recruited by successive flights of refugees from the revived Zoroastrianism of that date, and the triumphant Mohammedanism of succeeding generations. Their sacred language is even now Syriac. Or, finally, may we not take the racial islands, like the ancient Basque nationality in France and Spain, the Black Celts of Ireland and Scotland, and the Germans of Transylvania? side by side with whom we may place the scattered and intermixed races, like the Jews and the Gypsies, who still preserve some relics of their ancient tongues, while speaking in each country the language of the inhabitants. It will be clear at once from so rapid a survey of these few familiar instances that a map of the world, colored by race, by speech, or by religion, would be dotted all over with insulated colonies, as quaint and suggestive in their way as that of the mutineers of the Bounty.

Consider, as one striking and well-known example, the curious history of the Parsees, earlier pilgrim fathers of an Oriental Mayflower, who fled eastward and southward before the face of Islam in Persia to the west coast of India. Their very name means Persians; they are the remnant of the ancient Zoroastrian religion, followers of that shadowy and doubtful prophet, whose very existence has been called in question by the skepticism of our century. But whether or not there was ever a Zoroaster, it is certain, at least, that Zoroastrianism flourished in Irania, from Tibet to the Tigris, at the time of Alexander; and that it declined before the fashionable Hellenism of the Seleucidæ, or, later, of the Parthian and Græco-Bactrian kings. Gradually, however, the Hellenic influence in inner Asia "petered out," as an American miner would say, for lack of fresh Greek blood, till at last hardly anything tangible was left of it save Greek names in Greek letters on coins of barbaric kings. Then a native dynasty, that of the Sassanians, upset the last of the half-Hellenized Arsacidæ, and the Zoroastrian faith, which had lingered on among the people, became, at the beginning of the third century after Christ, the established religion. The Magi had things all their own way, and persecuted Greek thought with the zeal of inquisitors. For four hundred years the creed of the Zend-Avesta held sway in Iran, till the Caliph Omar bore down upon the land with his victorious Mohammedans. The mass of the population were "converted" *en bloc* by the usual argument of Islam, at the battle of Nahavand; and the faithful remnant, who declined to accept the creed of the Prophet at the point of the sword, fled as best they might to the desert of Khorassan. A few thousand persecuted and despised Zoroastrians, known as Guebres, still linger on in the dominions of the Shah; but the greater part of the incorruptible took ship to India, where they settled for the most part in the neighborhood of Bombay and the other trading towns of the western coast. As they never intermarry with Hindus or Mohammedans, they still remain pure, both in race and religion, and can not be regarded as in any sense representative of the people of India. Their sacred language is still the Zend of the Avesta, and their fire worship is as pronounced as when they fled from Persia.

These historic examples are familiar to most of us. Far more interesting, however, are the prehistoric facts of similar implication, which are known to few save the students of ethnology. It is not everybody, for instance, who is aware that the language of Madagascar is not African at all, but a pure Malayan dialect. The ruling race of the island (till France displaced them) were the very unnegrolike Malayan Hovas. Now, the Malays in their day were the Greeks or the English of the Indian Ocean. Just as the Hellenic race annexed the Mediterranean, turning the inland sea with their colonies into a "Greek lake" (as Curtius calls it), and just as the "Anglo-Saxon" race annexed the Atlantic and the Pacific, colonizing the United States, Canada, South Africa, and Australasia, so did the Malays annex the Indian Ocean, penetrating every part of it in their light pirate craft, and settling where they would among subject populations. They may be compared with the Phœnicians in the earlier world as pioneers of navigation among the far-eastern islands.

The aboriginal people of Madagascar, again, were apparently not African at all, but members of the still more ancient Melanesian race, which is scattered in little groups over so many parts of the Pacific and the Malay Archipelago. This race apparently spoke already, at an early date, the common Malayo-Polynesian tongue—that widespread speech which, as we now know, forms the basis of all the dialects in use from Madagascar itself, right across Java, New Zealand, and Melanesia, to the Sandwich Islands and the very shores of America. And, what is odder still, the Malagasy dialect of the present day approaches nearest to that of the Philippines and of Easter Island. In other words, at these immense distances relics of an ancient common language survive, which elsewhere has undergone specialization and simplification into the modern Malay of Java and its neighborhood. It is almost as though somewhere, among scattered villages in Portugal and in Roumania, people were still speaking tolerably pure Ciceronian Latin, which elsewhere had glided by imperceptible degrees into French and Spanish, Italian and Provençal.

The lowest and oldest layer of the Malagasy population thus probably consists of black, woolly-haired Melanesians; above it come true yellow-brown Malayan immigrations, the last of which is apparently that of the dominant Hovas. These two have intermarried more or less with one another. But there is also a true negro admixture on the side nearest Africa; while the intrusive Arab has, of course, established himself along the coast line wherever he found an opening for his peculiar genius. Thus, even before Christianity and the European element came in to disturb our view, the ethnical facts of the island were tolerably mixed, and presented several problems on which I have not space to touch. But if this seems a good deal of ethnology for a single land, we must remember that Madagascar would cut up into four of England; and even in our own country the known elements of the population, Silurian, Cymric, Brigantian, Cornish, Anglian, Saxon, Norwegian, Danish, Norman, and so forth, are sufficiently numerous; while modern anthropologists would probably fight hard for an admixture of Palæolithic, Neolithic, Roman, Dacian, and Spanish elements, as well as for a trifling fraction of Jewish, Gypsy, Huguenot, and negro blood. It is a truism now to say that "there is no such thing as a pure race"; every individual, especially in civilized countries, is a meeting place and battlefield for endless hostile and conflicting ancestors. Our idiosyncrasy depends in the end upon the proportion of each which comes out victor in the formation of our character.

Take the single kingdom of Scotland alone. Englishmen are carelessly wont to suppose there is such a thing as a Scotch temperament. Scotchmen know better. Even if we omit from the reckoning such remoter and more doubtful elements as Black Celts, and so forth, we may say, roughly speaking, that Scotland consists of six distinct nationalities—the English of the Lothians, the Welsh of Strathclyde, the Irish Scots of Argyllshire, the true Gaels of the Highlands, the Picts of the east coast, and the Scandinavians of Orkney, Caithness, and Sutherland. All these, of course, though in some places tolerably pure, are in others inextricably intermingled; while outlying islands of each, such as the Picts of Galloway, are universally recognized. The "Little England beyond Wales" in Pembrokeshire, mainly peopled by Flemings, who are English in speech among a Welsh-speaking population, forms a similar example in the southern half of our island; while, conversely, little outlaw communities of Welsh-speaking Britons are known to have held out in the eyots of the Fens for many generations against the conquering English of East Anglia and Mercia.

Take a linguistic case again. How strange it would seem to us to-day if there existed, say in Newfoundland, a colony of Anglo-Saxons, sent there by King Alfred, and speaking still the pure old Saxon tongue of King Alfred's Wessex! Yet this would exactly parallel the case of Iceland. While Danes and Swedes have modernized the ancient Scandinavian of the Sagas into the Danish and Swedish of the present day, the Icelanders still go on speaking the tongue of their forefathers pretty much as it was spoken by Rolf the Ganger and Harold Hardrada; they read the Sagas in the tongue of the old singers as easily as our children can read Shakespeare and the English Bible. Mr. Steffanson, the learned Icelander, tells me another interesting fact of the same sort. It seems the women in certain parts of Normandy still wear a peasant cap with silver ornaments identical to this day with the cap commonly worn by Icelandic women. I need hardly add that the names of Norman villages are but Frenchified corruptions of the old pirate nomenclature—Ivo's toft has been shortened to Ivetôt, while Hacon's home has declined into Haconville.

On the other hand, nothing is more fallacious than the old-fashioned argument from language to kinship. It used once to be thought there was a "great Aryan race" because there were many peoples who spoke the Aryan languages. I doubt whether even Professor Max Müller himself really believes nowadays in Our Aryan Ancestor; certainly, for the rest of the world, that exploded old humbug has vanished into the limbo of central Asia, whence he never came, according to our latest authorities. (If he existed at all, it was probably in Scandinavia.)

A race, indeed, may speak the language of another without having received any appreciable admixture of its blood; just as, for example, the pure-blooded negroes of the West Indies and the Southern States speak no tongue but English, Creole French, or Spanish. So, again, English has become the language of Ireland, without interfering to any large degree with the Celtic nationality of the people; indeed, writers who talk about the "Anglo-Saxon race" in America and the colonies forget that the Anglo-Saxon who emigrates is generally either an Irishman, a Welshman, or a Highland Scot, without prejudice to the chance of his being a Cornish miner or a Celtic Yorkshireman. Through these Anglicized Celts, the English language has taken possession of North America, South Africa, and Australasia; not only is it swallowing up the French of Canada or Louisiana, the Spanish of California or New Mexico, and the Dutch of the Cape, but in the New World it has blotted out the African and Indian tongues, and is assimilating in the second generation the German, Scandinavian, Russian, and Italian immigrants. Your true New-Englander is not a prolific father, like the German or the Irishman; and I believe myself that the proportion of Anglo-Saxondom in the America of our day has been grossly overrated. "Anglo-Celtic" is perhaps the truest description of the British nationality.

One of the greatest surprises of modern discovery in ethnical and linguistic science is similarly the overthrow of the Great Chinese Fallacy. Time was when the remote antiquity of China and Chinese civilization was an article of faith for European scholars. It was believed that the yellow man had developed his own culture, such as it is, independently for himself, in the far east of Asia. He was the pioneer in writing, printing, and the use of gunpowder. But now Chinese scholars have shown us, alas! that China really derived its civilization, like all the rest of us, by indirect steps, from Babylonia and Egypt. M. Terrien de Lacouperie first demonstrated the fact that long before the ancestors of the Celestial race reached the middle kingdom which they now inhabit, by the Hoang-Ho and the Yang-tse-Kiang, they lived in close contact with that ancient civilized people, the Akkadians of Babylonia. From the wise men of Akkad they learned the rudiments of their arts; and when they set forth from Mesopotamia, a little horde of Bak tribes, on their long journey eastward, they carried with them both the early elements of Akkadian science, and the words and phrases of the Akkadian language. They reached China with letters, astronomy, and arts ready made, and they have done little since but live on the traditions of their far-western ancestors. The truth is, for the eastern hemisphere at least, there is but one civilization, which began in Egypt and the Euphrates Valley, and spread in either direction, eastward to Persia, India, and China, or westward to Asia Minor, Greece, Italy, and the Atlantic.

Even the Chinese language turns out, on examination, to be just the opposite of what earlier investigators thought it. Elder philologists took it for granted that primitive tongues *must* have been monosyllabic; and since Chinese is monosyllabic, they regarded it, somewhat illogically, as therefore primitive. But Terrien de Lacouperie and Douglas have shown, on the contrary, that Chinese is really Akkadian by origin, and that it was once polysyllabic, like most other languages. Its words have been shortened by wear and tear, or by that familiar process which turns omnibus into "bus," photograph into "photo," and bicycle into "bike." It consists of words said "for short," like the common abbreviation of William into Bill, Richard into Dick, or Theodore into Theo; or rather, it has suffered by that imperceptible phonetic change which has reduced *eleemosyne* to "alms," *semetipsissimum* to *même*, and Aethelthryth to Awdry. In fact, it turns out that Chinese, instead of being one of the most primitive languages, is really one of the most worn and degraded. In place of "psychology" it would content itself with *psy;* while *tel* or *pho* would do duty for "telephone."

In this case, the diffusion of a language and a culture is by simple migration, as in the well-known instances of Tyre and Carthage, of Greece and Sicily, of England and America. In other cases, the diffusion is rather by conquest, as in the equally well-known instances of Alexander's successors, of the Roman Empire, and of the Arabs in Egypt, North Africa, and Syria. Greek, Latin, and Arabic, with their accompanying arts, became naturalized among the subject peoples. Most often, it is the conquerors who thus impose their language on the conquered; we need go no further afield than Wales or Ireland, where the process is incomplete, and Cornwall, where it reached its termination a century ago. But sometimes it is the conquered who absorb and assimilate the conquerors; the Normans seem to have been good hands at thus losing their identity wherever they went; for in Normandy, they dropped their native Scandinavian and adopted old French; while in England again they lost their French, and in a few generations became thoroughgoing Englishmen. In Ireland, too, as an Irishman expressed it, they "inculcated Celtic habits," and gave rise to the famous saying, so often repeated, that they were "ipsis Hibernis Hiberniores."

On a large scale, this absorption of the conquerors by the conquered appears to have gone on over the entire Malayo-Polynesian region. It is curious that over this wide area from Madagascar to Hawaii only one type of language is spoken by the remotest islanders, belonging to all races, and having attained the most varied degrees of culture. The black and woolly-haired Melanesians of the South Pacific Islands, the warlike Maories of New Zealand, the gentle, brown Polynesians, the yellow Mongoloid and Mohammedan people of Java, the dark and half-negrolike Malagasy of Madagascar, all speak varieties of this widely diffused language. At one time it was supposed that the Malays, those active Vikings of the far East, had carried their own tongue to these remote places; but then, as Mr. A. H. Keane has pointed out, Malay itself is not the most primitive, but the latest and most developed, member of the group. It answers to French rather than to Latin; it is like modern Danish rather than modern Icelandic. The truth seems to be, as Mr. Keane suggests, that the language in question is a very old one, originally belonging to the true Polynesians. Before their arrival the Pacific isles were peopled by the low black race whom we call Melanesians. Many of the archipelagoes, however, were afterward conquered and colonized by the lighter and essentially Caucasian people, closely akin to our own, whom we call Polynesians. These white Polynesians intermixed and intermarried more or less with the black Melanesians, remaining relatively pure and light-colored in a few of the archipelagoes, while in others they acquired such an infusion of black blood as made them in time dark brown or copper-colored. They imposed their own speech upon the black people everywhere, exactly as the English have imposed the tongue of Shakespeare and Newton upon the rude American and West Indian negroes. In the remotest and blackest islands, Mr. Keane points out, the oldest and crudest form of the common language survives, just as the ancient Scandinavian of the Sagas survives in Iceland; in the more advanced light-brown Polynesian groups, it has been improved and simplified into a more modernized form, just as in Europe the ancient Scandinavian has been improved and simplified into modern Danish and modern Swedish. Finally, at a still later period, the Polynesian tongue was adopted by the yellowish Mongoloid Malays, who conquered the same region, and who further improved and simplified it into the Malay of commerce, as the Normans did with the English of King Alfred. Unfortunately, however, the languages in the lump are generally called Malayan, after the latest people who adopted them, instead of Polynesian, after their original speakers; which is somewhat the same error as if we were to describe English as the Norman tongue, or speak of Latin, Spanish, and Portuguese as belonging to the French Canadian group of languages.

The fact is, we have to recognize that changes such as those which we know to have taken place during the historical period also took place in prehistoric times and in unhistoric countries. Just as the English now colonize the coasts of the world, from Australia, Tasmania, and New Zealand, to South Africa, Canada, British Columbia, and Demerara, so the Phœnician and the Malay colonized in earlier times the Mediterranean or the Indian Ocean, and so the Melanesian in a very remote past spread across the Pacific in the frailest of vessels. And just as the Goth and Hun and Tartar swept down in historic times on the Roman Empire or the Asiatic world, so, long before, unknown migrations and unnamed hordes of savages swept down upon Egypt, Mesopotamia, and India. For the historic periods and places, we have documentary evidence; for the prehistoric or unhistoric, we have but the evidence of the existing and resultant arrangements.

Even these, however, tell us a great deal. What, for example, can be more curious than the existing diffusion of that tiny black "Negrito" race, with woolly hair and very protruding jaws, which is now in all probability the earliest surviving variety of the human species? These pygmies occur in Africa as the dwarfs of the forest country, the Akkas, Wochuas, and others, barely four feet high; as the Batwas and Bushmen of the south; and less pure, as the Hottentots. They crop up again in the undersized aborigines of the Andaman Islands of the Gulf of Bengal, in the Negritos of the Philippines, and in the small black Papuans. Hence we are justified in concluding that this widespread half-developed race of dwarfs once covered a large part of the southern world, from which it has now been ousted by newer, bigger, and more developed tribes; while the primitive pygmies hold their own best either in a few remote islands, in a few barren deserts, or else in very dense and pathless forests, through which taller races would creep with difficulty.

Not less interesting than these romances of race as race are the romances of the interaction of race and religion, or of race and culture. For example, the Moors of the towns and of the seacoast in North Africa, largely intermixed as they are with Arab and other Semitic blood, have swallowed Islam entire, adopting not only its religion but also its social order—its polygamy, its harems, its veiling of women. The Kabyles and Berbers of the hills, on the other hand, fairly pure descendants of the old native Mauritanian or Romanized inhabitants, though they have accepted Mohammedanism more or less fervently as a religious faith, have never really assimilated it as a social system. To this day they are practically strict monogamists; their women do not veil, but freely show their extremely pretty and piquant faces; while the family is organized on much the same basis as in Europe generally. In other words, the racial habit of allowing a certain freedom and independence to women has proved stronger in practice than the law of Islam; the intrusive Semite has not been able to inoculate with his ideas the Hamitic North African. Nor in "Aryan" Persia, again, has the prohibition against wine been so successful as elsewhere; while the native artistic and pictorial spirit of the Persian race has made a dead letter of the restriction against fashioning an image of anything that is in heaven above, or in earth beneath, or in the waters that are under the earth. Race, in short, has proved stronger than religion. For the Persians are Shiahs, not orthodox Sunnis; they have transformed the materialistic tenets of Islam into a mysticism not far removed from that of India or the Buddhists. Who could mistake Omar Khayyam for a mere Mohammedan?

Very similar ethnical diversities of faith may also be noticed in our own islands. The Anglican church, as a rule, has firmly established itself in the more Teutonic and southeastern half of Britain alone. The Gaelic Celts, both in Ireland and the Scotch Highlands, have remained Roman Catholic; the Cymric Celts, both in Wales and Cornwall, have adopted Wesleyanism or some emotional form of Protestant nonconformity. Even in England proper it will be found that the Establishment flourishes best in the Teutonic southeast, while dissent is rife in the half-Celtic north, in the Yorkshire dales, in Lancashire, and in the west country. I may add, side by side with these facts, that poets, musicians, and painters spring most frequently in Britain from the Celtic or semi-Celtic north and west, while they are rarer in the Teutonic or Teutonized south and east. Vocalists, in particular, are very frequently Welsh. Even in London, that vast congeries of mingled races, it is not without reason that nonconformity is led by Cambrians like the Rev. Hugh Price Hughes, and that song is dispensed for us by Mr. Hirwen Jones and Mr. Ben Davies.

Canon Isaac Taylor has pointed out a still more curious cross-division of Europe as a whole, dependent upon underlying racial features. Two main types of skull are generally distinguished throughout the whole historic and prehistoric period—there are the dolichocephalic or long-headed, and the brachycephalic or short-headed people. "The dolichocephalic Teutonic race," says the learned canon frankly, "is Protestant; the brachycephalic Celto-Slavic race is either Roman Catholic or Greek orthodox. . . . The Teutonic peoples are averse to sacerdotalism, and have shaken off priestly guidance and developed individualism. Protestantism was a revolt against a religion imposed by the South upon the North, but which had never been congenial to the Northern mind. The German princes, who were of purer Teutonic blood than their subjects, were the leaders of the ecclesiastical revolt. Scandinavia is more purely Teutonic than Germany, and Scandinavia is Protestant to the backbone. The Lowland Scotch, who are more purely Teutonic than the English, have given the freest development to the genius of Protestantism." And then the intrepid canon, instead of worrying about theological explanations of the fact, goes on to show that the mean cephalic index (as it is called) of the Protestant Dutch is nearly that of the Swedes and the North Germans; while the Belgians are Catholics because their cephalic index approaches that of the Catholic Parisians. If a Swiss canton is long-headed, it is Protestant; if round-headed, it is Catholic. And Canon Taylor accounts (rightly, as I think) for one apparent British exception by saying shrewdly, "The Welsh and the Cornishmen, who became Protestant by political accident, have transformed Protestantism into an emotional religion, which has inner affinities with the emotional faith of Ireland and Italy."

Unless so distinguished a divine had led the way, I do not know whether I should have ventured myself to follow into this curious by-path of ethnology. But, in future, whenever one is tempted to ask one's self the once famous question, "Why am I a Protestant?" the answer will be obvious: "Because 75 is my cephalic index. If it were 79, I should, no doubt, have become a Dominican brother."

How charming is divine ethnology! I have said enough, I hope, to show that it is not harsh and crabbed as dull fools suppose, but teeming with odd hints of unsuspected quaintness.—*Cornhill Magazine.*

EDUCATION FOR DOMESTIC LIFE.

By MARY ROBERTS SMITH, Ph. D.,

ASSISTANT PROFESSOR OF SOCIOLOGY IN LELAND STANFORD JUNIOR UNIVERSITY.

THE need of some kind of education as a basis for every activity is constantly emphasized to-day; but this emphasis is rarely applied to the need of training for domestic life, for which it is usually supposed that any kind of preparation will do. One million six hundred thousand women in the United States are engaged in domestic service, and eleven million one hundred thousand more are married and presumably have some kind of domestic duties. Several writers have called attention recently to the fact that a woman does not necessarily have an instinct for home-making; that while her instinct for the care of children may be strong, yet she may lack the skill to make a fire properly or to mix the ingredients of wholesome food. Or she may be skilled in handling modern kitchen appliances, but may lack the knowledge of the effect of exercise, regular hours, wholesome food and clothing adapted to climate, upon the future health and mental development of her children. It seems to be only just now dawning on women that domesticity—that is, the care of the household and children—is in itself a profession for which the best training and the fullest development attainable are not too much.

The education of women has tended to develop along the same lines as that of men. The classical education for the gentleman has changed to the general education for the average man, and to the specialized education for the industries as well as for the professions. A similar change is taking place in the education of women, but has reached only the second stage. Those who first insisted upon the value of a higher education for women thought it sufficient that they should have the same opportunities as men. This experiment has been tried now for a generation, and it is found that all women do not need the same kind of training as men any more than all men need a purely classical or a purely scientific education. In other words, individualism is breaking up all the accepted lines of education for women as it has for men. As a result, differentiation of courses within the higher training is demanded to meet the practical needs of a life in which no two individuals can possibly do precisely the same things. The fact that one third of all women in the United States are married sets them aside as needing a peculiar training for their profession.

In domestic life women need at least two things: first, the greatest general culture attainable to enrich the home life and to retain the sympathies of children, as well as to store up for themselves resources in hours of difficulty, loneliness, or sorrow; second, they need an education adapted to the everyday business, especially to the emergencies, of domestic life. No education is complete nor, indeed, of great permanent value that does not teach how to live contentedly and to economize nerve energy. To be contented, one must feel sure that one is in the right place, and must have spiritual and intellectual resources to tide over life's emergencies whose end one can not see. To be economical of nerve energy, one must learn a finely balanced self-control and a large-minded discrimination between the values of competing duties and attractions.

It is a significant fact that of one hundred and eighty-four living children of two hundred and twenty-eight almshouse women, less than one third are self-supporting. One fourth are lost—that is, they have been separated from the mother in one way or another, and she no longer knows where they are. The women themselves give all sorts of plausible reasons why their children do not support them; but the fact is, as the stories show, that nineteen women were cast off by their relatives or children because of their drunken, vicious, or filthy habits, and nearly as many because their children were ashamed of them; five have quarreled with daughters or grandchildren. These facts show that the home life was defective in those characteristics which tend to bind the family together. In the Elmira Reformatory seven per cent had had a good home, thirty-nine per cent fair, fifty-four per cent poor, showing the preponderance of bad home conditions. In conducting a student employment bureau it was found that there was an undue supply of those who wished to do bookkeeping, typewriting, and clerical work, while there was great difficulty in securing any one who could do mending, plain sewing, or ordinary housework satisfactorily. There was a large amount of this domestic work to be performed in the community, but the young women who were obliged to earn a part of their living in college were quite incapable of doing what was needed. Charity and settlement workers continually testify that the women of the laboring classes lack proper training and skill in making home comfortable and wholesome. Without additional illustration, it appears that women are being prepared for everything else than domestic life—the life which, as statistics show, nearly one half of them are living.

What, then, does the average woman need? In the first place, a thorough manual training. She needs to know how to cook a wholesome meal properly, to put it on the table appetizingly, and to do this with the minimum expenditure of energy. It is one of the most hopeful signs in elementary education that kitchen gardening and household training are being introduced into those schools which the children of the general population attend. The need of this practical domestic training for girls has probably been sufficiently emphasized, but in the general readjustment of occupations and duties going on between men and women, it is more and more apparent that boys as well as girls need a certain amount of elementary domestic training. It is a mere fetich, for instance, that women should do all the mending or even have all the care of children. There are many families in which family happiness, comfort, and prosperity would be greatly promoted if the husband and father could, at least in an emergency, take a competent share in the routine work of the household. There are many generous and kindly husbands who would be glad to help, but who are incapable through lack of elementary training. Since the bearing and rearing of children is the most important function of women, the mother must be relieved, at least at times, from many of her ordinary household cares. If there be not money enough to hire extra service, it is inevitable that the father should take, at least temporarily, some of these duties, if the family is to be maintained in comfort.

Again, the average mother needs a thorough grounding in elementary physiology and hygiene. Five per cent of all children born in the United States die under five years of age. When this occurs, the waste of human energy both before and after birth is something appalling. Prof. A. G. Warner estimates that it costs about a hundred dollars in loss of labor on the part of the mother, in doctor's bills, medicine, and nursing, to bring a child into the world, in a laboring-class family; while in families where a higher standard of living prevails this may amount to hundreds or even thousands of dollars. From a purely economic standpoint it is of the utmost importance to society that a child which costs so much, not merely in money but in vital energy, should be reared to maturity. The appalling mortality of children that are born fairly normal and vital is chiefly to be accounted for by the ignorance of mothers. The average woman may not need to know how many bones there are in the body, but she does need to know the connection between rich gravies, indigestion, and bad colds. She may not need to know how to bandage a broken arm, but she does need to realize the effect of sudden changes of temperature upon the delicate infant organism. The value of applied physiology in preserving infant life and diminishing hereditary and individual disease can not be overestimated; and no woman is fit to be married who has not had a training which gives her the elements of this essential knowledge.

Finally, women need a training in ethical standards. One of the curious anomalies disclosed by the entrance of women into industrial life is that while they have higher standards of purity than men, they frequently have much lower standards of honor and honesty. They do not hesitate to outwit, deceive, and "manage" difficult husbands; they train children in dishonesty by continually violating the most common standards of sincerity and directness. Children learn far more by example than by precept: the mother who continually promises, but always finds excuses for not performing; who threatens, but does not punish; who suppresses the child's frank comments on evil actions in others, while herself gossiping about her neighbors; who pretends to dress and to live above the scale of the family income, gives an education in dishonesty and sham which can not be overcome by any amount of so-called moral training.

If to all these practical and utilitarian attainments the mother can add the graces of culture in music or art or literature, she may give the child a background for education and a resource in life beyond the power of statistics to estimate. The elevation, enrichment, and sweetening of the family life by these contributions from the mother's own storehouse of culture are a safeguard against temptation from without not to be matched by legislation or training, nor even by church influence. To make the household sweet, wholesome, dignified, a place of growth, is certainly a profession requiring not merely the best training, but a specific training adapted to these ends.

SUPERSTITION AND MAGIC IN CAMBODIA.

By M. ADHÉMARD LECLÈRE.

THE Cambodians are superstitious, and believe in ghosts, familiar spirits appearing as Jack-o'-lanterns, were-wolves, benevolent and malevolent genii, and demoniac possessions. They believe, too, in witches and diviners, evil-minded persons, who take advantage of what they know to make ill or damage whom they will, or drive a good trade in love philters and antidotes. The people are afraid of these uncanny persons, and yet they sometimes resort to them.

The ghosts are very much like our own ghosts, and when displeased with their still living friends annoy them with noises and mysterious breakings, but are seldom seen. Much in their behavior, however, depends upon the kind of persons they were in life. Some of the more evilly disposed kind enter the bodies of people and render them ill, when a *thmup*, or ghost-disperser, is sought who knows the special prayers and exorcisms that will drive them back to their tombs. It is said that most ghosts will cease to return when the last part of the flesh of their bodies has been decomposed, but some persons assert that riddance of them is not assured till the last particles of their bones have disappeared.

The Jack-o'-lantern spirits are much more mischievous than the others because, I am assured by one of the *literati*, they are ghosts of women who have died pregnant, and are affected by the disappointment of the child at not having been given the privilege of a worldly existence. Both kinds of ghosts are liable to bring with them fever, cholera, dysentery, and other diseases, and, penetrating the bodies of persons on whom they desire to be avenged, leave their ills there. They often resist the efforts of the exorcists for several days, and do not seem to comprehend the special prayers that are directed against them, and some refuse to go away till they have brought on the death of the person whom they have possessed. They sometimes also amuse themselves by misleading travelers. They change the blazes on the trees and break branches of the bushes in the forest paths, so that the wanderer can not tell which is the route he had marked in the same way, or they will call him aside and lead him into the swamps. Many persons, mistaking their light for that of a house, have thus followed them and been lost.

The approach of spirits menacing a household is announced by the hooting of the owl, "that hungry wild bird of the night with a cat's head and eyes," that scents death from afar. Then mothers tremble for their children. I have seen, in remote farmhouses, fragrant torches placed around the cradle, while the frightened mother stood with folded hands watching. Her fear ceased as soon as I came in, because she had a *parang* with her and was safe—for the Cambodians believe that these evil spirits keep well away from all places where Europeans dwell.

A more terrible and powerful class of spirits are the *arac*, or demons, who take possession of a body and bring death and madness to a whole family. Sometimes, to get more complete possession, the demon takes away the proper soul of the possessed, and hangs it on a tree, where it has miserably to wait for its reincarnation. The possessed ones behave very much like the hysterics of the sixteenth and seventeenth centuries, suffering violent convulsions, and accusing this one or that one of having bewitched them.

The genii are as much feared as the demons, although they are regarded as being good; but as they have also the reputation of being just, they inspire dread, because one can never know when he may have given offense. They take possession of particular places—of mountains, forks of roads, roads, and rice fields—as their protecting and avenging spirits; and numerous spots are regarded with peculiar awe on account of their abiding there. The distinguishing trait between the demons and the genii is that the demons are always bad because they are never good, while the genii are friendly or hostile according to the character of the persons they are dealing with. The former are of infernal, the latter of human, origin. The genii are ancestors passed into oblivion, who, having no longer to watch over their direct descendants, watch over the whole country, over the Cambodian people, and are guardian angels of the nation, as the ancestors are the guardian angels of the family. The Cambodians see in them justice and often counselors to the people.

It was believed, according to an old tradition, that Buddha was to reappear before the year 1888 passed away, and the prediction threatened woe to those who did not prepare the ways. Taking this to refer to the roads, and to mean they should be prepared for the holy saint as they were for the king when he traveled, the people set themselves at work upon the required improvements. Stakes would be found in the morning, driven by no one knew whom, in places where they had not been, when men, women, and children would come out with shovels and hoes to remove the earth, and baskets to carry it away. In some places the bonzes, who were certainly not ignorant concerning the stakes, directed the workmen, and had the roads made straight to their pagodas. The Chinese and Malays do not escape the road-making fever, and while I was French resident at Kampot I heard some very curious stories of men who were mysteriously struck down for ridiculing or opposing it. At one place a Malay questioned the utility of the work. "What do we want of roads?" he said. "We have always got along without them; this is a French idea." His fellows warned him to look out, or harm might come to him. He went home, and in a little while cries were heard coming from his house. His neighbors went in and found him lying on his side, with his arms stretched out, crying: "Untie me; take a knife and cut the ropes from my arms; cut them and let me work on the road! I have been bound because I spoke ill of the genius." Without a smile, one of the neighbors took a knife and made a gesture of cutting the invisible cords that bound the arms of the unhappy man. He rose, shook his arms to get the stiffness out of them, and went to work on the road. Nobody doubted that he had been bound by a road genius. When I ordered a road built between Kompong Bay and Mac Prang, the Malay under-governor, who was hostile to the project, did nothing toward carrying my orders into effect, till one night a genius appeared to him and ordered him to proceed with the work, because Cambodia must have as broad and fine roads as Paris. He set his gangs to work the next morning.

The witches are not willing to confess to the possession of mysterious powers, because they are afraid of the courts and of popular prejudice; but they may be known by their strange appearance, their bright, lively, black eyes, and restless demeanor. "A witch," I was told, "is always looking anxiously around, because she always has her devil with her." Some witches acquire their standing by imitation, but more by inheritance. The daughter of a sorceress, even if she does not practice her craft, and is not acquainted with its secrets and magical formulas, is supposed to be possessed of a fatal power of which she can not be deprived. She casts the evil eye and terror about her, and her neighbors fear and despise her.

A woman sixty-two years old, who had worn irons on her feet by order of her governor for more than a year, was sent to me, charged with sorcery and the evil eye, although no mischief could be laid up against her. To justify his course the governor said he apprehended that the people would treat her cruelly; but he was really as superstitious as they, and was afraid of her power. The governor of another province refused to take her as a servant when she asked him to, because he was afraid for his family. The interpreter of the residence, a Roman Catholic of Khmero-Portuguese origin, refused to take her home at my request, because of her lively eyes and fear for his wife. A niece, who probably knew more about the unreality of her powers than the governor and the others, at last agreed to take care of her. She told me that her ancestors were reputed to be sorcerers, but she knew nothing about the art, and had never practiced it.

There are other sorcerers who pretend to be acquainted with the demoniac science, and make a trade of it. They sell love philters and magic formulas that will compel the passion; potions that will produce abortions; poisons and more or less effective remedies; and fetich strings that will keep devils and ghosts away. All Cambodians, even the king, believe in them. We need not ridicule Norodom and his countrymen for this, for I have found instances of like weakness among Frenchmen.

Amulets play a prominent part in Kmer life. Besides the cords that keep away evil spirits, they have small cylinders of lead or tin with a cotton or hempen cord running around them, to preserve them against certain diseases; and usually they contain an inscription in Pâli, and a mysterious invocation. Soldiers wear pieces of white cotton cloth marked with arabesques and letters and figures, for protection against death and serious wounds. A lover who repeats nine times the words *Setthi théa jac juc tas ae pac kai sang khac annamac* into a pocket handkerchief he intends to give a young woman feels certain that he will win her love. Another way of securing the love of a woman, however indifferent she may be, is to write her name on a betel leaf and pronounce upon it four times, before taking it into his mouth to chew, the words *Oru chéa sac rat svahap.* The sorcerers also sell marvelous invocations to augment the love of a spouse who is too cool, to prevent jealousy troubling the peace of polygamous households, and to cure slaves of the disposition to run away. They have, too, formulas to cure the bites of scorpions and snakes, to drive rats and mice away from granaries and sacks of paddy, to dispel sorrow, and to make their persons plump.

Many secrets have been lost in the course of time. I was told that there were formerly sorcerers who could travel through the air astraddle of a broomstick or of a porter's rod. The *Maha Rusey*, or hermits of the Satras, are represented as having been able to ascend in the air and penetrate everywhere, to bewitch arms, to manufacture amulets, and render their friends and adepts invulnerable. The modern sorcerers, who have succeeded the *Maha Rusey*, are much less powerful and less skillful. There are said to be sorcerers who even make wax figures to which they give the name of a person they wish to hurt or kill, and then stick with a knife, pronouncing magical words at the same time, when the person represented by the statuette is supposed to be wounded in the same way. Others, having made and named the statuette, put it where the sun will shine upon it, and as it wastes away in the heat the person represented by it declines, until, when it has all melted away, the person dies—very much like a Western form of enchantment.

Another form of sorcery is beating a buffalo hide with an enchanted stick, pronouncing a magic formula the while, to cause the hide to shrink till it is invisible. It is then ordered to enter the stomach of the victim of the spell, and obeys, when it swells out again till the victim is killed. Yet, if the stomach is examined after death, nothing will be found in it, because the hide has shrunk again to nothing.

These sorcerers pretend to cure diseases. When they are called for this purpose, the first thing looked after is the day when the malady developed itself, for each of the spirits has its special day for appearing, and it is important to know which of them is to be driven away. The "doctor" hardly looks at the patient, for he is of no account in the affair, and the spirit is all. He molds three rude statuettes with rice dough, and puts them in a small box made of a single piece of banana bark, and by the side of it ten leaf packages containing food. A wax candle is attached to one side of the box, and a fragrant stick to each corner. The exorcist then takes an areca knife, and with it touches the forehead at the root of the hairs three times, saying in Cambodian: "One, two, three (*mé keo, mé kot, mé chan*, or *mé si*). Come out of this body, go back to your country, so that this sick man may be no longer ill." He lays the knife by the side of the patient, takes the banana-bark box, goes out of the house toward the south, crosses the yard, and throws the box over the fence or the hedge. He returns, declaring that the evil spirits have gone home and the man is cured, and recites a prayer in Pâli. If the patient fails to recover, they say the spirit has refused to obey, and begin the performance again after two days.

The sorcerers are also fortune tellers. In one of their methods they use a tablet containing twelve figures arranged around a square. The figures are the tower, the silver parasol, the royal dragon, the silver house, the golden house, the dragon that causes eclipses, the golden parasol, the angel, the man with his head cut off, the doctor, the witch, and the man's head without a body. When consulted, the honorable prophet sets his tablet before him, so as to have the numbers 1, 2, 3, and 12 at the bottom. Having ascertained the sex and age of his consultant, he counts up and refers to the figure on the tablet supposed to correspond to them. If he does not know by heart the prophecies which he is to draw from each figure, he can find them in his satras, reading somewhat after this fashion: "If it is a man that consults you respecting his future, he will be a mandarin; if it is a girl, tell her she will be married before the year is over. If it is a man who wants to marry, he should be told likewise that he will find a wife within a year. If you are consulted concerning a lawsuit, inform your client that he is protected by a powerful man who will see that he wins it. If a sick man consults you, give him to understand that his illness is not serious, and that it comes from his having offended some power, or from not having fulfilled a promise." All this is not very hard. But the satras containing these revelations and prophecies has lost much of its importance in recent years. It has been stolen, and several copies have found their way into the hands of the *sachars*, who have very little faith in it. I have, however, seen a *literatus* consult it seriously, and have heard several persons affirm that it is infallible.

This business is innocent trifling, and the prophecies are not of the kind that lead the seers who sell them into the courts. It is not for predicting good fortune that they are sometimes condemned to death, but for real crimes committed under color of sorcery.

Loup-garous are victims of witches, who cast a spell upon them or cause them to absorb some magical essence. They leave their homes in a state of insanity, fly to the woods, climb trees, or hide in the thickets. They are followed by tigers, who wait till the seventh day, when the hair has grown upon their bodies, and then take them away into the forests to live by hunting. There are stories of women transformed in this way, who have become terrible tigresses, living wholly on human flesh. When a person is afflicted in this way he must be pursued with a pole and struck very hard on the head before the seventh day, the pursuer uttering magical invocations. Then he can be taken home well or convalescent.

It appears from this that Europe has not invented its magic, and that the superstitions which have prevailed there for generations of wizards and witches, ghosts, familiar spirits, *loup-garous*, love powders and philters, amulets, secret cures, love formulas, magical incantations and exorcisms are also to be found in Cambodia.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

The report of the Clerkenwell Public Library, London, for 1897, represents that scientific works are very largely circulated. Biology, including evolution and methods of scientific research, is a very popular subject, the sixty-eight works on it which the library contains on this topic having been issued twenty-eight hundred times during recent years. In this subject two copies of Darwin's Descent of Man have been issued nearly two hundred times, a record which is exceeded only by the most popular novels.

THE TRAINING OF MENTALLY DEFICIENT CHILDREN.

By MARTIN W. BARR, M. D.,
CHIEF PHYSICIAN, PENNSYLVANIA TRAINING SCHOOL FOR FEEBLE-MINDED CHILDREN,
ELWYN, PA.

A CORRECT classification is of paramount importance in the work of training the feeble-minded.

We *must* have some clear, positive standard by which we are to discern and separate the unimprovable from the trainable, lest we deceive the public by false hopes and accept those for whom we can do nothing. Again, the necessity for much individual work—the varied capacity of those to be trained, and the impossibility of bringing all up to one common plane—necessitate the arrangement of grades in which very different means of development may be employed to attain very different ends.

Guided by these needs, therefore, we have adopted a nomenclature dictated by experience as essential to the practical work of training, and which is also in accord with the anatomico-physiological demonstrations of scientific investigation.

This gives, broadly, two classes—the imbecile, trainable, and the idiot, unimprovable—which, modified, stand thus:

1. The imbecile—trainable in three grades: low, middle, and high.
2. The moral imbecile—found in all these grades; trainable only under rigid custodial care.
3. The idio-imbecile—improvable as regards cleanly living, and trainable in a very limited degree.
4. The idiot—except in rare cases and by expensive methods, absolutely unimprovable.

The imbecile, the only trainable class, divides into low, middle, and high grade. The first of these may be brought to give, always under direction, fairly good service for farm or house, if training be begun early, before apathy or indolence becomes a settled habit. He rarely if ever learns to read, and very soon reaches his mental limit. The imbecile of middle grade is capable of making great progress in primary-school work. I might say in about four years, especially if he has had previous training in the kindergarten, he will attain some proficiency in reading, writing, and number work, together with such a knowledge of form, color, and practice in free-hand drawing as shall materially aid him in learning a trade; indeed, mental development for him is best attained through simple handicrafts having their initiative in the kindergarten.

The high grade shows children but slightly mentally deficient, who progress slowly as far as the ordinary grammar-school grade, frequently developing an aptitude for music, drawing, and the various industries. These are the backward children that the schools complain of—the "feebly-gifted" ones of England, the "*tardivi*" of Italy, "*les enfants arrièrés*" of France.

These are they so often not recognized in seminary or college life until under excessive pressure or the excitement of competition comes complete breakdown—idiocy, insanity, or early death.

So nearly normal are many of these that their defect would perhaps be noticed only by the initiated, and the question is often asked, "Why are these who do so well accounted feeble-minded?" the public little knowing that the time and labor have been double those expended for like results with a normal child.

The moral imbecile, generally of high or middle grade, quick of apprehension, crafty, and cunning; or, if of low grade, sullen and cruel often to brutishness, absolutely destitute of the moral sense—what might be termed ammoral or unmoral—is too dangerous an element to be permitted in the schools. This, the saddest victim of a fatal inheritance, is he who claims most at the hands of society and who gets least, because, precocious and often abnormally bright, he is, as a certain jurist once delighted in saying, "the kind we hang." As intellectual training does but add to his armament of ill, for him should be provided, within strongly guarded asylum walls, all the benefits of a manual training school and its outcome in the various trades, which shall at once give vent for his superflous energy and render him self-supporting; but this should be coupled with all the ameliorations of cheerful living that humanitarianism owes to this scapegoat for the sins of others.

Hard labor and lifelong sequestration are the only medicine for his ill—a disease too often due to the sins of a normal ancestry.

The idio-imbecile, who, as the name implies, partakes of the nature of both the idiot and the imbecile, is generally undersized, with very defective speech, and a limited vocabulary confined to a few scattered words, never a full sentence. His improvement is but limited. The most we can hope to do is to keep his nervous, restless fingers employed. He can sometimes learn to knit, to weave mats, or do simple housework, but never to read or write. For him, as for the idiot, but little can be done beyond giving the custodial care best adapted to his peculiar needs, the *genuine* benefit being found in the family relieved of such a burden, as it has been computed that for every case sequestrated, two if not four normal persons are released to society.

The idiot is usually but poorly developed, in most cases unable to stand or even to sit alone. Hardly conscious of his physical needs, he has no language but a cry. He rarely learns to talk; indeed, in all my experience of idiocy do I recall but two: of these one, after much effort, was able only to speak his brother's name, and the other acquired three words in three years.

A teacher endowed with originality in devising means, versatility in presenting so as to avoid monotony, gentleness and unwearied patience in constant repetitions, possessed of that fine perceptiveness and devotedness to her vocation that shall enable her to note improvement imperceptible to a layman—all these valuable qualities combined with good physical condition (which alone can insure that tenderness and firmness giving power of control over herself and the child)—*may*, in years, raise an idiot to the plane of an idio-imbecile, enabling him to do perhaps the work of an idio-imbecile—an aid in the care of his associates. But is it worth it—more especially when, while we are raising the idiot to this, we are shutting our doors upon hundreds of idio-imbeciles who are lapsing into idiocy for lack of these very occupations which alone can keep them from retrograding? Will not history stamp such an act as in itself most idiotic, second only to that other of carefully *guarding* the comparatively *harmless* idiot and turning loose the moral imbecile, a firebrand upon society to desolate homes or to transmit his moral leprosy to generations?

The absurdity, therefore, of placing unimprovable idiots in a training school is self-evident. Yet willful misrepresentation on the part of a sensational press, coupled with every influence that mere sentimentality can bring to bear, is daily burdening our work with an element fit only for asylums, and crowding out the improvable imbecile who can in time be so trained as to enable him, under constant care and supervision, and with proper facilities for control, to become almost self-supporting—this, too, in a life freed from anxious care, and, what is of the first importance to society at large, a life freed from temptations, from opportunities for crime, and from the power of transmitting ill. *Always* under guidance, *always* under control, this "child"—who never attains the full measure of maturity—must ever be, lest his unconquerable indolence or his lack of will power make him the slave of vice, the victim of poverty and wretchedness, or the tool of the designing and the wicked.

So much for aims and means. A word further as to methods.

These, based upon the theories of physiological education dictated by Pestalozzi, Froebel, and Rousseau, first successfully practiced with mental defectives by Itard and by Seguin, include all the means that modern thought and experience have gathered.

Kindergarten, Nature studies, object lessons, sloyd, and the many occupations included under the name of manual training, all lend a successive and continuous stimulus—the one underlying principle and aim of the schools being to induce observation and comparison as a basis of *thinking* and *doing*.

Calisthenics and military drill induce physical development and muscular co-ordination, quick observation, and prompt subordination. These vital principles of physiological education have practical and intellectual application in the exercises in freehand drawing, modeling in clay and wood, in sloyd, in basket and straw braiding, and in the phonetic and articulaton drills and musical exercises of the classroom, each being the initial of a lifelong occupation. Believing as we do that "the working hand makes strong the working brain," there is always something for the child to do, some object to be made; not an abstract thing to be put out of sight when finished, but something of use to himself, or to one for whom he cares. Work constantly stimulated through the emotions is his, all along the line from kindergarten, classroom, and sloyd, to shoe shop, printing office, and other useful trades. Should his limit of application be soon reached, and the avenue of happiness and safe living be for him reduced to one single groove, the more active pursuits of the farm, the garden, laundry, or household service will interest and provide vent for superfluous energy or by constant stimulus keep him from retrograding or lapsing into apathy. For these varied occupations he is all the better fitted by the previous training of the senses received early in the schools, and if happily he should have there learned to read or draw, to color, to carve, or has acquired any skill in music, he will have many avenues of recreation closed to his less fortunate brother, to whose comfort and pleasure he himself will be the better able to minister.

All this we can do and are doing in our training schools, both here and abroad, in spite of being handicapped by the burden of the idiot, the care of the moral imbecile, without adequate accommodation, and by frequent loss, from one cause or another, of trained workers just as they become useful members of the community.

The possibilities for the trained imbecile have not, therefore, yet been made clear on account of this diffusion of energy, nor his true sphere recognized, mainly because of the *false idea of cure* which is continually being presented to the mind of the public.

Worse than foolish is the idea that training can prepare even those of high grade to battle with the world or fit them for any life outside of institution walls.

Animal propensities, weak wills, sluggish or excitable temperaments, characters utterly abnormal, will inevitably drift in large numbers to swell the insane or the criminal ranks; and it may not be out of place for me to say that from the standpoint of the alienist, criminal procedure against such irresponsibles, especially those in that period of adolescence when most susceptible to suggestion or to nervous excitations, is not less reprehensible than was the delusion regarding witchcraft in a less enlightened period of our history.

THE GENEALOGY OF CHEMISTRY.

By M. E. BERTHELOT.

MODERN science is the child of ancient science—that is, of Grecian science; for it was the Greeks who constituted science under the form which we recognize now. Before the Greeks no really rational science existed, free from mystical and priestly attachments. While astronomy was cultivated in Egypt and Chaldea, it was at first with the object of determining the times of the religious festivals and of keeping agriculture correlated with natural phenomena; and next for the discovery of the mysterious connection which astrology predicated between the positions of the stars and public and private events, under the belief that the life of men and the development of phenomena were determined by the fatality of the sidereal influences which presided at their birth or origin. Geometry and mechanics made considerable advance at Babylon, Thebes, and Memphis, being applied to the measurement of the lands and the construction of buildings, as is attested by the study of the indestructible monuments of ancient Egypt; and the equilibrium of the Chaldean structures of brick, now in ruins, required knowledge of the highest quality, yet more developed, perhaps, than that of the Egyptians. But both peoples always accompanied their work with prayers and magical invocations. The excellence of the processes of ancient times in the treatment of metals, pottery ware, colored glasses, and dyed cloths, with which experimental science is now very busy, is demonstrated by the relics of ancient civilization which we have collected in our museums. The old alchemical manuscripts tell us that these practices were explained in the Book of the Sanctuary of the Temple. The origin of medicine was traced to the temples, and this was not an empty metaphor; for the temples were the repositories of all knowledge in the East, and even to-day all Mussulman instruction gathers round the mosques. But the members of the old priesthood never imagined that it would be possible to separate the double part they were playing of priest and scientific student. They combined scientific practices with prayers and religious rites, the performance of which was deemed indispensable to the success of the processes. The idea of a miracle granted by the favor of the gods, and, if necessary, imposed upon their will by the formulas of magic, was held inseparable from the secret action of natural forces. The Greeks dissolved this connection of ideas, and founded, in the sixth century B. C., rational science, stripped of mystery and magic, as it is now current among us. The Alexandrian period witnessed the triumph of the new method; when astronomy was fully disengaged from astrology, geometry separated from the ancient rites of the field measurers, medicine and surgery rid of pilgrimages and superstitious practices, and chemistry rendered independent of the incantations by which it was thought the success of its manipulations could be assured.

This took place, in principle at least, with the most enlightened minds. But the mysterious and charlatanish part of these sciences, and their association with mysterious prayers and invocations, did not disappear all at once. They persisted in antiquity, and even acquired new favor as the ancient culture fell into decay; they were held in honor during all the middle ages, and still rule in the East.

European science has gradually, since the sixteenth century, regained the firm tradition of the Hellenic philosophers. It has rid itself of the old train of dogmas and chimerical operations, and has pursued steadfastly the construction of the edifice founded by the Greeks. While the accumulated work of generations has raised it to a height not dreamed of by the ancients, and while it has extended its dominant applications to all branches of the social organization, we still have no right to say that our methods and our modern spirit would be rejected by Archimedes or by Aristarchus of Samos. On reading our works they would recognize their legitimate heirs.

There was, however, an interval of sixteen centuries between Grecian science and that of the moderns, during which no transmission of facts, ideas, and methods took place directly, but it was effected through intermediaries of less stable minds, who were imbued with the ancient prejudices. Hence arose a mixture of pure reason and mysticism, which dominated science toward the end of the Roman Empire and during all the middle ages. By virtue of this association of two contradictory elements, now become irreconcilable, Greco-Alexandrine science took on a strange figure at the beginning of the Christian era, when the pure rationalism of Democritus, Aristotle, and their earliest disciples had declined. Hence that curious amalgam in which the positive notions of genuine chemistry were confounded with the contradictions of gnosticism and the survivals of the religious traditions of ancient Egypt. This mixture lasted longer in chemistry than in any other science, and it was not till the end of the last century that chemistry was completely freed from these singular ideas and constituted under a purely scientific form. The long history of its successive advances and its systematic tentatives, in both the practical and the philosophical departments, is most remarkable.

In the period that followed the Alexandrine epoch and preceded the definite recognition and naturalization of alchemy in western Europe, in the thirteenth century, the name of the Arabians is predominant; and the most widely known authors usually ascribe to them the progress which the Greeks made in most of the sciences. They have sometimes even gone so far as to attribute to the Arabs the discovery of chemistry—a view which has to be abandoned on obtaining an exact knowledge of the original authors.

I have devoted nearly ten years to the study of this subject, and have published for the first time the texts of the Grecian chemists, as well as those of their Syrian and Arabian followers, drawing them from their hiding places in the libraries of London, Paris, and Leyden—works which no one would read, because they were supposed to be chimerical and unintelligible. Yet there is a real and profound science in these old texts, mingled, it is true, with erroneous notions concerning the transmutation of metals, and with illusionary and often charlatanish pretensions.

Except gold, which has been mined native from the earliest times, pure metals are rarely found in Nature. A native alloy of gold and silver is found in similar conditions as gold, which was called white gold or electrum by the ancients, and was considered a separate metal till the sixth century A. D. It was used as a material for money by the Lydians, and by the Grecian cities of Asia Minor, till near the time of Alexander. This alloy, however, has no constant properties, for the relative proportions of its two components are variable. By reason of this diversity it had an important place in the thought and attempts of the alchemists seeking for the transmutation of metals; for we can extract gold or silver from it at will, according to the treatment we give it. Hence the opinion that electrum was susceptible of being changed into one or the other of these two noble metals.

These notions and experiments were confirmed by the metallurgical methods employed in the fabrication of other metals. Iron, copper, lead, tin, and silver do not exist as such in Nature except in unusual minerals. They are ordinarily found in oxide or sulphide compounds, and are, when separate, products formed by human art. In fact, it is by submitting these compounds to more or less complicated reactions, in which fire, combustible agents, drying, or roasting in contact with the air are applied, that the different metals are prepared. These preparations were formerly made according to a traditional empiricism, the origin of which is lost in the night of the ages. It has hardly been more than a century since chemists first succeeded in accounting for the reactions and in improving upon them by the aid of more precise notions founded on the theories of modern science; and our own age has witnessed a still more radical transformation in metallurgy resultant upon the discoveries in electro-chemistry. But everything rested, in antiquity, upon empiricism, unguided, except by vague analogies.

The metals which the ancients thus obtained and made use of were not always pure metals. The ancients had a number of varieties of copper and of lead. First, a distinction was made between black lead and white lead; the first being our modern lead, while the second has become our tin. These names were, however, applied to other metals and alloys, including antimony, which was obtained by roasting and reducing its sulphuret, under conditions which are described by Dioscorides; and some alloys of silver originally designated by the name of *cassiteros*, which was afterward applied to our tin. The *stannum* of Pliny also has this double meaning.

The white alloys, of brilliant and little changeable surface, were given a special name—*asem*, or Egyptian silver—a name which was continually reappearing with the Greek alchemists, and was confounded with the name of silver without definite title—*asemon*—a designation which was given to very diverse substances, from pure tin to electrum. So it was with the metal called *chalkes* in Greek, *aes* in Latin—a name which included innumerable species; whence modern translators use indifferently the words brass, copper, and bronze to represent it. Modern pure copper is too soft to be used for forging arms or solid tools, and the Greek and Latin names usually refer to alloys. The ancients had copper of different colors, and specified the species by adjectives derived either from these colors, or from the place of origin of the substance. Thus, they had red copper and Cyprian copper, *aes Cyprium*—an epithet which, in the time of the Roman Empire, became the name of the metal, *cuprum*—besides yellow copper, white copper, etc. Yellow copper in its turn included several varieties, for its composition varied greatly. First, there were the bronzes, alloys of copper and tin, used for many centuries in the manufacture of arms, till they were dethroned by the advances in the manufacture and tempering of iron. In the Roman Empire one of these alloys, which was used for mirrors, was designated, after the name of Brindisium, where the manufacture was carried on, *aes Brundusinum*, whence our word bronze is derived; in other alloys of various shades, yellow or whitish, copper was combined with lead or zinc—a metal which the ancients did not know in a state of purity, but of which they were acquainted with the minerals, natural *cadmies* or *calamies* as they were called, whence our word calamine. The fusion of these minerals with those of copper produced alloys similar to our brass.

While some of these compounds of copper, by virtue of the importance of their applications, thus acquired special names, there were others among the yellow alloys which, employed in antiquity and the middle ages, have fallen into disuse; compounds of copper with arsenic and antimony, for instance, which were useful for promoting the combination of substances like iron with copper or tin, which would not readily unite with them directly. Modern chemistry has very little to do with such alloys. But an alloy of copper and antimony has been revived and patented within the past twenty years which has the appearance and many of the properties of gold. It was known to the Greek alchemists, and is mentioned in the Syriac translations of their works. There existed, therefore, in antiquity and the middle ages, a multitude of artificial metals, passing under the general names of lead, iron, tin, electrum, and gold and silver. Furthermore, as pure silver was confounded in goldsmiths' practice with various alloys designated under the name of *asem*, so the name of gold was not applied to pure gold alone, but was extended to alloys of that substance with copper and other metals; alloys which differed greatly in richness, but were used for making base goods for which the goldsmiths tried to make their customers pay the price of pure gold. These fraudulent practices and tricks have continued down to our own time in countries where the law has not fixed the standard of merchantable gold and silver with severe penalties for violating it.

With these facts before us we can easily comprehend the ideas and theories of the alchemists, and imagine on what their practices and hopes were based. One of the first ideas their experience gave them was, doubtless, that the properties of the metals varied. The theoretical definition of our simple bodies, which we now know continue unchanged in nature and weight through the course of their metamorphoses, was developed slowly, and was not recognized as a certainty till within a century. The positive minds of the Roman lawgivers no doubt perceived the necessity of employing pure gold and silver, or alloys of a fixed standard, for coinage; but this was a practical prescription, and not a scientific principle. Although the artisans who worked these metals knew how to obtain substances of legal purity, they had no sign to inform them whether these substances really represented a single metal of unchangeable quality, or whether they were dealing with a conventional stage in the undefined series of transformations of matter. These legal divisions applied to gold and silver. There is nothing to prove that any one of the innumerable species of copper, lead, and tin represented more than another the fundamental state to which all of them bore relation. In short, gold, silver, copper, and lead were really, in the eyes of the alchemists, mixtures or compounds, the properties of which could be modified at will by adding or subtracting certain of the components.

The idea of this fundamental unity of matter was derived from a more remote principle. It was subject to the existence of the four elements—earth, water, air, and fire—from the association of which, according to Plato and Aristotle, all the substances in Nature were constituted. We know now that these ancient elements were not real substances, but symbols of the fundamental states of matter, such as solidity, liquidity, the gaseous and all static conditions; the fourth element, fire, represented a dynamic state of bodies. These symbols had, on the other hand, a really substantial value for the alchemists, a character defined by the approximate identification of their supposed elements with certain products, in which the properties corresponding with one of the elements seemed to reside in a more eminent degree. Modern science has become more precise. At the same time the substantial elements of the ancients have come to be regarded by it as symbols of qualities and phenomena. Still, the Grecian philosophers conceived, behind the elements which were supposed to add their peculiar properties to bodies, an essential unity, residing in a higher degree in indeterminate primary matter; modified by multiple forms and accidents, it concurred in forming all things. The elements, they said, are opposite by their quality and not by their substance. This more general notion did not cease to prevail in the Cartesian conceptions and in those of our own times too.

Such metaphysical views were, however, too vague to furnish the goldsmiths and alchemists a clear explanation of the facts which their daily practice offered them. In this a special state of mind is manifested. Chemistry, indeed, has always had a singular aptitude for creating a sort of materialistic metaphysics, in which the names of beings and of first principles are employed with a restrictive and in a certain way a tangible significance. The Grecian chemists said that the metals were like man: they had a body and a soul. The soul was, however, to most of the ancient philosophers, nothing else than a more subtle matter. The alchemists were thus led to imagine a primary matter, appertaining to the metals alone, which constituted their common essence. It seemed to be indicated by that general condition of fusion which all metals take under the action of fire, in which they are ready to go into alloys and receive coloration and the impression of new properties. The ancient Egyptians regarded lead as this primary matter, and gave it the name of *Osiris*. About the time of the Peloponnesian war a new substance came under notice—mercury, or liquid silver—which corresponded still more nearly with the idea of the primary metallic matter. No author has informed us concerning the origin of the discovery of this singular metal. We only know that the Carthaginians were at that time working the mines of Betica, and that the minerals of mercury, situated in the same region, were well known and operated in the time of the Roman Empire. At any rate, the appearance and properties of this liquid and vaporizable silver, which was almost as refractory to chemical reagents as its ancient solid homonym, struck the imagination forcibly. It only seemed necessary to fix it—that is, to take away its liquidity and volatility—to obtain the other metals, particularly real silver. Mercury thus became the primary metal of the alchemists. A letter is extant from Synesius, a writer of the end of the fourth century, to Dioscorus, embodying a kind of catechism concerning the qualities and relations of this substance, from which we gather that, being the primary matter of metals, the first essential proceeding was to fix it or make it solid and stable as to fire, like other metals; then to color it, by the aid of some white or yellow tinctorial substance, such as sulphur or the sulphurets of arsenic, by which it would finally be changed into gold or silver. The name mercury had a variety of significations. It represented native mercury, extracted directly from the mines; artificial quicksilver, prepared from cinnabar, which was called copper mercury, lead mercury, or tin mercury, according as it was prepared in the cold by crushing cinnabar in a mortar with copper, lead, tin, etc., when the mercury produced appeared to participate in the qualities of the metal which had been used in its preparation. To us it is always the same mercury, rendered impure, indeed, by some trace of the precipitating metal; but in the eyes of the alchemists there were different metals. Furthermore, the term mercury was applied to two substances which we know were radically different: modern mercury, or mercury extracted from cinnabar, and metallic arsenic, which they called mercury extracted from orpiment. Both are, in fact, volatile and susceptible of sublimation, and both form red sublimates; both turn copper white, and both form red sulphurets. From these particulars we can see how broad was the meaning of the common word mercury, and how the mercury of the philosophers represented a kind of quintessence, common to these various kinds of mercury, or the primary matter of the metals, susceptible of being changed by coloring into gold or silver. The work to be done, then, was to extract this mercury from ordinary metals, and then color it to gold or silver; or to operate on its substance as it was contained in the copper, lead, tin, and iron, so as to eliminate the contrary qualities and perfect the conformable qualities by means of suitable reagents, which would at the same time color it. These coloring reagents were designated, generally, the philosopher's stone.

Governed by these ideas, the Greco-Egyptian alchemists obtained a great variety of metallic alloys, some white and nearly as unchangeable as silver, to which they assimilated them; others yellow, and having a stability like that of gold, of which they gave them the name. Real gold and silver were besides often included in the composition of these alloys, when they were regarded as the seed, and were supposed to multiply, as if they had been living beings, under the action of certain ferments. The alchemists frequently found that their recipes for transmutation were not sufficient to produce gold and silver; that after combining a certain number of properties, others were still wanting; at this point they fell back upon the mystic part of their science. The confusion between real silver and gold and the white and yellow alloys was carefully nursed by the alchemists, who even went so far as to call gold and silver metals which were only superficially colored by the action of mercury and the sulphurets of arsenic, and metals that were only covered with a golden varnish. This confusion of language exists even in the industries of our own times, as when manufacturers speak of the gold of a color or a cloth.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

THE LIFE AND WORK OF FELIX HOPPE-SEYLER.*

By ALBERT P. MATHEWS.

IN the summer of 1895 the world lost two men, each of whom, in his own way and in his own country, had exerted an unusual influence on the development of science. They were born and they died within a few months of each other. Each was endowed by Nature with the gift of seeing the relationship of apparently unrelated phenomena; each passed through a medical training; each devoted time, much against his will, to dissection and anatomy; each was a fighter for what he believed true; each was gifted with a winning personality that attracted friends from all sides; each was a great teacher, having a ready sympathy for young students, and each was remarkable for the breadth of his knowledge and the keenness of his insight. One was Thomas H. Huxley, an Englishman, the other Felix Hoppe-Seyler, a German.

* In part adapted from an article entitled Zur Errinnerung an Felix Hoppe-Seyler. By E. Baumann and A. Kossel. Zeitschrift für physiologische Chemie, Bd. xxi, 1895.

Very similar in natural gifts though Huxley and Hoppe-Seyler were, the different environments under which they were placed determined their development in radically different paths. Huxley, though possessing a strong natural tendency toward physiology, was forced to become an anatomist, and from a very early date his great controversial powers were called into such requisition that his name became almost a household word among the English peoples. Hoppe-Seyler, on the other hand, while still very young, was given a decided impetus toward the study of the chemistry of organism, and, as a pioneer in a new science, was little known outside the immediate circle of his personal friends and scientific colaborers.

Felix Hoppe-Seyler deserves to be remembered by mankind not only for the valuable contributions he made to our knowledge of the chemical processes of life, not only for the impetus he gave to the development of a new science, physiological chemistry, but also for the influence he exerted on the minds of his pupils and colaborers. Great investigator though he was, and lasting though his influence on the development of biochemistry will be, he probably served mankind best in his capacity as a teacher. As there has not appeared in any English or American journal a just account of the value of the life and work of this illustrious man, a brief sketch of one to whom the world in the future will probably consider itself indebted, not less indeed than to Jenner, Pasteur, Koch, and Lister, may be of interest, and some recognition, insufficient though it be, of his lifelong services.

Ernst Felix Immanuel Hoppe, better known as Felix Hoppe-Seyler, was born in Freiburg in Thuringen, on the 26th of December, 1825, and died suddenly of heart disease at his summer home on Lake Constance on the 10th of August, 1895. He was the tenth child of the Pastor Ernst Hoppe and Frederike Nitzsch. He came of a long line of school teachers and ministers. His mother died when he was six years old, and his father three years later. The lad received a temporary home with his brother-in-law, Dr. Seyler, but soon entered the orphan asylum at Halle, where he attended the gymnasium.

His stay in Halle exerted a great influence on his later life, for the *régime* at the institution which was his home was of Spartan-like simplicity and rigidity. He came under the influence here, also, of the old apothecary of the institution, who took great delight in introducing young Hoppe to the mysteries of chemistry, in which he soon acquired considerable proficiency. He was dismissed from the gymnasium as a diligent student in 1846, with a preference for the natural sciences and mathematics, and in the autumn of the same year was matriculated in the medical faculty of the University of Halle. Here he passed much of the time of his year's stay in the pharmaceutical laboratory of Sternberg.

One of the inheritances he received from his boyhood and which he carried with him to the end was a great liking for an active outdoor life. In the summer vacations he would frequently take long pedestrian tours, and in the course of one of these he met the celebrated Weber brothers, Ernst and Eduard, of Leipsic, with whom there thus began a long friendship. Influenced by his new friends, Hoppe, the next year, betook himself to Leipsic and entered the classes of W. Weber in physics, E. H. Weber in physiology and anatomy, and of Eduard Weber in nerve and muscular physiology. He attended, also, Erdmann's lectures in organic chemistry and Lehmann's in physiological chemistry and pharmacology. In the spring of 1850 he went to Berlin, and the same year took his doctorate, with a thesis entitled On the Structure of Cartilage and on Chondrin. This thesis and Hoppe-Seyler's subsequent work in the same direction, which confirmed previously expressed views of Virchow, attracted the favorable notice of the great pathologist, who thereafter became to young Hoppe a helpful friend.

He was approved as practicing physician in 1851, spent some time in Prague in the study of obstetrics, returned to Berlin, and entered practice. He found little liking for this, and in 1854 was appointed prosector in anatomy in Greifswald, where he became later *Privatdocent.* His personal relations here not proving to be of the pleasantest, and the outlook for the future being anything but promising, Hoppe resolved to go to America, and wrote Virchow to that effect. The latter, however, induced him to remain, promised him a position in his new laboratory, and soon had him appointed assistant. Here his time at first was so taken up by students that he was only able to carry on his chemical studies on Sundays. Again Virchow came to the rescue, had a second assistant appointed, and put Hoppe in charge of a laboratory of pathological chemistry. He was appointed extraordinary professor in 1860, and his laboratory quickly became the center of physiological chemistry in the world. To it came Kühne, Alexander Schmidt, v. Recklinghausen, Leyden, Wilson Fox, Botkin, and many others.

In 1861 he was called to the chair of applied chemistry at Tübingen, where he was shortly made full professor. His laboratory here was of the most primitive description. It was located in the former kitchen of the old castle on top of the hill. The big chimney place, and the spits, were converted into appliances for chemical research. Here began a most fruitful period of Hoppe-Seyler's career; from this laboratory appeared much of his best work. Among the students who gathered about Hoppe-Seyler here were Miescher, Baumann, Froriep, Gaehtgens, Parke, Salkowski, Zalesky, Löbisch, Tolmatscheff, Polz, Diakonow, Liebreich, Lubavin, Manassien. Here he remained for ten years, until in 1872 he went to Strasburg to take the chair of physiological chemistry, the first and only professorship of its kind in Germany. In Strasburg he spent the remainder of his life, and here, as in Tübingen, many students came to him, among whom were Kossel, Hoffmeister, Neumeister, Frederiq, v. Jaksch, Ledderhose, v. Mering, Mauthner, v. Udránsky, Popoff, Rajewsky, Sokoloff, Howath, Herter, and Giacosa.

In 1864 Hoppe was formally adopted by Dr. Seyler, and thereafter took the name of Hoppe-Seyler. In 1858 he married Agnes Franziska Maria Borstein, by whom he had one son, Georg Hoppe-Seyler, now professor of medicine in Kiel. In appearance Hoppe-Seyler was an erect, vigorous, active man, above medium height. Although at the time of his death nearly seventy years of age, his hair was not yet gray, his step was still youthful and elastic, and he appeared yet to have many years of life before him. He was eminently what the Germans call "*liebenswurdig*"—kindly and sympathetic, especially toward his pupils, whom he made his friends. With all his kindliness, however, Hoppe-Seyler, like Huxley, had little patience with half truths or errors, and he possessed a sharp pen, which, in truly German fashion, told the whole truth about one unfortunate enough to incur his displeasure.

The scientific work of Hoppe-Seyler extended over forty years. His contributions to science are embraced in some hundred and forty-six separate papers. He was the author of a handbook of physiological and pathological chemical analysis, which has had six editions, and is still the best book of its kind extant. In the years 1877 to 1881 he published his celebrated text-book of physiological chemistry, which still remains as a monument to his industry, to the wide scope of his knowledge, his keenness of perception, and his power of correlating facts. Though many of the conclusions contained in the work have been modified by more recent investigation, the book stands unique among similar productions as the most exhaustive treatise on the chemistry and chemical changes of the animal and plant kingdom ever attempted.

The range of subjects in which Hoppe-Seyler published observations, outside his biochemical work, is remarkable, and includes botany, mineralogy, geology, chemistry, and physical diagnosis. He detected the presence of the newly discovered element, indium, in wolframite, and he devised a spectroscopic test for manganese, which is one of the most delicate known, and is still called Hoppe-Seyler's manganese test. Throughout his life he took a keen interest in mineralogy and geology. In 1865 he made the not unimportant discovery that gypsum, heated with sodium chloride to 130° C., was converted into the crystalline anhydride, and in 1875 he published a series of researches on the formation of the dolomite masses of Germany, which did much to elucidate the problem, indicating, as they did, the formation of dolomite by the action of sea water on calcium carbonate. His works on percussion and the pulse were valuable contributions to physical diagnosis.

In biochemistry his work is remarkable not only for his discoveries, but also for the great number of ingenious methods of research devised by him. Our methods of examining pathological transudations, pus, the blood, are derived in large part from him. He was quick to perceive the value of the spectroscope in the study of the chemical changes in the pigments of blood, urine, bile, exudations, and elsewhere in the animal and plant kingdom, and he applied the method with particular success to the study of the blood pigment and chlorophyll. He seized upon the Soleil-Ventzke improved polariscope as a valuable means of estimating the albumin and sugar contents of urine, blood serum, transudations, and milk. He studied the circumpolarizing action of gelatin and the substances contained in gall, together with their decomposition products. By means of these methods he rendered great service to physiological chemistry.

In the chemistry of the organism he broke ground in a great variety of places, but left the further development of nearly all the paths thus indicated to his students. His earliest work was done upon the chemistry of cartilage and the relation of cartilage to bone, work which bore closely on Kölliker's discoveries on the genesis of bone, and showed the essential similarity, in a chemical way, of the great group of connective tissues, first classified by Virchow.

He made extended analyses of the enamel of teeth, showing its essential identity with the rock apatite, and that the enamel of the teeth of fossil and living animals was identical in chemical composition. During his stay in Berlin he published a number of treatises on the composition of transudates, and later compared the effect on the composition of transudations of frequent drawings off of the fluid. He compared the transudations derived from various parts of the body, and endeavored to refer the differences in chemical composition found to differences in the capillary network and blood pressure. He demonstrated the presence of soaps in the blood and lymph, at that time commonly denied, and studied the presence of indican in the urine, a body the true significance of which as a measure of the putrefaction in the alimentary canal was shown by his pupil Baumann. One of the last most important of his discoveries was that of "chitosan," a decomposition product of chitin, the discovery of which threw light on the chemistry of this important animal substance. Hoppe-Seyler's main work, however, to which we may direct attention, was done upon the red pigment or hæmoglobin of the blood, upon processes of oxidation in the organism, upon the chemistry of fermentation, and upon chlorophyll.

It is not too much to say that if all work but Hoppe-Seyler's upon hæmoglobin should be obliterated, we would still have nearly all that is known of that important substance. It was Hoppe-Seyler who gave the name hæmoglobin, it was he who discovered that it was this substance in the red blood-corpuscles that gave them their power of carrying oxygen, and that hæmoglobin was a definite chemical compound. He discovered the difference between hæmoglobin and oxyhæmoglobin. The absorption bands in the spectra and the difference in the spectra of hæmoglobin and oxyhæmoglobin were also discovered by him, and he did more than any other one man to apply the spectroscope to the study of the blood pigment. It was Hoppe-Seyler who found that the oxygen combined with and was given up from the hæmoglobin in a molecular and not an atomic form; he showed that carbonic oxide enters into a stable combination with hæmoglobin, and thus explained the peculiarly poisonous nature of this gas. He discovered and named the decomposition products of hæmoglobin, methæmoglobin, and hæmochromogen. He showed that hæmin was simply the hydrochlorate of hæmatin, and pointed out how the hæmoglobin molecule could be taken to pieces and built up by reduction. On the chemistry of hæmoglobin he published no less than thirty papers.

An interesting discovery made by him was the cause of the sudden death to which men were subject who, after working under compressed air, suddenly returned to the ordinary atmosphere. He showed that under such circumstances the dissolved gases of the blood quickly escaped from solution with fatal results. This discovery indicated the proper manner of avoiding such disaster by a gradual return to the normal atmosphere, and has been the means of saving many lives.

One of the greatest discoveries of Hoppe-Seyler was that the tissues and not the blood are the seat of the oxidations of the body. This was still more convincingly shown later by Pflüger. By this discovery Hoppe-Seyler's attention was attracted to the respiration of protoplasm, with what results we shall shortly see.

His work on hæmoglobin led Hoppe-Seyler in two directions: one was toward the composition of cells, the other toward respiration. Both paths have been followed with good results. In examining the composition of the red blood-corpuscles of mammals, Hoppe-Seyler discovered that the percentage of phosphoric acid contained in the residue of the alcoholic extract was too high for the body to be protagon, as had previously been supposed. He put his pupils Manassien and Diakonow on this problem. The former quickly found the substance to be not protagon, but lecithin, a peculiar nitrogenous phosphorized fat, and the latter laid bare the chemical nature of this substance. Hoppe-Seyler himself proceeded to examine other cells for the presence of lecithin and cholesterin, and soon recognized that these substances, as well as the albumins, potassium phosphate, and glycogen, must be considered ever-present constituents of protoplasm. Hoppe-Seyler further showed that the lecithin generally existed in the cell, not free, but in combination with albumin. This fact drew Hoppe-Seyler's attention to similar compounds which are formed by albumin combined with other substances, and he proposed for such bodies the name "proteids," a name which they have subsequently borne.

The discovery of lecithin drew attention to the organic compounds of phosphorus in protoplasm. There were many indications that the nuclei contained such a substance, although the difficulties in its isolation had hitherto been insurmountable. His pupil Miescher was placed on this problem, and discovered the "nucleins," probably the most important constituents of protoplasm thus far recognized. Hoppe-Seyler himself discovered "vitellin," the first of the pseudo-nucleins, and casein was soon shown to have a similar phosphorized radicle.

In the chemistry of respiration Hoppe-Seyler was personally active, and formulated a hypothesis of the chemical nature of respiration and living matter which is practically the only well-grounded theory of its kind extant, and one which has seldom been surpassed for brilliancy. By a stroke of genius he correlated the newly discovered reducing powers of protoplasm with its oxidizing powers, and recognized the essential identity of the processes of life and putrefaction. This idea threw light on many phases of cellular metabolism. It was first briefly mentioned in the *Medicinische-chemische Untersuchungen* in 1871. It was clearly stated in volume xii of Pflüger's *Archiv für die gesammte Physiologie* some years later, and forms the kernel of most of his subsequent work.

The oxygen of the air, as is well known, is in a molecular or inert state, and not in an atomic form. It is unable, in this form, to carry out the oxidations of protoplasm. To do this it must be first made "active," either by conversion into ozone or by having its molecule split. Hoppe-Seyler's theory of respiration turns on the fact that in protoplasm and in putrefying masses, reducing substances are formed which are able to split the oxygen molecule, setting free atomic oxygen. In this manner, if only air have access, putrefying fluids, like protoplasm, are able to oxidize completely the most resistant substances, side by side with strong reductions. Hoppe-Seyler noticed that if animal substances be allowed to putrefy in vessels deprived of air, intense reductions ensue, hydrogen gas is often set free, and the whole chemical transformation is entirely different from that which the same substances undergo if a current of air be constantly forced through the fluid. In the latter case the transformations are oxidations, and finally are of a most complete kind, little else than nitrates, carbonates, and sulphates being left. If a putrefying fluid be allowed to stand exposed to air, Hoppe-Seyler discovered that at the surface the most intense oxidation ensued, while in the depths there were equally intense reductions. He found, further, in studying the fermentation of fibrin and calcium lactate, as well as other substances, that if no oxygen were present large quantities of hydrogen gas were evolved, if air were present no hydrogen was evolved. He immediately recognized in nascent hydrogen a reducing agent capable of causing the strong reductions and of splitting the oxygen molecule, thus indirectly causing oxidation. He suspected that nascent hydrogen would combine with one atom of the oxygen molecule to form water, setting the other atom free, and experiment fully confirmed this hypothesis. If palladium be heated in a stream of hydrogen, it combines with the latter. If it now be brought into water, the hydrogen is liberated in the atomic state. Hoppe-Seyler found that palladium loaded with hydrogen would carry out oxidations and reductions similar to those of putrefying fluids. If such a palladium mass be half immersed in water containing benzol, hæmoglobin, potassium iodide, or indigo, in the depths of the fluid strong reductions ensue, with at the surface equally violent oxidations. In such circumstances oxyhæmoglobin at the surface is transformed into methæglobin, benzol to phenol, indigo to indigo white at the bottom and indigo yellow at the surface, and iodine is liberated from its potassium combination. Hoppe-Seyler believed that in protoplasm a substance was present which acted somewhat like potassium hydrate or the ferments in the putrefying masses, causing a saponification, and at the same time a transference of an oxygen atom from a hydrogen to a carbon atom, with the liberation of nascent hydrogen, or other reducing substance. The nascent hydrogen, in the manner already indicated, caused both intense reductions as well as oxidations. In this manner, as is well known in chemical processes outside of the cell, many syntheses and polymerizations can be brought about, and it would seem necessarily to result, in protoplasm, in just such a constant rearrangement of molecules as is imagined constantly to be transpiring there. Hoppe-Seyler believed that the oxygen would cause the formation in living matter of a great number of syntheses by the building of anhydrides with the formation of water. The chief difference between living and lifeless protoplasm was about the difference between an anhydride and an acid. When death ensued, oxidation no longer took place, but the saponification continued until complete.

Although this hypothesis is necessarily difficult of proof, many facts indicate its possible truth. That protoplasm is the seat of reduction and oxidation no one will probably deny, and that by a process of alternate reduction and oxidation many of the transformations of substances by the organism may be repeated outside the cell is also undoubted. Thus Drechsel, by a rapidly alternating electric current, has succeeded in producing urea from albumin. It is also well recognized that many of the best-known syntheses effected by the organism are formed by a dehydration. This is true of the formation of fat, of the ethereal sulphates, of hippuric acid, of the camphor-glycuronic acid, and of the chondroit-sulphuric acid of cartilage. In this manner, too, as Hoppe-Seyler discovered, fatty acids of many carbon atoms may be synthesized from comparatively simple compounds. It seems not improbable that Hoppe-Seyler thus obtained a glimpse of that promised land toward which the physiological chemist has been patiently working for the past forty years, where the mysteries of protoplasm shall be made clear. Whatever may be the exact details of the process of respiration, certainly Hoppe-Seyler's discovery that reducing substances in the presence of air may induce powerful oxidations is one of the most brilliant and suggestive made in biochemistry.

Impressed by the similarity of living and fermentative processes, Hoppe-Seyler devoted much time to the chemistry of the latter. He made the first classification of fermentations, distinguishing those in which a simple hydration or saponification takes place, as in the digestive fermentations, from those characterized by the transference of an oxygen atom from a hydrogen to a carbon atom, with the liberation of hydrogen. To a certain extent he made clear the chemical processes of fermentation, and his researches serve as a solid and suggestive basis for further work. Hoppe-Seyler was throughout a strenuous upholder of the Liebig view of the essential identity of fermentations, whether induced by chemical bodies or living germs. His position has been justified by the recent brilliant discovery that the alcoholic fermentation of sugar by yeast, long believed to be dependent on the life of the yeast cell, is due to a substance which may be isolated from the living yeast. Hoppe-Seyler contributed also to our knowledge of the fermentation of cellulose into carbonic anhydride and marsh gas, which, as he showed, was due to a bacterium resembling or identical with the *Bacillus amylobacter.*

As might be expected, Hoppe-Seyler devoted considerable time to chlorophyll. He discovered and named the "chlorophyllan," a crystalline derivative of chlorophyll. He devised an ingenious method for showing that chlorophyll, in the sunlight, liberated oxygen in a molecular and not an atomic state. If a green plant be brought into a glass tube in water, a little putrefying blood added, and the tube hermetically sealed and placed in the dark, all oxygen is consumed and the tube shows the spectrum of hæmoglobin. If the plant be brought into the direct sunlight, the hæmoglobin is transformed by the oxygen liberated by the chlorophyll bodies into oxyhæmoglobin, which gives a characteristic spectrum. If the oxygen were liberated in an atomic state, the spectrum of methæmoglobin would appear.

Let us now glance briefly at Hoppe-Seyler's influence upon physiological chemistry. He may be called the father of this science, for, although the beginnings of biochemistry were identical with those of organic chemistry, both taking their origin in Lavoisier's experiments on oxidation, Regnault and Renard's on respiration, Chevreul's on the fats, and Liebig's and Wöhler's on urea, muscle, and animal metabolism, yet in the early half of the century the interest of the purely chemical analysis and synthesis of organic bodies had almost completely absorbed the attention of chemists. It was Hoppe-Seyler's great merit to perceive and to emphasize, with all his might, the great importance of physiological chemistry in the arts, in industries, and in medicine. His clear glance perceived that a knowledge of the chemical constitution and chemical processes of organisms in health and disease must underlie any proper treatment or understanding of disease, a fact which in the world at large to-day is becoming better and better recognized.

To further the development of this science, whose importance he perceived, he saw that it must have an undivided attention; that it must be divorced from physiology and pathology on the one hand, and from chemistry on the other, and given an independent position in the university faculty. In this contention Hoppe-Seyler met with fierce opposition in Germany, particularly from Pflüger and other physiologists and chemists, so that to-day there is but one professorship of physiological chemistry in Germany—namely, that at Strasburg. In other countries Hoppe-Seyler's idea received more favorable attention, and he lived to see such professorships established in Sweden, Norway, Switzerland, Austria, Russia, and America.

Hoppe-Seyler should be gratefully remembered by posterity for his service in thus putting on its feet and starting in motion a science the future of which man can but guess at, but which is perhaps fuller of promise for the alleviation of suffering, for the betterment of the conditions of existence of mankind, than any other science or group of sciences, for it holds somewhere within it the keys of the riddles of life, disease, decay, and death.

In no one way did Hoppe-Seyler set the science further forward than in the founding of a journal, the *Zeitschrift für physiologische Chemie*, devoted exclusively to biochemistry. The journal received at the outset both hearty support and hearty opposition, but it still remains as the official organ of publication of biochemical works. Previous to the establishment of this paper, works treating of the chemistry of organisms were scattered in agricultural, chemical, physiological, pathological, and medical journals, just as they are in the English language to-day. They thus lost largely in effectiveness. Hoppe-Seyler brought all biochemical efforts to a focus, with admirable result.

Hoppe-Seyler as a teacher could be known only by his immediate pupils. Baumann and Kossel have written of him that "with untiring patience he introduced the beginner to practical chemistry; no ignorance, no lack of skill exhausted his forbearance." He may be judged, however, by us through the men who were his pupils. No test of a man's mind is more certain than the influence he exerts upon those who associate with him, particularly his pupils. Judged by this test Hoppe-Seyler must rank very high indeed. Whether it is that a man of his type naturally attracts to him the most promising of the rising generation, or whether even an ordinary man absorbs from such a teacher an amount of light which, like a fluorescing substance, he is enabled thereafter to emit, certain it is that Hoppe-Seyler's pupils include an extraordinary number of men of ability. His pupils and his pupils' pupils are the principal workers in physiological chemistry to-day, and a mere enumeration of their achievements would be a history of the development of the science in the last forty years.

As a teacher Hoppe-Seyler strongly resembled Ludwig, his great contemporary physiologist, Brooks, of Johns Hopkins, Agassiz, and Liebig, the chemist. He offers a striking contrast in this respect to Claude Bernard, whose great genius affected the science of physiology principally by its own extraordinarily keen and suggestive researches, and when it died left no heirs.

Such was Hoppe-Seyler—a winning personality, a courageous upholder of what he believed true, a keen investigator, a far-sighted, broad-minded, kind-hearted man.

Editor's Table.

TOLSTOI ON ART.

THE great Russian writer, to whose views on the subject of science we made a passing reference last month, has published a book under the title of What is Art? which has been translated into French by M. de Wyzewa, a well-known contributor to the *Revue des Deux Mondes* and other periodicals. The author's treatment of the question is very radical; and, as he has assailed the theories of all previous writers on the subject, the theory which he himself puts forward will probably receive abundant criticism. To our mind, waiving all minor questions, his book seems to be one of great importance and value. It is a direct appeal to the conscience and intelligence of the cultivated classes, summoning them to consider whether far the larger part of that which they applaud as art is art at all in the true sense, and whether its effect on themselves and on the world at large is not injurious rather than beneficial. The appeal is made with so much vigor and sincerity, and is supported by so many apt and powerful illustrations, that we shall be surprised if it does not produce far-reaching effects of a most salutary kind. Such a voice as has now been raised has long been wanted to cry out to a luxurious generation that they are abusing the advantages they possess, that their ideals of life are false, and that art in their hands has sunk from its high position as a chief means of the moral and intellectual elevation of mankind and become little else than the echo of their affectations and the servant of their vanity and pride.

Count Tolstoi examines the various definitions that have been given of art and finds them all unsatisfactory, though he pronounces the views put forward by Darwin and Spencer as infinitely superior to those of the metaphysical school which founds art upon the perception of beauty. He hazards a theory of his own, which is that art is the means adopted by men to communicate their emotions and sentiments, as distinct from simple statements of fact, to their fellows. Where any communication is made from man to man in such a way as to awaken in him who receives it the same emotion as is experienced by him who makes it, there, according to Tolstoi, art has intervened. Art may be employed in the service of an evil sentiment; but that does not prevent its being art, provided the sentiment is truly personal to one individual and effectively conveyed to another. In the same way ordinary language might be employed in perfectly logical form to convey a false statement or a wrong opinion; but just as the proper and normal use of language is to convey true statements and correct opinions, so the proper and normal use of art is to convey right sentiments, and, above all, sentiments which make for the binding together of mankind in fraternal union. Art finds, according to this writer, its highest use when it is employed in the service of religion; and the religion of to-day, he holds, consists mainly in the affirmation that all men should be brethren. The best examples of art are those which give expression to sentiments in which all mankind can share; and judged by this standard the art most highly prized by the cultivated classes of to-day is not art at all, since it is designed merely for the amusement of a few, and is altogether beyond the comprehension of the many. Moreover, if the many could comprehend it, it would do them as little good as it does to the exclusive circles for whose special gratification it is produced.

Whatever may be said of this definition of art, there is little doubt in our mind that it furnishes a basis for a fruitful consideration of the whole subject. We incline, indeed, strongly to the opinion that for the average man the most profitable point of view is that which the author has indicated. Let it be granted that the purpose of art is to convey emotion from one mind to another and we have at once a criterion that can be usefully applied both to alleged works of art and to alleged artists. We can ask the latter: What emotion personal to yourself have you that you wish to convey? If you have none, then, whatever your technical ability, you are not an artist. If the emotion is one the propagation of which will do harm, then you are using your art to do injury to your fellow-men, simply to earn from the unthinking or the vicious the praise of having done a bad thing well. If the emotion is one which all men will be the better for sharing, then in proportion to the strength with which you experience it and the power you possess of communicating it to others, you are an artist and a benefactor of mankind. Or we can deal directly with works tendered for our admiration as artistic. What emotion do they convey? To what sentiments do they appeal? Does the message which they bring come direct from the heart of the author, or is it the repetition of another man's message—an echo of tones and a mimicry of methods elsewhere found successful? If these works give pleasure, what is the nature of the pleasure they give? Is it such as accompanies an enlargement of our sympathies and the raising of our hopes for the future of mankind? Or is it the pleasure of gratified vanity or cynicism? Is it a pleasure which makes our hands "swifter unto good," or one that makes us more self-centered, more self-sufficient, more self-enthralled?

It is much to be desired that men in general would criticise works of art from this point of view. They might occasionally err in doing so; but their errors would be rare in direct proportion to their own sincerity, and the effect in strengthening their powers of judgment would be very marked.

Our author furnishes in the following passage a familiar example of what we are frequently called upon to admire as "art":

"A musician of renown seats himself before you at the piano, and plays for you what he says is a new composition of his own or of some present-day musician. You hear him produce strange and noisy sounds, you admire the gymnastic exercises accomplished by his fingers, and you also see clearly that his intention is to make you believe that the sounds which he produces express different poetical moods of the soul. His intention, I say, is clear; but the only feeling he communicates to you is one of mortal weariness. The performance lasts a long time, or at least seems to you to last a long time, owing to your utter failure to receive any distinct impression; and the idea comes to you that perhaps the whole business is a mystification—that the artist is trying an experiment on you, and is just flinging his hands at random over the keys in the hope that you will be taken in, and that he will have a good laugh afterward at your expense. But no. When at length the piece is finished, and the performer, all trembling and bathed in perspiration, rises from the piano manifestly expecting your applause, you see that it is all very serious. The same thing happens in concerts where they play pieces by Liszt, Berlioz, Brahms, Richard Strauss, and numberless composers of the new school."

It strikes us that there is much truth also in the following: "To say that a work of art is good, and that nevertheless it is incomprehensible to the majority, is as if we were to say of a certain food that it is good, but that most men should be careful not to eat it. The majority of men may not like decayed cheese or 'high' game, dainties much esteemed by persons whose taste is perverted; but bread and fruits are only good when they please the majority of men; and it is the same in art. A perverted art may not please the majority of men, but good art must perforce please everybody."

We must add a passage which contains a most powerful arraignment of the absurdities and wrongs which are every day being perpetrated in the name of art. Regarding art as an organ of human progress, the author points out the disastrous consequences which flow from its perverted action:

"The first of these consequences is too conspicuous to escape notice. It is the vast expenditure of human labor upon things that are not only useless but, as a rule, pernicious. To think that children, handsome, full of life, with every natural endowment necessary for happiness, are condemned from the moment they leave the cradle, some to practice scales six, eight, ten hours a day, others to dance on tiptoe, others to do singing exercises, others to draw from the antique, from the nude, and others again to compose phrases destitute of meaning according to a particular system of rhetoric! From year to year these unhappy victims go on wasting in these murderous occupations all their physical and intellectual forces, all their aptitude for the comprehension of life. We often say, What a lamentable spectacle to see little acrobats twisting their legs round their neck! But is it not a still more sinister exhibition to see children of ten giving concerts, and little collegians of the same age who know by heart all the exceptions in the Latin grammar? In such pursuits they not only waste their physical and mental forces, but they undergo a process of moral depravation which renders them incapable of any kind of service useful to human beings. Accepting in society the position of purveyors of amusement to the rich, they lose the sentiment of human dignity. A hunger for praise develops in them to so monstrous an extent that they suffer through life from this diseased condition, and expend their whole moral being in the effort to appease an insatiable craving. Yet there is something more tragic still, namely, that men who sacrifice their whole life to art, and who are lost for all other purposes, not only do nothing to advance their art, but even cause it immense damage; the reason being that in their academies and colleges and conservatories all they learn is to counterfeit art, so that they become henceforth incapable of conceiving true art or of doing aught except helping to crowd the world with the counterfeit works of an art divorced from Nature."

Before finishing his book Count Tolstoi finds time to say a needful word or two about those men of science who forget the social function of science as completely as some artists or would-be artists forget the social function of art. He well compares science and art in their relations to one another with the lungs and the heart in the human organism. Neither organ can work perfectly unless the other works perfectly also. A defective science makes a defective art, and *vice versa*. This is an interesting point and one that deserves careful attention. We have said enough to show that the great Russian has produced a work which the civilized world of to-day can not afford to ignore, and which, when it has drawn the fire of all who are offended by the positions it takes, will be recognized as a strong and irrecusable plea for the rights of humanity in the judgment of works of art and of all other works whatsoever.

A GREAT COUNTRY.

What is "a great country"? The schoolboy idea is that it is one that can thrash other countries; and, according to this notion, the greatest country of all is one that can "whip all creation." This idea might not do much harm if it were confined to schoolboys, but when it is shared by grown men the case is more serious. "When I was a child, I spake as a child, I understood as a child, I thought as a child; but when I became a man, I put away childish things." Here is a childish thing, however, which thousands who have reached man's estate find it very difficult to put away, and have not in point of fact put away. They still think that a country's greatness consists in its military strength—in other words, in the power it could bring to bear for the destruction of rival nations; and, if that country is their own, they exult to think of the havoc it could create among its enemies in the event of a conflict. That a country should be strong for defense is not enough, in the opinion of such persons; it must be strong for offense also; it must be strong enough to swagger.

How very different this is from the spirit of true patriotism hardly needs pointing out. Take that passage in Shakespeare in which the spirit of patriotism receives perhaps the strongest expression ever given to it in literature, and how little do we find of mere exultation in military strength! We refer to the words in which the dying John of Gaunt laments over the evils which the new king, Richard II, is bringing on the state:

> "This royal throne of kings, this sceptered isle,
> This earth of majesty, this seat of Mars,
> This other Eden, demi-paradise,
> This fortress built by Nature for herself
> Against infection and the hand of war,
> This happy breed of men, this little world,
> This precious stone set in the silver sea,
> Which serves it in the office of a wall
> Or as a moat defensive to a house
> Against the envy of less happier lands,
> This blessed plot, this earth, this realm, this England,
> This nurse, this teeming womb of royal kings,
> Feared by their breed and famous by their birth,
> Renowned for their deeds as far from home,
> For Christian service and true chivalry,
> This land of such dear souls, this dear, dear land!"

There is some reference here to military power—not unnatural when we consider that the date of the play is within eight or ten years of the Spanish Armada—but how little in comparison with the heartfelt expression of love for a land that was the home of a happy and prosperous people—"this land of such dear souls, this dear, dear land"! Moreover, in so far as the poet exulted in the strength of his country, it was the quality of its inhabitants he thought of and dwelt upon—not the engines of war that it possessed or the vastness of its pecuniary resources. A great country in the true sense is one that evokes this feeling in its sons and daughters, and evokes it not less in times of peace than in times of war.

It may here be remarked that the ambiguity of the word "great," as applied both to men and to nations, is the source of no slight perversion of moral judgment. When a man is spoken of as a "great" man without qualification, the inference is only too readily drawn that he is one who may serve as a model for imitation; and yet many so-called great men have had the most serious vices of character, and many have been guilty of the most appalling crimes. "Even so," their eulogists contend, "it can not be denied that they were great." So be it, only let it be understood that the word great so employed has no necessary connotation of moral excellence, of superior humanity, or of any of the qualities which might entitle a man to the love and gratitude of his fellows. The trouble is that, make what reserves we may, the word, as often as it is used, creates illusion, or else has the equally disastrous effect of making us think that where "greatness" is concerned moral considerations are of quite inferior importance.

So, when we speak of a great country, we are only too apt to think of its wealth and strength, and only too readily ignore the elements which go to make up a really great national character and a prosperous and stable commonwealth. We do not care to ask how it got its gold, or what it is doing with it, or at what moral cost it is maintaining its military organization. We do not ask whether liberty is flourishing within its borders, or whether its people are strong in the sum of their qualities, in energy, in resourcefulness, in a sense of public duty. We are ready to consider these things at other times; but the spectacle of military strength imposes on our imaginations; and, in schoolboy fashion, we account that nation especially great that has all its preparations made for striking a deadly blow at an enemy in the shortest possible time. It is lamentable that, in a country like this, such views should prevail to the extent to which they do, and that a large proportion of our people should have become enamored of the military ideal. The evil resulting from such a state of opinion is twofold: a wrong direction is likely to be given to our foreign policy, and the internal development of the country is in danger of receiving a serious check.

For, let it never be forgotten that the great problem which every community is set to solve is the problem of social evolution under the guidance of the principle of justice. Even the most military communities are working at this problem in their own way, but under disadvantages directly proportioned to the extent of their military organization and the amount of national energy which it absorbs. No reasonable person will deny that the highest well-being of any state depends upon the equity with which its laws are administered, the protection accorded to individual rights, and the scope allowed to individual initiative and energy. No one will deny either that the intellectual and moral condition of a people is, with reference to the ultimate ends of human existence, of vastly more account than their preparedness for offensive warfare. If these propositions are admitted, how can it be regarded otherwise than as a calamity that the ambition of our people, whose position is so eminently favorable to peaceful development, should be diverted into military channels and turned toward military ideals? Some day we shall have to turn back and seek for things that make for peace, the things that tend to the true upbuilding of the nation and the development of a civilization founded on justice and humanity; but unless that day comes soon evil may be wrought both to our national character and to our institutions which it may take long years to repair.

Scientific Literature.

SPECIAL BOOKS.

Mr. H. C. Porter's translation of *Strasburger's Text-Book of Botany* * was undertaken with the consent of both authors and publishers from the second revised German edition. The translator has aimed to adhere closely to the German original, making neither alterations nor omissions; to avoid any unnecessary introduction of new terms, adopting as far as consistent with the German the existing terminology, and conforming as far as possible to the usage of previous translations in rendering technical words of a purely German signification. For such departures as he may make from these rules he offers satisfactory explanations. The names of the authors, all of the University of Bonn, and their high reputation in their several fields of botanical study, attest the quality of the book, and this testimony is fortified by the fact that it was necessary to issue a second edition within a year after its first appearance. In the introduction the subjects of the imperceptible difference in the fundamentals between animal and vsgetable life, of evolution, of the distinction between living organs and lifeless bodies manifested by the quality of irritability in the former, and of spontaneous generation disproved by the researches of Schwann and Pasteur, are touched upon. Botany is divided into a general and a special part. In the general part the structure (morphology) and function (physiology) of plants are considered; in the special part the particular structure and functions of the special orders of plants are discussed. In the former part morphology and physiology are treated separately, in the latter part conjointly. The morphology is treated as external, involving the development of form in the plant kingdom, relations of symmetry, branch systems, the shoot, the root, and the ontogeny of plants; and internal, embracing the histology and anatomy. In the special part the theory of evolution is credited with having first afforded a true basis for a natural system of classification, expressive of relationship and family. The system of Alexander Braun, as modified and further perfected by Eichler and others, is followed. This book would ordinarily be characterized as a technical as distinguished from a popular scientific work, for it embodies the fruits of deep research by masters of the science. But it appears to be, for a technical work, remarkably easy reading. This is because of the simple forms of expression preferred by the authors and the translator, and of the pains taken to explain the hard words which are by no means wanting. The publishers promise shortly an edition of the work in two volumes, which will be sold separately, the first volume to contain Strasburger's

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* A Text-Book of Botany. By Dr. E. Strasburger, Dr. Fritz Noll, Dr. H. Schenk, and Dr. A. F. W. Schimper. Translated from the German by H. C. Porter. With 594 Illustrations, in part colored. New York: The Macmillan Company. Pp. 632. Price, $1.50.

Morphology and Noll's Physiology, or the general part, and the second the special part, or Schenk's Cryptogams and Schimper's Phanerogams.

Mr. *William E. D. Scott* seeks in his *Bird Studies** to place before students and others who wish to acquire knowledge on birds a means to that end—in other words, to invite them to a more intimate acquaintance with them. To this work he brings, in the shape of original notes based on field work, the fruits of his own studies during the past thirty years; and has further consulted, to insure accuracy, the standard works on North American birds; and he believes that all the kinds of birds of the land known to occur in the cases dealt with down to November 1, 1897, are included in his treatise. We say birds of the land, because the water birds are not included, being reserved for another volume. The area covered—called eastern North America—is that part of the continent east of the Mississippi River, Lake Winnipeg, and the western borders of Hudson Bay, with Greenland and the islands which naturally associate themselves with the mainland of the region. In the descriptions the birds are not grouped by the usual systematic classifications, but as one would be most likely to meet them and according to the places they frequent. "It is believed that a knowledge of the birds nearest to us is the best point of departure, and is less liable to lead to mental confusion than if all the members of a given systematic group—as, for instance, all the thrushes or all the sparrows of the entire region—were to be introduced or placed before the student in a body." Certain kinds have come to associate themselves more, on the whole, with the regions round the house than wifh any other locality. Others are in the same way characteristic of the woodland, the field and meadow, bush, and swamp. After these the birds along the highway, "in the woods," "across the fields," "in marsh and swamp," and "by stream and pond" are described; and, finally, a systematic table of the land birds of eastern North America is given. The letterpress descriptions are models of what such articles should be when directed to untechnical readers—brief, comprehensive, direct, and definite. The one hundred and sixty-eight illustrations are of various degrees of satisfactoriness. The pictures of live birds and nests and of bush surroundings are lifelike and true, but show the difficulty of managing outdoor light when the bird, and not the artist, selects the moment for taking the picture. The pictures of dead birds are mostly excellent photographs, but liable to objection in other respects; they do not show the bird as it is in life, and are useless for purposes of identification; they are not agreeable to look at, and, at a time when the most strenuous efforts are hardly sufficient to prevent destruction of the birds and secure their preservation, they are a bad example. The book would have been better if they had been left out of it.

Our impression as we take up Mr. *Goldwin Smith's Guesses at the Riddle of Existence* † is a strong one of the pity it is that we can not enjoy the reading of the books of the Bible free from the traditions with which they have been surrounded, and the glosses and scholasticism and false interpretations that have been put upon them. Here is a man, candid and one

* Bird Studies. An Account of the Land Birds of Eastern North America. With Illustrations from Original Photographs. New York and London: G. P. Putnam's Sons. Pp. 363. Price, $5.

† Guesses at the Riddle of Existence, and other Essays on Kindred Subjects. By Goldwin Smith. New York: The Macmillan Company. Pp. 244. Price, $1.25.

of the strongest-minded thinkers of the time, religiously and devoutly inclined, expressing his anxiety about subjects that need not have troubled him at all if he had been permitted to read his Bible without thinking of things that really belong outside of it, but are taught us all in childhood as gospel truth. The spirit in which his pages are penned, he says, "is not that of agnosticism, if agnosticism imports despair of spiritual truth, but that of free and hopeful inquiry, the way for which it is necessary to clear by removing the wreck of that upon which we can found our faith no more. To resign untenable arguments for a belief is not to resign the belief, while a belief bound up with untenable arguments will share their fate." Three of the five essays in the book have appeared in periodicals; the others are new in print in their present shape. In the first, which gives its name to the book, the works of Drummond, Kidd, and Balfour relating to man, his origin and destiny, are reviewed. In the second, The Church and the Old Testament, the authenticity of the Old Testament is questioned. The other essays relate to the doctrine of another life, the miraculous element in Christianity, and morality and theism. While theologians have done harm with their hard-and-fast interpretations "essential to salvation," evidence that is added to and never contradicted with every new season's explorations in the Orient shows that the critics whom Mr. Smith seems inclined to follow have egregiously erred in the ground and method of their attacks on the authenticity of the books of the Old Testament. These explorations show that those books reflect the very life and spirit of the times to which they relate, and must have been contemporary with them or compiled from contemporary documents, giving in the cosmogonies, etc., the earliest traditions of mankind, and in the historical statements references to facts concerning which other evidence has been or is likely to be at any time found.

GENERAL NOTICES.

The life and work of Pasteur have been affectionately and appreciatively described from the familiar and the French point of view in M. Vallery Radot's *Histoire d'un Savant par un Ignorant* and in M. Duclaux's *Histoire d'un Esprit*, and from a more purely scientific point by Mr. Roux in his article on *L'Œuvre Médical de Pasteur*. Now, *Dr. and Mrs. Percy Frankland*,* acknowledging indebtedness to all these authors, present the subject from the point of view of English students of science. Their purpose is to extend and make more universal the general world's acquaintance with the great master and the methods through which his wonderful discoveries were made. His achievements, they say, "are so interwoven with the circumstances by which our daily life is surrounded, that it is all but impossible to find any one who is not directly or indirectly concerned with some part or other of his great life work." The authors make a straightforward, clear, and attractive presentation of the early life and studies and successive researches by means of which Pasteur achieved the highest point of scientific fame and won the right to be regarded as one of the world's greatest benefactors. A full account is given of the organization and methods of the *Institut Pasteur* and of the work of Pasteur's associates there and of his students.

The chief aim of Mr. *Clark's Laboratory Manual of Practical Botany*, we are informed by the publishers,* is not to find the names of flowers, but to gain some real knowledge

* Pasteur. By Percy Frankland and Mrs. Percy Frankland. New York: The Macmillan Company (Century Science Series). Pp. 224. Price, $1.25.

* A Laboratory Manual of Practical Botany. By Charles H. Clark. American Book Company. Pp. 271. Price, 96 cents.

of the life histories of plants. It seeks a new presentation of the subject, making use of the best modern method of study, and giving prominence to laboratory processes. The course of study outlined in it is intended to give the student a general view of the subject, and at the same time to lay a foundation on which more advanced studies may be built. As the length of time given to the study of botany differs widely in different schools, the author has endeavored to furnish a course that may be made very elastic; and room is therefore provided in it for selections, in aid of which a few hints are given. A considerable amount of previous study is supposed to have been given to the gross morphology of the parts of flowering plants, with some attention to the division into groups and classes, and knowledge enough of analysis to find the names of plants. "With this preparation it seems . . . that the pupil can enter with profit upon a course which will give him a general view of the whole plant world, beginning with plants of the simplest organization." Such is the present course. The explanations to the experiments are clear and direct.

Mr. Mallock, in his Aristocracy and Evolution, has submitted the preachings of the socialistic and labor agitators with arguments drawn from philosophy. Mr. *Freeman Otis Willey* attacks them and disposes of most of them in *The Laborer and the Capitalist** by subjecting them to the test of plain common sense. He takes them up as they are declared on the street, in the press, from the pulpit, in the legislative halls, and on the stump, and, one after another, exposes the practical fallacies that are in them. Thus he does with the questions of monopoly, the accumulation and concentration of wealth, the relations of capital and labor, railroads, rented homes, wages, taxes, etc.; as to all of which points the practical method of looking at the subject and treating it gives his observations great force.

In the series of Physical and Electrical Engineering Manuals of J. Henderson and S. Joyce, it is the object of the authors to provide a course of instruction for carrying out a progressive series of experiments in the subjects, arranged so that the usual apparatus at the disposal of a laboratory, though not especially designed for any particular experiment, may, nevertheless, be used with advantage in a variety of ways. They have also sought to arrange experiments of such character that a student working *alone* may be able to obtain satisfactory results. The second volume of the series* is devoted entirely to practical work in electricity and magnetism, the department of physical work being reserved for a volume by itself. The introductory chapter contains a most excellent series of instructions as to the methods of observation and the manner of making them. The student "must never be in a hurry. A week spent in discovering and overcoming some source of error will be well-spent time, and may be of more educational value than the performance of the original experiment itself. Above all things, however, the experimenter must be methodical," and more of similar tenor. Exact directions are given, likewise, concerning the management of the instruments. The measurement of resistance is dealt with first in the order of experiments, with a brief account of the methods of measuring in absolute units. In choosing methods for the various measurements it has been the aim to take only those best suited for the purpose. Lists are given, at the end of each chapter, of references to the more important original papers bearing on the subject of the chapter to be found in the scientific periodicals.

Mr. *R. Floyd Clarke* assumes that the law seems to laymen and to some who attempt the study of it a crabbed, difficult, and dry pursuit, and attempts in his *Science of Law and Law-making* † to make clear to average readers some of its truths and introduce them to a correct conception of the system under which they live. While admitting it as true that the detail and doctrines

* The Laborer and the Capitalist. By Freeman Otis Willey. New York: Equitable Publishing Company. Price, $1.25.

* Practical Electricity and Magnetism. By John Henderson. Vol. II. New York: Longmans, Green & Co. Pp 488.

† The Science of Law and Law-making. Being an Introduction to Law, a General View of its Forms and Substance, and a Discussion of the Question of Codification. By R. Floyd Clarke, of the New York Bar. New York: The Macmillan Company. Pp. 473. Price, $4.

and the applications thereof of any system of law have, to the general student, the forbidding qualities ascribed to them, he maintains that that which is valuable as wheat or gold is to be got out of it. "While the decision of special law cases, petty or otherwise, that arise in daily life may embrace complicated deductions to be made from technical rules, and end in inductions of interest only to the professional man, and which to the unlearned mind appear to have no reason for their existence, yet other special cases may require in their decision the assertion and application of most important general principles—principles of interest to every one, and whose assertion either way reacts upon the future well-being of all." He tries, therefore, to write an introduction to law which shall enlighten the intelligent lay reader as to the beauty and interest of its problems; to reduce the discussion of the code question to a practical, concrete form; to elaborate the idea of the fundamental and intrinsic difference between the two forms of statute and "case" law; and to draw the proper conclusions and apply those principles to actual legislation, judicial or legislative, and to determine by a practical test the province of each and the best way to conserve them.

The late Professor Jowett is credited with having pronounced Italian literature the greatest in the world after Greek, Latin, and English. It is more intimately affiliated to antiquity, Mr. *Garnett* says in the preface to his *History* of it,* than any other European literature, and may indeed be regarded as a continuation or revival of the Latin. Yet it was long in appearing. This fact is perhaps partly due to the earlier Italian writers of mark having continued to express themselves in Latin, and the vernacular writings having had to fight their way slowly up. This fact, further, worked greatly to the disadvantage of the appreciation of Italian literature, for much that should have belonged to it and which might have helped us estimate the capacity of the Italian mind was in another language. Dante and Petrarch and others, masters and classics in Italian, wrote also much in Latin, and their native language is robbed thereby of much that would otherwise have been its best work. It is another disadvantage to the reputation of the Italian mind that many of its greatest geniuses did not express themselves at all, or at most comparatively little, in writing, but in other fields, especially art and music. So it was with Michelangelo—greatest of all—Leonardo da Vinci, and half a dozen others whom Mr. Garnett names, including Galileo, Columbus, and Napoleon; while Michelangelo, Leonardo da Vinci, and Benvenuto Cellini have written enough to show that they might have been among the greatest masters of literature if they had not had other things to do. Italian literature has been continuous, abundantly productive in every century, of unequal merit perhaps, but always affording enough of mark to give it standing, and presenting one name at least the peer of the greatest, and it is of this continuous succession of writings that the present history furnishes a view.

* A History of Italian Literature. By Richard Garnett. New York: D. Appleton & Co. Pp. 431. Price, $1.50.

*Brown Men and Women** is the title given by Mr. *Edward Reeves* to a lively, picturesque account of his voyages through the South Sea Islands and of life as he found it there in 1895 and 1896. Mr. Reeves is a New-Zealander, and living, according to distant American perspective, almost among the South Sea Islands, he goes into them in his book without preliminary ceremony, landing the reader, almost at the first leap, among the cannibals of old, whose customs are contrasted with those which prevail in the same regions now. The spirit with which he passes through his adventures and describes them is revealed in his opening sentence: "The South Sea Islands! To us New-Zealanders, when we were young in the sixties, what a charm they were of mystery, barratry, piracy, kidnapping; of tales of innocent, gentle southern natives torn from the paradises and sold into slavery by English-speaking devils; of more northern fierce cannibals, Fijians, New Hebrideans, and Solomon Islanders, down whose throats disappeared, in most satisfactory retribution, some of our compatriots." In a series of running

* Brown Men and Women; or, The South Sea Islands in 1895 and 1896. By Edward Reeves. London: Swan Sonnenschein & Co. New York: The Macmillan Company. Pp. 294. Price, $3.50.

sketches and stories, like the smoking-saloon yarns of the second chapter, Mr. Reeves gives his experiences and impressions of the Friendly Islands, Tonga and its recent troubled history, "Kava and some Customs," Samoa, the Fijian group, the Cook group, and the Society Islands, adding *obiter* observations and incidents of various sorts, and not by any means omitting solid information. The last chapter relates to the missionaries, and is unfriendly to them.

In a sermon on *The Evolution of a Sentiment—Kindness to Animals in the Christian World*, the Rev. *Newton M. Mann*, of Omaha, argues that the duty of kindness and tenderness to animals is not an original Christian doctrine and is nowhere mentioned in the Scriptures, but is of later development; and that the Hindus long anticipated Christians in enunciating it. (H. S. Mann, Omaha. Five cents.)

The Chemical Publishing Company, Easton, Pa., publishes *Methods for the Analysis of Ores, Pig Iron, and Steel, in Use at the Laboratories of Iron and Steel Works in the Region about Pittsburg, Pa.;* contributed by the chemists in charge, and edited by a committee of the Chemical Section, Engineers' Society of Western Pennsylvania (price, $1). In a circular inviting these articles from chemists the committee defined the aim of the section to be to secure accurate statements of analytical processes, describing with minuteness and clearness the successive steps, in order that the compilation may represent as correctly as possible the present status of analytical chemistry as applied to iron and steel. Sixteen responses were received, detailing the methods pursued at as many furnaces. They are all given in this volume, with an appendix containing various special methods of analysis of ores and furnace products.

Prof. *Alfred Fairhurst*, of Kentucky University, publishes in the volume entitled *Organic Evolution Considered* the objections to the theory of organic evolution that have occurred to him from time to time in the course of his discussions of the subject in his college classes. He finds that organic life can not be accounted for as a function of chemistry, energy, or spontaneous generation; that natural selection does not afford an adequate explanation of the varieties of life, the argument for it is inadequate, and the objections to it are forcible; and "that the lack of harmony in the teaching of evolutionists shows that there is much vagueness as to the details of the theory"; that many difficulties beset the argument from paleontology; failure of the argument from embryology to cover the ground sufficiently; and special objections. Under the head of Several Chapters on Other Subjects included in the book may be placed the chapters on Instincts, The Origin of Man, a Future Life, Design in Nature, Evil and Altruism in Nature, and Agnosticism. The author presents his arguments in good shape and with good temper, but they seem to us to relate to a phase in the discussion that has been passed by both sides. (Published by the Christian Publishing Company, St. Louis.)

The Phylogeny and Taxonomy of Angiosperms was the subject of the address of the retiring president, *Charles E. Bessey*, of the Botanical Society of America, in August, 1897. The author approached the problem by the three lines of investigation—viz., the historical, in which the materials are supplied by phytopaleontology; the ontonogenetic, in which the development of the individual supplies the necessary data; and the morphological, in which the different development of homologous parts supplies our index of relationship.

The principal portion of Part XXXIII of the *Proceedings of the Society for Psychical Research* is taken up with Dr. Richard Hodgkin's Further Record of his Observations of Certain Phenomena of Trance (Mrs. Piper's case). The development of automatic handwriting is considered, and the indications are noted of the trnth of the "spirit" hypothesis as against that of telepathy from the living. In a supplementary article Mr. Harlow Gale gives an account of Psychical Research in American Universities.

Another of those clear, practical, wholly readable and wholly comprehensible garden manuals by *L. H. Bailey*, and published by the Macmillan Company, is *The Pruning Book*, a monograph of the pruning and training of plants as applied to American conditions. No prefatory ceremony is observed, but the reader is introduced at once to "the fundamentals." The philosophy of pruning is explained and illustrated by recording and picturing the history of a branch, and it is shown that pruning does not devitalize plants, but increases vigor by removing that which would perish or be weak in the struggle for existence, and concentrating the nourishment in the rest. The nature and relations of the fruit bud are described, as to different fruit trees; the nature of wounds and the healing of them are treated of in a separate chapter; the principles of pruning are unfolded; and under the heading of the incidentals the details of the art are described, with its special applications to different trees and in "some specific modes of training," and three chapters are given to the grapevine.

We find *The Plant World: a Monthly Journal of Botany*, edited by *F. H. Knowlton*, of the United States National Museum, a work of attractive qualities. The articles in the third number—the only one we have received—are brief, fresh, and to the point, furnished by competent botanists and original observers. The magazine is published by William N. Clute & Co., at Binghamton, N. Y., for one dollar a year.

The *Little Pottery Objects of Lake Chapala, Mexico*, described by Prof. Frederick Starr, in a bulletin of the Anthropological Department of the University of Chicago, consist of vessels, ladles, spindle-whorls of terra cotta, considerable numbers of which were found in the lake, but none in sites on the land. They are too small for any practical use, but are made with much artistic taste and skill. Professor Starr explains them tentatively as votive offerings let down into the water by cords passed through holes provided in most of them, or in which resin or gum may have been burned, or other offerings placed. They are not unique, for the American Museum of Natural History in New York has similar objects from Tillo, Oaxaca, and others are said to have been found near Palenque and near Tehuantepec.

Mr. *William Paul Gerhard*, a distinguished sanitary engineer and writer on the subject, has given in a little book entitled *Sanitary Engineering*, published by himself at 36 Union Square, East, New York, a comprehensive manual of the qualifications and duties of the sanitary engineer, considering the subject wholly from a practical point of view. A course of study in sanitary engineering is described, intended to embrace a general knowledge of civil engineering, architecture, and sanitary science in all their branches; under the head of General Practice of the Sanitary Engineer are given brief directions and hints concerning water supply, sewerage, purity of water courses, sewage disposal, street pavements, street cleaning, removal of ice and snow, removal of refuse, laying out of cities and towns, sanitation of towns and houses, and a variety of kindred subjects; and the appendix includes an article on The Work of the Sanitary Engineer in Time of Epidemics, in Time of War, and in Sudden Calamities in Civic Life.

The Ninth Annual Report of the Interstate Commerce Commission on the *Statistics of Railways* for the year ending with June, 1896, contains the usual reports and summaries of the statistician, a summary of railways in the hands of receivers, notes of decisions, and detailed statistical tables of mileage, corporate charges, receipts and expenditures, etc. But little change is shown from the conditions that prevailed in the year preceding.

In *The Fungous Foes of the Farmer*, a more than ordinarily useful contribution to the Bulletins of the Pennsylvania Department of Agriculture, Prof. *Byron D. Halsted* undertakes briefly to describe the worst fungous diseases of the farmer's crops and to give methods that have been successful in contending with them. As far as possible, the fungi have been considered in the order of their importance with each crop, beginning with those of the field and ending with those of the garden.

The first three volumes of the *Observations made at the Blue Hill Meteorological Observatory* were numbered XX, XXX, and XL, the more easily to distinguish them from the other volumes of the Annals of the Astronomical Observatory at Harvard College; but the system could not be continued indefinitely without leaving too many numbers to be assigned to later volumes not yet published, so the report for 1896 is numbered Volume XLII. The whole of the Blue Hills having been taken by the Metropolitan Park

Commission for a public reservation, a satisfactory arrangement has been made under which the premises of the observatory are reserved to it so far as is necessary for observatory use, so that the continuation of the work is assured, with the expectation that it will ultimately become a part of that carried on directly by Harvard University. At present Mr. A. Lawrence Rotch provides the means for carrying it on. Of the observations recorded in the present report, the most important were those of clouds in co-operation with the international system of cloud observations, and the exploration of the air by means of kites.

The fourth volume, 1896, *Studies from the Yale Psychological Laboratory*, E. W. Scripture, editor, contains articles on Reaction Time in Abnormal Conditions of the Nervous System; Influence of the Rate Change upon the Perception of Difference in Pressure and Weight, and Weber's Law in Illusions, by C. E. Seashore; and on Reaction Time, Voluntary Effort; New Apparatus and Methods, and Psychological Measurements, by the editor, E. W. Scripture. Published at Yale University, New Haven (pp. 141), for $1.

Owing to the large amount of original matter that has lately appeared in the Pharmaceutical Review, and the consequent reduction in other departments, it has been deemed advisable hereafter to publish the more technical scientific articles under a separate cover, to be known as the *Pharmaceutical Archives*. This will be supplied for $1 a year, while the price of the Pharmaceutical Review is $2, and both will be sent for $2.50 a year. The first number of the Pharmaceutical Archives consists of 24 pages, and contains four articles. Published at Milwaukee, Wis. Edward Kremers, editor.

In the *Thirteenth Annual Report* of the Bureau of Labor Statistics of Connecticut, the scope of the investigations has been enlarged as to the inquiry respecting the conditions of workingmen. The readiness manifested by the people in assisting the agents' bureau is recognized. Of the five parts into which the report is divided, the first relates to the condition of workingmen, the second to the condition of manufacturers, the third to the hours of labor and wages in mercantile establishments, the fourth to the rates of wages paid in municipal employment, and the fifth includes an abstract of bills passed or rejected during the last session of the General Assembly and decisions of courts in various States. The operation of the act concerning alien laborers is represented as having been "most beneficial." The services of the State Board of Mediation and Arbitration were not required during the year covered by the report (1897).

The Story of Germ Life, in D. Appleton and Company's Library of Useful Stories, has been prepared by Prof. *H. W. Conn*, of Wesleyan University, one of our most expert bacteriologists, in view of the fact that bacteria are associated in most minds chiefly with disease. "The last few years have, however, emphasized the importance of these organisms in many relations independent of disease, but this side of the subject has not yet attracted very general attention, nor does it yet appeal to the reader with any special force." His purpose, therefore, is to give a brief outline of our knowledge of bacteria and their importance in the world, including, besides their well-known agency in promoting disease, their even greater importance as agents in other natural phenomena. Their nature as plants is described, and their uses in the arts, the dairy, and natural processes are discussed, and the relations of parasitic bacteria to disease and the method of combating them are considered.

The Economic Relations of Life Insurance to Society and State is the subject of Publication No. 218 of the American Academy of Political and Social Science. It includes papers on the subject, read at a meeting of the academy, held in December, 1897, by L. G. Fouse and M. M. Dawson, with discussions by W. D. Whiting, G. E. Freyer, and R. P. Falkner. Published by the academy at Philadelphia, for 35 cents.

N. W. Ayer & Son's American Newspaper Annual for 1898, including its catalogue and accounts of American newspapers and descriptions of towns, etc., in which newspapers are published, forms a volume of 1366 pages, besides those devoted to advertisements. It contains the names of 2,142 publications not found in the previous volume, yet the total net gain is only 137—the smallest, with one exception, ever yet recorded. Reasons are adduced to show why the gain should not naturally have been larger, but, making full allowance for these, there still seems to have been an unusually large mortality in the newspaper world during 1897. A growing conviction of publishers is noted, "that in a very large number of cases there have been too many newspapers, and that one strong paper is better than two or three weak concerns struggling for existence."

The Passing of Plato, a commencement address by Prof. *O. P. Jenkins*, of Leland Stanford Junior University, celebrates the decay of the scholastic methods and teaching, and the advance of the scientific method to supremacy.

We have received the first number of the *Journal of Applied Microscopy*, *L. B. Elliott*, editor, published monthly by the Bausch and Lomb Optical Company, Rochester, N. Y. It is intended to supply what is believed to be a want of the country, of a journal devoted to microscopical instruments and technics, regarded from the practical point of view. It is to be conducted on an entirely independent basis. Subscription price, $1 a year.

An important paper on *Road Materials and Road Building* has been prepared by Dr. *Frederick H. Merrill*, director of the New York State Museum, and is published by the University of the State of New York. In it the problem of road improvement in New York, and the character and value of the material in the State available for road making, are discussed, directories of producers of road material and quarrymen are given, and liberal citations are made, largely as to the methods of construction, from the reports of the Massachusetts Highway Commission. Two pocket maps show the distribution of rocks in New York suitable for road material and the location of quarries; and more than a dozen photographs illustrate what has been done in Massachusetts.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Cornell University: No. 147. Fourth Report upon Chrysanthemums. By Wilhelm Muller. Pp. 36.—Indiana: Report of the Botanical Department. By J. C. Arthur. Pp. 10.—Michigan: No. 157. Hog Cholera. By G. A. Waterman. Pp. 8; No. 158. Some Experiments with Poultry. By C. D. Smith and C. S. Brooks. Pp. 16.—Ohio: Peach Trees. Pp 192; Newspaper Bulletin, No. 183. Cucumbers, Melons, Tomatoes, Peach Trees, and Weeds. Pp. 2.—Purdue University: Special Bulletin on Commercial Fertilizers. By H. A. Huston, State Chemist; No. 65. Formalin for Prevention of Potato Scab. By J. C. Arthur. Pp. 16.—United States Department of Agriculture: No. 15. Forest Growth and Sheep-raising in the Cascade Mountains of Oregon. By F. W. Coville. Pp. 54; No. 16. Forestry Conditions and Interests of Wisconsin. By Filibert Roth, with a Discussion by B. E. Fernow. Pp. 76; No. 22. Climate of Cuba; also a Note on the Weather of Manila. By W. F. R. Phillips. Pp. 23; North Dakota Weather and Crops. By B. H. Bunson. Pp. 8.

Britton, N. L., and Brown, Hon. Addison. An Illustrated Flora of the United States, Canada, and the British Possessions. Vol. III. Apocynaceæ to Compositæ (Dogbane to Thistle). New York: Charles Scribner's Sons. Pp. 588. $3.

Bulletins, Reports, etc. Harvard College Observatory: The Meteoric Shower of November 13, 1897. By William H. Pickering. Pp. 16, with plate.—Johns Hopkins University Circulars: Notes from the Physical Laboratory. Pp. 16. 10 cents.—Minnesota: Third Annual Report of the Chief Fire Warden. 1897. Pp. 80.

Conant, Franklin Story. A Biographical Sketch and Memoir on the Cubomedusæ (a memorial volume). Baltimore: The Johns Hopkins Press. Pp. 63, with portrait and 8 plates.

Crook, James W. German Wage Theories. History of their Development. Columbia University (Studies in History, Economics, and Public Law). Pp. 113. $1.

Elliott, A. G., Editor. Industrial Electricity. Translated and adapted from the French of Henri de Graffigny. New York: The Macmillan Company. Pp. 149.

Fairlie, J. A. The Centralization of Administration in New York State. Columbia University (Studies in History, Economics, and Public Law). Pp. 207. $1.

Haddon, A. C. The Study of Man. New York: G. P. Putnam's Sons. Pp. 410.

International Correspondence School. What Correspondence Instruction is. Scranton, Pa. Pp. 24.

Lange, D. Handbook of Nature Study for Teachers and Pupils in Elementary Schools. New York: The Macmillan Company. Pp. 329. $1.

MacEwan. The Essentials of Argumentation. Boston: D. C. Heath & Co. Pp. 412. $1.12.

Mathews, F. Schuyler. Familiar Life in Field and Forest. The Animals, Birds, Frogs, and Salamanders. New York: D. Appleton and Company. Pp. 284. $1.75.

Miller, John. The School System of the State of New York (as viewed by a Canadian). Toronto: Warwick Brothers & Rutter. Pp. 204.

New Jersey, Geological Survey of. The Physical Geography of New Jersey. By R. D. Salisbury, with Appendix by C. C. Vermeule. Trenton. Pp. 200, with plates.—Also, accompanying this, a Relief Map of New Jersey, 24 × 42 inches, with name-sheet

New York Academy of Sciences. Vol. XI. Part. I. G. Van Ingen, Editor. Pp. 135, with plates.

Parker, F. W., and Helm, N. L. Uncle Robert's Geography. II. On the Farm. New York: D. Appleton and Company. Pp. 158. 40 cents.

Rasius, C. E. Rechte und Pflichten der Kritik (Rights and Duties of Criticism). Leipsic: William Engelmann. Pp. 171.

Reprints. Bessey, C. A. and E. A.: Further Notes on Thermometer Crickets. Pp. 2.—Black well, Rev. A B.: Consciousness and its Helpers. Pp. 6.—Craig, C. T.: Neurotic Lithemia. Danbury, Conn. Pp. 3.—Fernald, M. L.: The Genus Antennaria in New England. Pp. 12.—Fewkes, J. Walter: The Winter Solstice Ceremony at Walpi. Pp. 38.—Fuller, M. L.: Notes on a Carboniferous Bowlder Train in Eastern Massachusetts. Pp. 12.—Hale, F. E.: Treatment of the Uric-Acid Diathesis. Pp. 7.—Van der Water, G. R., D. D., and Beaman, C. C.: Anniversary Addresses at Babies' Wards, New York Post-Graduate Medical School and Hospital. Pp. 12.—Watson, L. H.: Uracidemia. Pp. 3.—Winter, H. L.: Notes on Criminal Anthropology and Bio-Sociology. Pp. 37, with plates.

Rice, Wallace, and Eastman, Bassett. Under the Stars, and other Verses. Chicago: Way & Williams. Pp. 64.

Rowley, John. The Art of Taxidermy. New York: D. Appleton and Company. Pp. 244. $2.

Sloyd Bulletin. Monthly. No. 1. May, 1898. Boston: Sloyd Training School. Pp. 40.

Smithsonian Institution: Review and Bibliography of the Metallic Carbides. By J. A. Mathews. Pp. 32.—Revision of the Deep-Water Mollusca of the Atlantic Coast of the United States, etc. By A. E. Verrill and K. J. Bush. Pp. 132, with plates.

Still, Alfred. Alternating Currents of Electricity and the Theory of Transformers. London: Whittaker & Co. New York: The Macmillan Company. Pp. 184. $1.50.

Taylor, A. R. The Study of the Child (International Education Series). New York: D. Appleton and Company. Pp. 215.

Thomas, Prof. Cyrus. Introduction to the Study of North American Archæology. Cincinnati: The Robert Clarke Company. Pp. 408. $2.

United States Coast and Geodetic Survey. Notice to Mariners. No. 232. May, 1898. Pp. 10.

Washburn, F. L. Preliminary Report upon the Introduction of the Eastern Oyster to the Oregon Coast, Summer of 1897. Pp. 4.

Whitten, R. H. Public Administration in Massachusetts: the Relation of Central to Local Activity. Columbia University (Studies in History, Economics, and Public Law). Pp. 167. $1.

Fragments of Science.

BALNIBARBIAN GLUMTRAP RHYME.

(*Repeated by the children in the nurseries of Balnibarbi.*)*

Distant scintillating star,
Shall I tell you what you are?
Nay, for I can merely know
What you were some years ago.

For, the rays that reach me here
May have left your photosphere
Ere the fight of Waterloo—
Ere the pterodactyl flew!

Many stars have passed away
Since your ether-shaking ray
On its lengthy journey sped—
So that you, perhaps, are dead!

Smashed in some tremendous war
With another mighty star—
You and all your planets just
Scattered into cosmic dust!

Strange, if you have vanished quite,
That we still behold your light,
Playing for so long a time
Some celestial pantomime!

But, supposing all is well,
What you're made of, can I tell?
Yes, 'twill be an easy task
If my spectroscope I ask.

There—your spectrum now is spread
Down from ultra-blue to red,
Crossed by dark metallic lines,
Of your cooler layer the signs.

Hence among the starry spheres
You've arrived at middle years—
You are fairly old and ripe,
Of our solid solar type.

Ah, your sodium line is seen
Strongly shifted toward the green.
Hence you are approaching me
With a huge velocity!

But, if some celestial woe
Overtook you long ago,
And to swift destruction hurled
Life on every living world,

Did there in the fiery tide
Perish much of pomp and pride—
Many emperors and kings,
Going to do awful things?

Mighty schemes of mighty czars—
Mighty armies, glorious wars!
From the Nebula they may
Rise to curse a world some day!

G. M. Minchin.

—*From Nature of April 14, 1898.*

* Balnibarbi is one of the countries visited by Gulliver; the "Glumtrap" is the Balnibarbian equivalent of the English nursery; and the babies of Balnibarbi are brought up on strictly scientific principles—as is evidenced by their knowledge in these verses.

The Total Eclipse at Viziadrug.—The following vivid description of the recent total eclipse of the sun appeared in the Times of India: "But high overhead was a sight it was worth a journey of thousands of miles to see. In the midst of the dull blue sky stood out the inky blackness of the moon with its slightly ragged edge, a silhouette more sharply defined than the mind can conceive. Encircling the moon was the corona, a mass of the purest and most brilliant incandescence, thin in the upper portions, and much broader below. On the lower left corner a blazing blood-red prominence cast a ray of beautiful color into the dazzling whiteness; a smaller and less conspicuous spot appeared upon the opposite quadrant. At the second of totality four extensions leaped from the corona into the surrounding darkness, feathery, ethereal streams of the most exquisite pearly luminosity. To the southward Venus shone with the brilliance of a tropical night; below her, Mars less clearly, and three stars of lesser magnitude were barely visible. The darkness, owing to the great clearness of the atmosphere, was not intense. Newspaper print could be easily read, or the position of the second hands of a watch noted without the assistance of a lantern. Still the landscape presented an unnatural appearance, and irresistibly suggested a world seen through a colored glass. Away to the westward the horizon was a dull gray purple, shading into a delicate violet, and then to a lovely subtle yellow like the tinge of an English winter sunset; to the east the shadow of the moon seemed to envelop the earth like an angry rain cloud. There were few opportunities of observing the effects of the eclipse upon the animal world. A number of crows circled restlessly over the trees which fringe the little sandy bay; a big yellow snake half crawled out of his hole near the wall, looked round, and withdrew. Other sign of animal life there was none."

The Field Columbian Museum.—The work of the Field Columbian Museum, Chicago, during the year covered by its last annual report, included two courses of eight lectures each, in one of which distinguished specialists were represented, while the other was given entirely by the curators of the museum; and the publication of seven works of research (in addition to the annual report) of great value. The library contains 8,062 books and 7,680 pamphlets. A large space in the report is occupied with the description of the accessions to the various departments of the museum, which are catalogued in another part of the book. All the agencies employed have given excellent returns, and all the departments seem to have shared in the results. The collection obtained by the African expedition of Mr. Elliott (to the Masai country) is very valuable, "probably the most important, certainly so as regards quadrupeds, ever brought out of any country by one expedition"; and consists of about two hundred animal skins, three hundred skins of birds, numerous reptiles, and about half a barrel of fishes, obtained on the coast and at Aden. Skeletons of every species, in certain cases two or three of the same species, were preserved, and casts of heads and parts of bodies showing the muscles of the large animals were made. Specimens forming a fair representation of the materials in use among the tribes were obtained, with photographic negatives of the people, scenery, and animals. Other expeditions were made by Messrs. G. A. Dorsey and E. Allen among the Indians of the far West; Mr. O. C. Farrington to the caves of Kentucky; Mr. C. F. Millspaugh for forestry specimens; and the assistant curator of ornithology for southern birds.

The Climate of Alaska.—An article by General A. W. Greely on climatic conditions in Alaska, in The National Geographic Magazine, is authority for the following statements: Almost everywhere in Alaska the climate changes decidedly within a hundred miles of the mainland coast and becomes continental in its characteristics. Rain and snow are less frequent, the summers are longer and warmer as we go inland, the skies less cloudy, and the winters marked with excessive cold. Freezing weather, usually below zero, continues for months, and even in July, with midday temperatures of 70° to 80°, it is an almost daily occurrence for the temperature to fall during the night to the neighborhood of the freezing point. Sitka is a typical coast station for southern Alaska. In forty-five years its temperature has varied between 88° and —4°. The cold-est month is January, 31.4°, and the warmest August, 54.9°. Every year it is either rainy or snowy two hundred days on an average. The annual rainfall is very great, being eighty-one inches. Point Barrow, the extreme northern point of Alaska, is in 71° 23′ north, 156° 40′ west, and its climate is that of the coast line of the whole timber or moorland region situated along the Arctic Ocean. The winter is long, freezing weather lasting from early September to early June. The mean winter temperatures are December, −15.4°, January, −17.5°, and February, −18.6°, with occasional periods when the cold is from 40° to 52° below zero. The average heat of July is 38.1°, but the temperature often rises above 50°, and has touched 65.5°. The snowfall is light. The severity of the cold is indicated by the fact that the ground was found frozen as far as excavations were made (thirty-eight feet). Temperature observations at Dawson, in the Klondike region, during the fifteen months from August, 1895, to November, 1896, show the following records: In July only the temperature did not sink below freezing. During June, July, and August, 1896, the temperature rose on twenty-nine days above 70° and thrice above 80°. The extreme severity of the winter is indicated by the fact that from December 1, 1895, to February 1, 1896, the temperature fell below zero every day. On twenty-eight days it fell lower than −40°, on fourteen days lower than −50°, and on nine days lower than −60°. The average temperature for January, 1896, was −40.7°, and for February −35.4°. Bright weather is the rule. The Yukon River broke up on May 17th. It was frozen solid November 25th.

The Holophane Globe.—The results of an inquiry by a committee of the Franklin Institute into the efficiency of Blondel and Psaroudaki's holophane globes are printed in that body's journal for April. The object of the holophane globe is "to secure diffusion of the light, as well as such a form of distribution that the light usually lost by being sent off into space above the source of light shall be distributed below that plane and thus made useful." In the globes under consideration the interior surface is made of a continuous series of vertical flutings. The function of these flutings is to secure a distribution normal to the direction of the incident light. The external surface of the globe consists of a series of circular grooves in a horizontal plane extending over the entire surface of the globe. These grooves are constructed with reference to the relative positions of the groove and the source of light. The committee reported that when the light from an arc lamp passed through the globe, the effect upon a vertical screen showed a distinct cutting down of the amount of light passing in a straight line through the upper part of the globe, and a definite increase of the light on a horizontal plane and at all angles below that plane, the space vertically beneath the globe being well illuminated. The fact that the diffusion is secured is shown by the character of the shadows cast. When an opaque body is held near the globe there is practically no shadow on a screen a few feet away. This property of the globe has the effect of entirely doing away with distinct shadows of bodies near it that is so objectionable in the ordinary arc light. In appearance the holophane globe is covered with bright points over its entire surface. Recent tests by Professor Lewes, of London, with a Welsbach mantle and one of these globes showed that in the angle between the horizontal plane and forty-five degrees below it the holophane globe increased the light from twelve to thirteen per cent, while the best of a number of others examined, a clear glass globe, gave a loss of 7.5 per cent. The general conclusions by the committee regarding the globe were that "Messrs. Blondel and Psaroudaki have invented a globe that secures much better diffusion and more satisfactory distribution than any other globe known to its members; that the conditions of its manufacture are such that it can be supplied to the trade in commercial quantities; and that the invention has secured a distinct improvement in the diffusion and distribution of artificial light." The committee recommended that the John Scott Legacy medal and premium be awarded to the inventors.

Epicurean Cats and Dogs.—While most instances in which eccentricities of animal tastes have come under observation are those in which animals, like dogs and cats, are taught to relish other than their usual food, cases are cited by M. C. Cornevin in which animals usually carnivorous spontaneously seek vegetables and fruits. A group of well-fed dogs came under his observation which manifested an epicurean taste for plums. He often found them in his morning walks in the orchard, they having crept through the holes in the fence, snapping at the fruit that had fallen off during the night. One of them, when offered bread soaked in bouillon and plums, took the plums. Another dog did not lose his appetite for the fruit when stung by a wasp concealed in a plum, but afterward turned every plum carefully over and examined it before biting it. The dogs seemed to prefer sweet fruits; they liked pears as well as plums, and the choicest varieties best. The author was told that shepherds who trade in dogs' skins have found that they got the best prices for the skins of animals that are slain in October after having been fed on fruit during the summer, and that the meat of such dogs had been found to be palatable and destitute of the usual unpleasant flavor. Cats were observed to be fond of melons, and to manifest a decided taste for cooked vegetables, especially leeks and onions. They will abandon for a time the meats given them with their dinners and eat the vegetables only. They are not fond of raw vegetables except asparagus, of which they have been known to keep the young shoots well down by biting off the tips as they appear. A cat is mentioned, however, that lived one summer chiefly upon beans in the pod; and another that spent the whole season in the garden, beginning with the asparagus bed, then taking to green beans, which he pulled down from the trellises that supported them; and next on carrots, of which he ate the tops down to the ground, but did not scratch the soil from the root. This cat would have led the same kind of life a second season, but, being as destructive to the garden as a rabbit, was shot. The fierce and carnivorous marten and weasel enjoy cherries, and become fat and hearty upon them. These peculiarities, and the fruit hunting of foxes, skunks, and bears, have been accounted for by some naturalists as induced by hunger; but the explanation is not sufficient. The tastes are manifested when food of all kinds is most abundant and most easily obtained. A more probable explanation is that they are atavistic reversions, or are adaptations to peculiar conditions of the digestion and its ferments, demanding the introduction of new agents to re-enforce those already at work, but which may have become enfeebled. The subject is a good one to experiment upon.

Revaccination. — The following paragraph is taken from a "memorandum" recently prepared by Dr. Bond for the Jenner Society in England: "The experience of every epidemic, and last but not least of that of Middlesbrough, shows conclusively that if we wish to protect the community against these increasingly frequent scourges we must take as much trouble to promote revaccination as we have hitherto taken to promote infant vaccination. So long as the public are led to believe, as they have been hitherto, that vaccination in infancy is the only thing about which the state need take any care, so long will epidemics of so-called 'vaccinated' adolescents and adults and of unvaccinated or badly vaccinated children be the opprobrium of our country. There is only one way of effecting this, and that is by requiring, so far as is practicable, every child who enters a school to be efficiently vaccinated, and that before it leaves school it shall be equally efficiently revaccinated. It is to the revaccination of her adolescent population that Germany owes the remarkable immunity from epidemics of smallpox which she has for the last twenty years enjoyed rather than to her compulsory vaccination in early childhood, for it is the adolescents and adults whose early protection in infancy has become attenuated by age who are most exposed to the risks of smallpox. If we can secure their protection by revaccination at the end of the school age, as well as that of the children at the commencement of it, we need not trouble ourselves much about the infants. We have been misled in this respect by false inferences from the experience of Jenner and the early vaccinators. When infants were the chief sufferers, because the adult population was in a large degree protected by having had the disease, the discovery of a means by which these unfortunate little victims could be almost absolutely protected naturally led to an undue estimate of the value of infant vaccination, especially as its effects were assumed to be more lasting than they really are; but we have now to deal with altogether changed conditions. Where infant vaccination is fairly well maintained, as it has been in Middlesbrough, it is the adults who have not been revaccinated who are now the chief source of danger—a danger which can only be avoided by investing every young person with the same degree of protection which we have for the last half century conferred upon the greater portion of our infant population."

The Eskimo Lamp.—Mr. Walter Hough, in The American Anthropologist for April, gives an interesting account of the Eskimo lamp, which is, it seems, the most important utensil of the latter's household. There are many drawbacks to the spread of a people into arctic regions—the cold, the long nights, the hardships of travel, scarcity of wood, and, paradoxical as it may seem, the difficulty of obtaining drinking water. This latter drawback is the most serious of all, and were it not for the Eskimo's lamp would have effectually prevented his settlement in arctic regions. The typical Eskimo lamp is a shallow dish of soapstone with the outline of the gibbous moon. It has hollowed out on the upper surface a reservoir to contain oil. The rear is curved and bounded by a low wall. The reservoir slopes gradually up to the edge upon which the wick is laid. This edge is straight. The wick is of moss, rubbed to powder between the hands, and carefully laid in a thin line along the wick edge of the lamp. The oil in the reservoir stands just at the lower margin of the wick. The flame is about two inches high, and is clear and smokeless if the wick is properly cared for. The oil is supplied by blubber melted by the heat of the lamp. With this contrivance the Eskimo lights and heats his house, cooks his food, and melts snow for his drinking water. The lamp is peculiarly the possession of the women. Each head of a family must have a lamp, though two or more families may live in the same hut. The Eskimos have no phrase expressing a greater degree of misery than "a woman without a lamp." After the death of a woman her lamp is placed upon her grave. The lamp is only useful with fats of high fuel value, such as are furnished by fish and seals. The wick line is found to increase in length toward the north. In southern Alaska this edge is about two inches long, while at Point Barrow, the most northerly point of Alaska, it is from seventeen to thirty-six inches in width. In fact, this variation is so uniform that by examining the wick edge a fairly close estimate of the latitude in which a lamp originated can be made.

Popocatepetl.—Popocatepetl, "the smoking mountain," and Ixtaccihuatl, "the white woman," are the highest peaks of a mountain range or sierra about sixty miles in length and eighteen in breadth, called the *Sierra Nevada*, or Snowy Sierra of Ahualco, which constitutes a barrier separating the valley of Puebla from the valley of Mexico. Communication is had between the valleys by a saddle-shaped pass, the lowest point of which is twelve thousand one hundred and eighteen feet high. Popocatepetl, the fourth highest mountain in North America, is a volcano with a snow-capped lava cone, which is now in the solfatara state, emitting only steam and sulphur. It is frequently ascended, although it is between seventeen thousand and eighteen thousand feet high, and rises about five thousand feet above the snow line. One of the grandest mountains of the continent and presenting a magnificent aspect from every point of view, its pride has been sadly mortified by its having been reduced to be a sulphur mine. The sulphur, which is obtained from the crater, is mined in June and July, those months being chosen with reference to the quantity of snow, which is then sufficient to allow of making a smooth trough on which the sulphur can be slid from the crater to the ranch of Tlamacas, five thousand feet below. The general features of the ascent, as Dr. O. C. Farrington describes his achievement of it in February, 1896, in the Bulletin of the Field Columbian Museum, are not strikingly different from those presented in the ascent of other not extremely difficult snow mountains. The lower slopes of the snow are broken up by long tongues of exposed sand on which the climbing was comparatively easy, but in the last stages every step had to be cut in the ice. The ice and ashes are very destructive to leather, so that a single ascent is enough to wear out a pair of shoes. The snow is rarely more than a few feet deep, but is cut up on the surface into numberless rough, wedge-shaped teeth, and is constantly dissolved at the bottom by the warm ashes beneath it. "Nothing like crevasses occur in the snow, and the yawning chasms reported by travelers or would-be travelers can be set down as purely imaginary." The approach to the crater was signalized by a strong odor of hydrogen sulphide that filled the air. The crater is about two thousand by thirteen hundred feet in diameter, and from eight hundred to fifteen hundred feet in depth, with nearly perpendicular walls from which jets of steam come hissing and sizzling, and rocks of various sizes are continually falling and plunging with a roar to the bottom. This bottom is heaped unevenly with *débris* of various sorts and colors; and, as Mr. Farrington had to look down into it with a wind so fierce that it caused the very walls to tremble, its aspect was dismal enough. There is none of the heat and movement usually associated with volcanic eruptions, for that phenomenon here is very mild indeed. Various parts of the crater rim have been named the *Pico Mayor*, or highest point; *El Portezuelo*, or Little Door; *El Espinazo del Diablo*, or Devil's Backbone; and *El Malacate*, the windlass, where the sulphur gatherers are let down. The layers of lava of which the walls of the crater are made are plainly visible at intervals, dipping at various angles.

A New Theory of Geyser Formation.—At a recent meeting of the Physical Society at Eton College, Prof. T. C. Porter discussed a new theory of geyser formation, which is reported as follows in the Chemical News: "The theories of Bunsen and others fail to explain why the geyser throat appears almost completely full at the end of an eruption. This immediate refilling is the more remarkable when it is remembered that some of the geysers of the Yellowstone region discharge a million and a half gallons at each eruption, and that the eruptions may occur at five-minute intervals. Moreover, the theories generally accepted assume steeper temperature gradients than those in a region like Yellowstone. Professor Porter suggests that the phenomena are better explained on the assumption of an arrangement of strata such as exists in artesian-well districts; the throat or shaft of the geyser being in the position of a well communicating with a subterranean stream—the 'tube' of the geyser. From the disturbed nature of the region, the tube of the geyser follows a waved course. The 'shaft' rises from the crest of the terminal wave; the other crests may be steam traps. Since a basinlike formation is characteristic of all geyser regions, it is fair to assume that the end of the tube remote from the shaft has an outcrop in the hills that form the sides of the basin. By means of this outcrop, water continually flows into the tube. Where the tube does not sink deeply enough to attain the temperature necessary for the generation of steam, a quietly flowing hot spring is the result. But if at any point the tube descends to underground temperatures sufficiently great, steam is formed, and is trapped at the highest point of a bend. Ultimately this steam checks the flow of water, until the accumulated head of cool water from the hills overcomes the resistance, condenses the steam, and re-establishes liquid continuity. Urged by the pressure behind it, the steam is impelled toward the geyser throat; it forces the hot water before it until equilibrium is once again restored in the tube."

Materials for Paper Making.—One of the most important considerations in the selection of materials for paper making is that of the structure of the fiber. The most perfect spinning fibers, and the best for paper making, are cotton and flax. They differ in that cotton—unique in that respect—occurs in the form of ultimate fibers and is a spinning unit, while flax is composite, or a bundle of ultimate fibers or spinning units. Next to flax are rhea, inferior on account of the irregularity of its fibers; hemp and jute, which have distinct qualities. After these are the fibers used in twine and rope making, but not adapted for spinning. All may be used in paper making, with various results in the quality of the product. Another important item bearing upon paper material is the chemical composition of the fiber, or its capacity of resistance to the natural agencies of destruction. This is the living question in modern paper making. In this point cotton and linen rags stand at one extreme and wood pulp at the other. The destructive agents are oxygen, the action of which is stimulated by resins used in sizing the paper; water, which provokes chemical changes that are facilitated by acid substances present in the sizings; and living organisms—molds and bacteria—which become more dangerous than ever when gelatin is introduced into the sizing. Paper must further possess mechanical qualities to enable it to endure—strength, a certain degree of elasticity, and resistance to rubbing and friction—all of which are involved in the questions of material and sizing. Then all papers are "filled" or "loaded," generally with clay, to give them "body" and opacity and to cheapen the manufacture. This does not actually injure the paper, but may be carried to such an extreme as to be a cheat. The best papers, and the only ones suitable for use in permanent records, are those made of what Messrs. Cross and Bevan, in their book fully treating of the subject, call normal cellulose—cotton and linen—with china clay only sparingly used. Such papers are now, unfortunately, rare. China clay is prodigally used, and wood and straw largely take the place of rags. Papers made of these substances are very inferior and perishable. They are easily liable to discoloration, oxidize readily and gradually crumble, rot, and perish—a fact of which any one may satisfy himself by looking at some newspaper cuttings only a few years old. The conclusion is drawn by Mr. C. F. Cross, from the examination of specimens of serial publications in various European languages, that "a large proportion of the literary and scientific work of the age is printed on an extremely perishable foundation." Happily, publishers have become aware of this deficiency of modern papers and are exercising more care in the selection of those to be used in their better works; and manufacturers claim that with improved processes and better methods they are able to make even wood paper that will last.

More New Elements in the Atmosphere.—In communications to the French Academy of Sciences and the Royal Society, Prof. William Ramsay has reported the discovery by himself and Mr. M. W. Travers of still other hitherto undetected elements in the atmosphere. The author, having obtained a quantity of liquefied air from Dr. Hampson, allowed it to cool and evaporate slowly till only about ten cubic centimetres remained out of the original quantity of seven hundred and fifty cubic centimetres. The gas obtained from this residue was then carefully purified from oxygen and nitrogen, and when examined spectroscopically showed the argon spectrum freely and also another spectrum which was believed never to have been seen before, especially characterized by the presence of two very brilliant lines, one in the yellow, close to but not identical with the helium line, and another in the green. Other lines were also seen, but they were much less intense. The new spectrum is under special study by Mr. Baly. The newly discovered gas is less volatile than nitrogen, oxygen, and argon, and heavier than argon, having a density measured at 22.5 as compared with hydrogen, but likely to prove greater when it is obtained free from argon. The ratio of its specific heats indicates that it is monatomic, and therefore an element. Professor Ramsay proposes for it the name *krypton* (concealed) and the symbol Kr. In a subsequent communication to the Royal Society, Professor Ramsay and Mr. Travers reported that on submitting argon to liquefaction, a colorless liquid was obtained with a white solid substance condensing partly around the sides of the tubes and partly below the surface of the liquid. A gas was obtained from the liquid by distillation and collected in two fractions. The spectrum of the gas was characterized by a number of bright red lines, one of which was particularly brilliant, and a brilliant yellow line, while the green and blue lines were numerous but not conspicuous. The measured wave length of the yellow line showed that it is not identical with those of sodium or helium, which equal it in intensity. Density measurements gave 17.2 for the first fractionation and 14.7 for the second—a result that encourages hopes that when obtained in greater purity it may have the density of about 11 requisite to give it a place in the periodic table. The name *neon* is proposed for this new gas. The white solid substance which was obtained with the liquid argon volatilized slowly, but on wiping off the coating of snow from the bulb with the finger was seen to melt and volatilize into the gas holder. The resultant gas when introduced into the vacuum tube showed a very complex spectrum, totally different from that of argon, while resembling it in general character. Its density was found to be 19.87. Inasmuch as it differs in a very marked degree from argon in its spectrum and in its behavior at low temperatures, it must be regarded as a distinct elementary substance. It would appear to hold the position toward argon that nickel does to cobalt, having approximately the same atomic weight, yet different properties. It is monatomic. In a sealed package deposited with the French Academy of Sciences, May 11, 1898, and opened when Professor Ramsay's communication on krypton was read, MM. Moissan and Deslandres announced the discovery of a new gas in the atmosphere resembling nitrogen but different from krypton.

MINOR PARAGRAPHS.

The best existing illustration in this nineteenth century of the stone age and what it was like, Mr. W. S. Lach-Szyrina said, in a paper read in the British Archæological Association, is to be found in Australia. The Tasmanians, now extinct, were considered the best representatives of the men of the early stone age, and the still existing Australian races—making allowance for different climatic forces—furnish some of the best representatives of mankind of the later stone age. Some information respecting the difficult subject of the habits of thought of the people of the stone epoch may be gleaned from a comparison of the folk and legendary lore of Australia and that of the countries of southern Europe. In Australian folklore a great confusion is apparent between human beings and animals; and in the folklore of Cornwall the remains of a very primitive folk-belief in the transmigration of men and women into animals, and *vice versa*, have lingered almost to our own day. Similarities may be traced between the folklore of Australia as it appears in Mrs. Langloh Parker's Australian Legendary Tales and that of Britain as regards the belief in spirits and the influence of the stars; and curious resemblances occur between our nursery tales and the legends of Australia.

The great number of Norse words in the dialect of the Shetland Islands—ten thousand—is accounted for by Dr. Jakob Jacobsen by the fact that the islands were colonized in the ninth century from different districts of Norway, where numerous dialects prevailed. Consequently, every district, parish, and island has a number of Norse words peculiar to itself. Synonyms, moreover, are very abundant in popular speech. A few nursery rhymes, riddles, and proverbs in Norse are still preserved, though in very corrupt shape. A curious system of taboo, reminding us of similar customs in some of the South Sea islands, and coming down from pagan times, prevails in these islands and farther south, by which, at the deep-sea fishing, everything has to be called by some mystic name. The minister and church are on no account to be mentioned by their right names at sea. They represented in the pagan days "the new conquering faith which aimed at doing away with the old gods, and consequently at diminishing the sea god's dominion of the sea. Being thus offensive to the sea god and the sea spirits, the church had to be called *de Benihoose*," or the prayer house, and the minister *de upstander* or *de beniman*, or prayer man. Other names were also given him, as *de predikanter*, or preacher, and *de loader* (from an old word meaning to utter sounds or speak in a peculiar tone), and in one island *de hoideen*. The little island of Fetlar, not seventeen square miles in area, has about two thousand place names

A derivation is found by Mr. Guy Le Strange for the word *tabby* as applied to the cat, which is indeed strange enough. The name comes originally, it appears, from Attāb, a great-grandson of Ommayyeh, of the family of caliphs, whom Mohammed appointed, A. D. 630, governor of Mecca. When afterward Bagdad was built and made the capital, certain lands in the city were assigned to the descendants of Attāb and became the Attābiyeh quarter. This quarter became famous for its silk looms, and the goods called Attābī, woven in variegated colors of mixed silk and cotton, were exported to all parts of the Moslem world, and were imitated in other places, as in Almeria, Spain, where eight hundred looms were kept at work upon it. The material was sent into all Christian countries, and its name is found in most European languages. Queen Elizabeth was *vestita di tabi d'argento et bianco* (dressed in silver-and-white tabby) when she received the Venetian envoy Scaramelli in 1602. Samuel Pepys records of a certain day that he put on his "false taby waistecoate with gold lace." And Miss Burney, on the occasion of the birthday of the princess royal, at Windsor, in 1786, appeared in a gown of "lilac tabby." Dr. Johnson explains in his dictionary that tabby is "a kind of waved silk," and adds that the tabby cat is so named from the brindled markings of its fur.

The "pine-barren region" of the Atlantic coast, sporadic and narrow in New England and Long Island, broadens as we go south, and in the Carolinas often extends to a distance of about eighty miles from the sea. It has a flora of its own, and quite distinct from those of the hill and mountain regions back of it. Mr. Thomas H. Kearney, Jr., reports in the new periodical The Plant World that he has found spots where a large proportion of this flat-country flora occurs in nooks of sandy ground hidden away among the high regions of the Appalachians. Especially along the French Broad River, in East Tennessee and western North Carolina, "there is a notable incursion of plants usually considered typical of the coastal plain. In some places these 'miniature pine barrens,' with their growth of pitch and scrub pine and the herbaceous plants that associate themselves with them, push their way up on the lower, near-by ridges, crowding among the oaks and chestnuts that are the rightful tenants. Such islands of coastal vegetation have been observed at several places in this mountain region."

Every one is acquainted with those water plants, the duckweeds, which appear to the eye as small oval leaves floating on the surface of ponds and streams, so closely packed together as to form an apparently continuous mass, often of considerable extent. Mr. Charles Henry Thompson, who has made a study of them, finds four well-defined genera and about twenty eight species in their order, the *Lemnaceæ*, distributed throughout the torrid and temperate zones. In our range the four genera are represented by about thirteen species and one variety, of which two species and the variety are probably peculiar to it alone, and ten are found only in the western hemisphere. There are difficulties in classifying them, because the species have a strong tendency to vary widely according to the surroundings, and because the flowers and fruit are only partially known in some species and not at all in others. Then some species may have two or three marked stages of growth differing from each other so widely as to give rise to different specific names for each. In the third of these stages, which the author calls the "resting stage," "winter fronds" are formed, and the plant sinks to the bottom, to rise again in the spring. Somewhat similar modified fronds are formed when the ponds recede or dry up, to start out again in healthy vegetation when the moisture returns.

NOTES.

A very interesting excursion is offered by La Nature to its subscribers, from the 4th till the 16th of August, to the central plateau of France, with its caves, gorges, and mountain ascents. An itinerary has been prepared contemplating a visit each day to some of the remarkable and curiously attractive spots in which the region abounds, including an experience of subterranean navigation in the *Gouffre* of Padisac, the *Gouffre* of Réveillon, the mines and factories of Decazeville, the buried forest of la Mougudo, the viaduct of Garabit, the *Course du Sauveterre*, navigation of the Gorges of the Tarn, the Grotto of Dargillan, and ascensions of the Puy Mary, with lunch on the summit, and of l'Aigoual. The entire cost of the excursion, covering all ordinary expenditures, is two hundred and fifty francs, or fifty dollars, from Rocamadour, where it begins, to Vigan, where it ends, with reduced railroad fares going and coming.

Dr. Stuart Jenkins has not been satisfied with the adequacy of the Darwinian doctrine of descent and natural selection. He is peculiarly struck with its failures to explain the infertility of hybrids and to fill the gap between the invertebrates and the vertebrates. After several years of independent study and investigation of the subject, he has published his conclusion in an elaborate article in the Medical Age that "the vertebrate organism, instead of being a single organism which has been evolved from a simple to its present highly complex form by a gradual and cumulative differentiation, is in fact a compound made up of two distinct organisms constantly associated; . . . that the divergence of the vertebrates from the lower type was caused by the plantation of one organism of the ganglionic type upon another, the implanted organism giving rise to the cerebro-spinal nerve system and internal skeleton." The author further believes that the ganglionic type is itself a compound, the ganglions being parasitic on a simple cellular matrix.

A resolution passed by the American Association at its Detroit meeting suggested, as a remedy for the obstacles imposed on the interchange of scientific thought by the prevailing diversity of tongues, the adoption by the civilized nations of an alternate language of Learning, Law, and Commerce, to be taught in higher schools in combination with the mother tongue, and used in interlingual correspondence and printed records. The resolution further authorized the officers of the association to pledge its co-operation in a general movement seeking that end, and to provide for its representation in any conference on the subject that may be called.

The Guildford Natural History Society, England, is trying to have Walmer Forest set apart as a sanctuary for wild birds, in which they and their nests and eggs may remain unmolested throughout the year; that it may not be let at any time for game preserving or for any purpose hostile to birds; and that it remain in perpetuity a national memorial of Gilbert White.

A notice, with portrait, of the late James Joseph Sylvester, Savilian professor of geometry in the University of Oxford, and formerly professor of mathematics in Johns Hopkins University, appears in the Proceedings of the Royal Society of London for May 9th. In the writer's opinion, Sylvester was one of the greatest mathematicians of all time, though it may be doubted whether he will take a place among those who "occupy absolutely the front rank" His greatest achievement was probably his paper entitled Algebraical Researches, printed in the Philosophical Transactions for 1864; but his published works do not properly represent his genius and greatness. He was so oppressed with floods of ideas that he was unable suitably to organize his researches. His personal character was one of singular beauty, and its salient points were simplicity and honesty.

A copper mask found inside the wrappings of a mummy pack in a grave at Chimbote, Peru, and in a valley thickly dotted with ancient cemeteries, is believed by Mr. George A. Dorsey to be unique. It was hammered from a single nugget of copper, and shaped by the aid of a mold or block. All the features are well formed and distinctive except the nose, which is pinched and dwarfed. A hole was made for the mouth, the ragged edges showing the method of the operation being still visible within.

A rather unusual competition is described by the Lancet as recently occurring in Milan. It seems that the nose possesses a peculiar significance for the Italians—so much, in fact, that they have a "cult of the nose," which has during the last seven years held two "*concorsi di nasi*" (nose competitions). The former of these was at Padua in 1891. The more recent one took place at Milan, when there were thirty-six competitors, the first prize being a gold medal.

We have to record the deaths, not previously mentioned in the Monthly, among men known in science, of Dr. Joseph Albert Lintner, State Entomologist of New York since 1881, at Rome, Italy, May 5th, aged seventy-six years; Ch. W. A. Herrman, formerly professor of mineralogy in the University of Breslau, but since 1853 a resident of New York city, whose fine collection of minerals was widely known, June 21st, aged ninety-seven years; H. Perigal, treasurer of the Royal Meteorological Society and fellow of the Royal Astronomical Society, author of works on bicycloidal and other curves, kinematics and the laws of motion, etc., early in June, in his ninety-eighth year; Hubert Sadler, contributor to Knowledge, The English Mechanic, etc., fellow of the Royal Astronomical Society, in June, aged forty-two years; Osbert Salvin, F. R. S., an eminent English ornithologist and entomologist, Strickland curator in the University of Cambridge, one of the founders and editor of the third series of The Ibis, author of articles on Humming Birds and Petrels in the British Museum Catalogue of Birds, and joint author of *Biologia Centrali Americana*, still in progress, to which he contributed the results of three journeys of scientific investigation in Central American countries—June 1st, aged sixty-three years; the Rev. Percival Frost, mathematician, editor of Newton's *Principia*, and author of treatises on solid geometry and curve tracing, aged eighty years; Dr. George Bauer, associate professor of paleontology in the University of Chicago, at Munich, Bavaria, June 28th; Dr. Theodor Eimer, an eminent zoölogist, professor in the University of Tübingen, May 30th, aged thirty years; Sir James Nicholas Douglass, late engineer in chief at the Trinity House, superintendent of many important engineering works, and author of numerous improvements connected with lighthouses and their illuminating apparatus and in buoys and beacons, aged seventy-two years; Dr. Friedrich von Zenker, pathologist, who first, in 1860, discovered trichiniasis in the human body, and author of valuable medical works, at Erlangen, aged seventy-three years; Dr. Anton Kerner von Marilaun, professor of botany in the University of Vienna and author of the Natural History of Plants, aged sixty-seven years; and Professor Cohn, of Breslau, distinguished for his researches on algæ, and later for his studies and cultures of bacteria, aged seventy years.

CHARLES GOODYEAR.

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GEOLOGICAL WATER WAYS ACROSS CENTRAL AMERICA.

By Dr. J. W. SPENCER.

INTRODUCTION.—From the days of early discovery, adventurers and explorers have repeatedly sought for accessible routes across Central America. For more than half a century engineers have ransacked the dense mountain forests for easy passes through which to connect the two great oceans by water or by rail. The number of low passes which dissect the Cordilleras and plateaus between North and South America is much larger than is popularly known. Indeed, there are so many deep breaks in the plateau regions as to suggest that many of them at no distant date were water ways between the Atlantic and Pacific. On account of the narrowness of the Isthmus of Panama and the low altitude of the divide, this region has been most noticed as a possible geological passageway between the Antillean waters and the Pacific Ocean. But it has been discovered that other water ways across the American continent can be even more surely established, and that neither the narrowness of the Isthmus of Panama nor the lowness of the divide form any additional evidence of the late interoceanic connection.

The early Tertiary period—the time when water connection across Panama had been suggested—was so long ago that the land animals have completely changed their characteristics, and even the sea shells have been mostly transformed into more modern species; accordingly, the time has been sufficiently long for several subsequent changes in the physical barriers between the Atlantic and Pacific. Indeed, geological straits across the continent have existed at different epochs since the early Tertiary period, and the last was so recent as to place it almost in modern times.

In searching for the geological water ways, the phenomena of the recent elevation of Mexico and Central America became so apparent as to establish the theory that the uplifting of the American barrier to its great altitude occurred principally since the period when the West Indian islands formed a high plateau bridge between the eastern portions of the two American continents (as described by the writer in The West Indian Bridge between North and South America).* Indeed, the discovery of the recent elevation of Central America and Mexico forms a most important sequel to the story of the now submerged West Indian lands, for it shows that Central America was low at the time when the Antilles stood at a great height—though it has subsequently been elevated, while the eastern region has been largely submerged. The discoveries of these great changes of level in recent periods are the necessary complementary phenomena of those found in the Antillean region.

Physical Features of Mexico and Central America.—*The Table-Lands.*—Much the larger area of Mexico and Central America is occupied by plateaus from six to eight thousand feet above the sea. Indeed, some of them have an altitude of over ten thousand feet. These elevated table-lands rise abruptly for thousands of feet above the inner margins of the coastal plains, which gradually slope upward from the seashores. The elevated plains, traversed by many mountain ridges, are, to the eye, apparently level. Out of their floors there also rise numerous island-like hills called *cerros*, as well as great volcanic cones. Thus the volcanoes of Popocatepetl and Iztaccihuatl, capped with perpetual snow, tower to a height of eight thousand feet or more above the Mexican plateau, as shown in Fig. 1.

The floors of the plateaus are substantially base levels of erosion—that is to say, the more ancient land surfaces were in olden days ground down by the action of the rains and rills to such low elevations above the sea that the streams could not further deepen their channels, whereupon the mountains were worn down into rolling plains. The hills and the mountains traversing the table-lands are often only the remnants of higher plains which have, so far, escaped destruction. Thus these elevated plateaus themselves demonstrate their subsequent great elevation above the sea.

In proceeding from Mexico into Central America, the high plateaus are not only necessarily of smaller extent, but they are more broken, and on the Isthmus of Panama they are almost replaced by mountain ridges rising from one to three thousand feet, except along a few lower passes.

* Appletons' Popular Science Monthly, 1898, vol. liii, pp. 10–30.

Interruptions of the Plateaus corresponding to the Antillean Basins.—In the paper upon The West Indian Bridge between North and South America it was pointed out that the Antillean seas formed three distinct basins—the Gulf of Mexico, the Sea of Honduras (between Cuba, Haiti, and Jamaica), and the Caribbean Sea, although the two latter are united at their surface under the name of the Caribbean Sea. In the investigations of the river valleys, now drowned beneath the West Indian waters, it was found that they were traceable to the floors of the three basins just mentioned. Accordingly, the hypothesis that these three basins were formerly drained into the Pacific Ocean called for corresponding depressions

FIG. 1.—VIEW OF THE MEXICAN PLATEAU FROM NEAR PUEBLA, showing the plains out of which rise isolated *cerros*, with the volcanic cones of Popocatepetl and Iztaccihuatl in the background.

across Central America and Mexico; and only such are found to occur (as shown in map, Fig. 2), although the continental barriers are now raised to considerable heights above the level of the sea. Thus the Mexican plateau rapidly narrows to a breadth of only twenty-five miles in the Tehuantepec Isthmus, where for a distance of sixty or eighty miles it is reduced so that the higher points do not exceed four thousand feet, and for a distance of perhaps over twenty-five miles the ridges do not reach an altitude of more than two thousand feet, with a repetition of base levels of erosion only nine hundred or a thousand feet in altitude among them. Indeed, these lower divides are further reduced at seven or eight passes which are only about eight hundred feet above the sea. Beyond these low depressions there are higher passes in the isthmus having an altitude of about twenty-seven hundred feet with accompanying plains. The Tehuantepec depression through the Mexican plateau corresponds in position to an extension of the basin of the Gulf of Mexico, toward which, from the Pacific side, there is a similar indentation of the continental mass as shown on map, Fig. 2. The Honduras basin, indenting the Central American plateau, has a corresponding depression across it at an altitude of about twenty-seven hundred feet. The Caribbean Sea proper has a more uniform

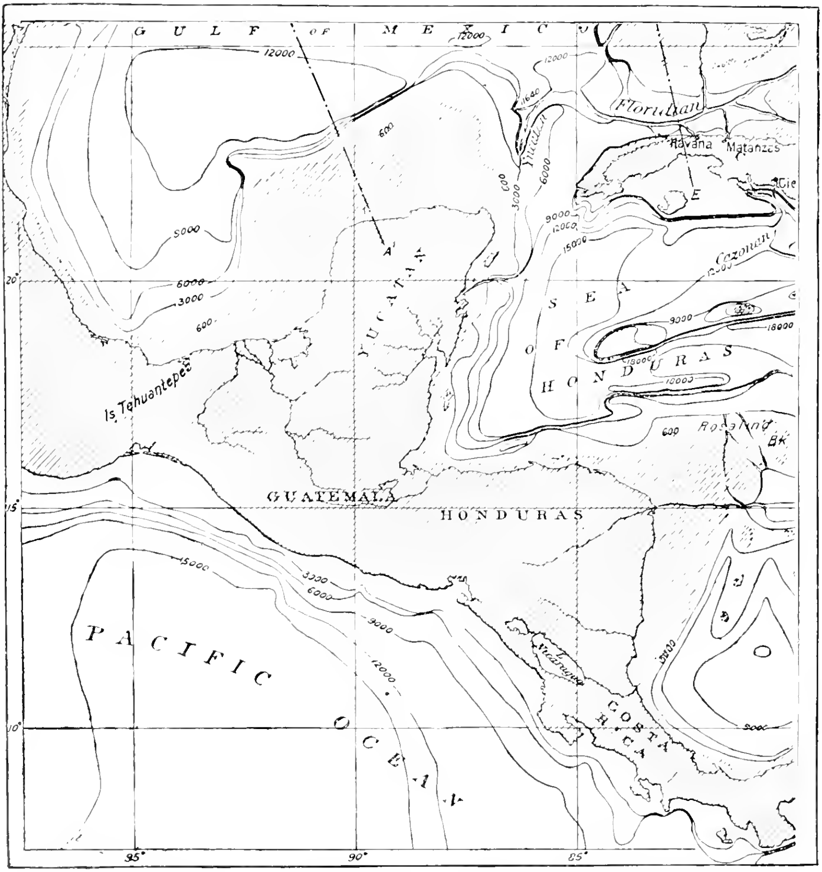

FIG. 2.—MAP OF CENTRAL AMERICA, showing the indentations corresponding to the Mexican, Honduras and Caribbean basins. (Soundings in feet.)

breadth than the other basins, and in like manner the American barrier, which is here narrower than farther north, is dissected in several places, as might be supposed. These depressions make it appear that the Caribbean basin was connected by several channels across the continent with the Pacific Ocean. The Nicaragua depression is the most northern. The elevation of the valley east of Lake Nicaragua is about three hundred and fifty feet above the sea, although the San Juan has further dissected it so as to reduce its channel to one hundred and three feet above tide. Between Lake Nicaragua and the Pacific the divide is reduced to two hundred and thirty feet, but a subsidence of the land to three hundred feet or so would connect the lake basin with the Pacific Ocean by eight or ten straits between as many islands.

While most of the Isthmus of Panama is traversed by mountain ridges from one thousand to three thousand feet high, these are dissected so that five of the deeper depressions are reduced to an altitude of from five hundred and fifty-three to eleven hundred and forty-two feet, while the Chagres River Pass, along which the railway is built, has a natural altitude of two hundred and ninety-nine feet, although the artificial cut reduces it to two hundred and fifty-four feet.

Besides the Nicaraguan and Panaman depressions across Central America, the valley of the Atrato and San Juan (to Buenaventura) forms a third and equally interesting depression between the Caribbean and Pacific basins. This valley is about three hundred miles long (direct course) and crosses Colombia between the Coast Range and the great Cordillera. The Atrato Valley is from forty to sixty miles wide, and for long distances above its mouth (Gulf of Darien) it is forty feet deep. At two hundred miles from its mouth the river is only forty-seven feet above the sea. Above this point, the tributary Rio Quito is still navigable for steamers to a distance of two hundred and seventy-three miles from the Gulf of Darien, and for eight miles farther canoes freely ascend the stream Santa Monica. Between this point and the navigable waters of the San Juan, only three miles distant, upon the other side of the divide, the elevation is so low that during high water canoes can even pass from the branches of one river to those of the other. Here the divide is reduced to about a hundred and fifty feet above the sea. The whole valley of the Atrato suggests a comparatively recent connection between the Caribbean Sea and Pacific Ocean. Across the Coast Range, separating the Atrato Valley from the Pacific, there are several passes at an elevation of only one thousand feet or less.

The Atlantic and Pacific Coastal Plains.—From the seashore, the coastal plains, on the Atlantic side of the continental plateau, slowly rise until they abut against the edges of the table-lands. These plains may have a width of only a few miles, or they may extend for a distance of considerably more than a hundred miles from the Gulf of Mexico. Back of Vera Cruz the coastal plains have a breadth of more than fifty miles and reach an elevation of seventeen hundred feet, while in the Tehuantepec Isthmus they extend for a distance of eighty miles from the sea and deeply indent the plateau region (see map, Fig. 7, page 588). Similar coastal plains form the eastern border of Central America, extending sixty-five miles into Honduras and a hundred miles into Nicaragua; but at Panama they are reduced to a width of five or eight miles. The Pacific coastal plains of Panama are wider than those on the Caribbean side; but, generally speaking, the plains upon the western side of the table-lands are much narrower than those upon the Atlantic side. In Nicaragua they are reduced to eighteen miles in width, and even at Tehuantepec, where they set in from the Pacific Ocean and indent the plateau region, their breadth is only twenty-five miles (see map, Fig. 7, page 588). The coastal plains represent the lands which have been most recently elevated above the sea. When they were covered by the oceanic waters the Isthmus of Tehuantepec was only twenty-five miles across, and still less where penetrated by dissecting arms of the sea. The Panama Isthmus was reduced to five miles across.

Characteristics and Terraces of the Valleys descending from the High Plateaus.—The plains, having no barriers to obstruct their drainage, and terminating at the margins of the high plateaus, indicate former base levels of erosion, and their great altitude shows the extent to which they have been elevated above

Fig. 3.—The Base Level or Elevated Floor of the Salazar Summit of the International Railway.

the sea. Their final surfaces may have been due in part to shallow accumulations of lake deposits leveling up the slight undulations of the old base-level surfaces, or these irregularities have at times been smoothed over by wind deposits. These superficial accumulations do not modify the general inference that the floors of the great table-lands were the effects of atmospheric agents, acting throughout a long period, in wearing them down to near sea level. The remains of such elevated plains were observed at an altitude of even ten thousand six hundred and thirty-six feet above the sea, as shown in Fig. 3. This represents a level plain bounded by mountain ridges about a mile apart. It is the summit of a divide, also about

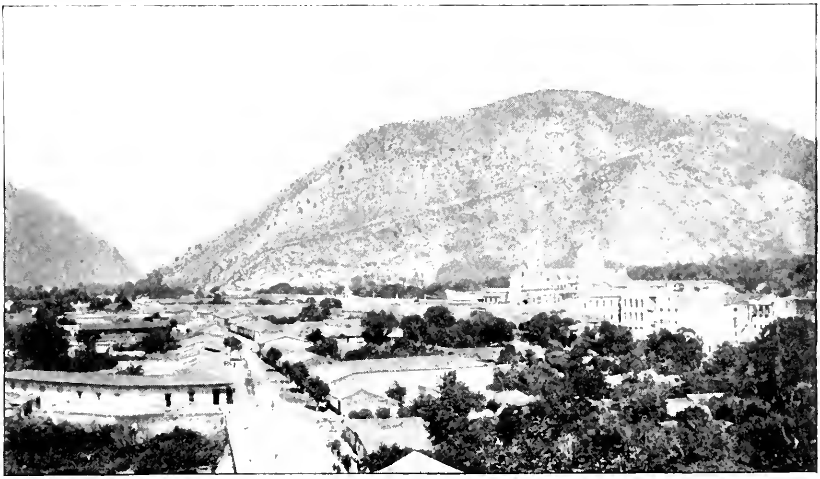

Fig. 4.—The Valley at the City of Orizaba, showing broad terrace plains bounded by sculptured mountain scenery.

a mile long. Both ends of the floor of this mountain-bounded depression are open, and terminate in abrupt steps of three hundred feet or more to the next lower and very much greater plains. The margins of this flat summit are indented by short ravines of recent date (the character of which is illustrated in Fig. 6, page 585), that have not yet had time to be extended backward into the summit plain and to dissect it into sharp ridges and deep ravines.

Equally abrupt are the margins of the plateau back of Vera Cruz (at about eight thousand feet above the sea), which may be taken as a type of the high base levels of Mexico. The borders of the high plateaus are dissected by deep valleys, which, when compared with the extent of the elevated plains, are remarkably short—often only a few miles long. The distance between Esperanza, upon the edge of the plateau (at an altitude of eight thousand and forty-two feet), and Atoyac (at fifteen hundred and twelve feet), near where the valley opens on the coastal plain, is only about forty miles in a direct course. The valley is from one to two or more miles in width, and is of course very deep. Upon its broad terrace plains the city of Orizaba and other large towns are situated, as shown in Fig. 4. Compared with the age of this large, deep valley, which is sufficiently old to have what were once the precipitous bounding walls of a great cañon now rounded off into sloping mountains, the Mexican plateau, of hundreds of miles in extent (at an altitude of eight thousand feet more or less), which is dissected for a distance of only forty miles, is of great age. Here again the elevation of the table-land has been too recent to have been converted into rugged mountain ridges and deep valleys.

This Mexican valley back of Vera Cruz, whose grandeur and beauty are perhaps unsurpassed, and depend more or less upon its youthful features, is not exactly modern, for since its first development it became partly refilled with muds and gravels, which the streams are again removing. The slope of its floor is not uniform, but it is represented by great series of gradation plains bounded by abrupt steps, as shown in Fig. 5. These steps may be only five or ten feet in height, or several may coalesce into one great terrace. Three of the greater steps are perhaps five hundred feet above the floor below. The valley heads abruptly in an amphitheater which forms a step a thousand feet in height. These gradation plains, thus abruptly separated from each other, represent pauses in the elevations of the table-land, when the streams were depositing muds and gravels and forming low flats near sea level. With the subsequent rise of the land these became terraces which the streams soon began to dissect and form in them deep channels and cañons. The newness of these cañons and smaller channels is shown by the fact that they are seldom more than a quarter of a mile long, although varying in depth from several hundred to a few feet; and the loose gravel floors, except at the margins of the terraces, have not even been

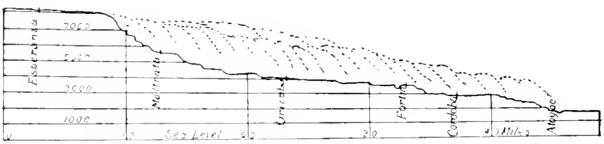

Fig. 5.—Section of the Valley between Esperanza and Atoyac, showing its gradient to be composed of numerous abrupt steps.

removed. These short cañons are characterized by beautiful waterfalls, as illustrated in Fig. 6.

The characteristics of the slopes and terraces of the valley descending from the high plateaus have been described because they illustrate evidence of great elevation, which has occurred in Mexico and Central America in recent geological times, with the later movements belonging to almost modern days.

In place of an elevation of from six thousand to ten thousand feet obtaining, as shown in many parts of the Mexican table-lands, the uplift in the Tehuantepec Isthmus closing the outlet of the Mexican basin into the Pacific Ocean apparently amounts to less than a thousand feet; and indeed an elevation of seven hundred and seventy-six feet has been enough to withdraw the waters from the last canal across the continental barrier. But of this again.

The same story of the rise of the land and the separation of the seas is repeated in Central America—in Honduras, in Nicaragua, and in Colombia, whether at Panama or not, as appears from the observations of Mr. J. Crawford, Dr. W. M. Gabb, Dr. G. A. Maack, and especially of Mr. F. C. Nicholas, in the Atrato Valley. But the phenomena accompanying the great changes of level have not been so fully studied farther south as in Mexico.

Fig. 6. — Falls below Atoyac, passing through a short, deep cañon, descending from the terrace plain faintly shown in the high background of the picture.

The Manner in which the Elevation of the Plateau occurred. — There are various great terrestrial movements known to geologists. Extensive continental areas are gently rising and others are sinking. These oscillations, so far as time is concerned, appear slow—as, for instance, the sinking of the New Jersey coast at the supposed rate of a foot in half a century, or of the New Orleans district, of a foot in twenty years; while the rising of the northern part of the continent, as between the Adirondack Mountains of New York and the St. Lawrence River, is at the rate of a foot in twenty or twenty-five years. Within a generation the changes of level in the physical geography of a special district are no more apparent to the ordinary inhabitant than the shallowing or deepening of small channels which interfere with or favor the passage of canoes or small boats, or the gentle backing of waters which make swampy grounds or the reverse. Even with their effects, accumulated for centuries, the changes do not often affect the course of the drainage or obstruct it. By this gentle continental movement the mountains are not formed, nor are ridges squeezed up into existence, although they often give rise to high land. Since the beginning of the Glacial period, the accumulations of such movements have raised the same superficial formations of the coastal plains of America to an altitude of one hundred feet near Cape Hatteras, to eight hundred feet farther south, to fifteen hundred feet in the neighboring mountain region, to only three hundred or four hundred feet in the Mississippi Valley; while the same coastal plain in Mexico has been elevated to seventeen hundred feet. Farther south, in the Tehuantepec Isthmus, the corresponding change of level has not been more than eight hundred feet. These movements do not bend, crumple, or break the strata, or appreciably affect their horizontality. The amount of elevation just mentioned was sufficient to cause the final separation of the Mexican Gulf and the Pacific Ocean, but inadequate to account for the high plateaus.

Another class of terrestrial movements gives rise to mountain folds, thrusts, and faults, with a general dislocation and disturbance of all the formations. Just how much of a plateau was elevated by these forces is not apparent, for the surface base levels of erosion still retain their older courses of drainage. Consequently, one is led to suspect that the great escarpments are not entirely due to denudation, but that a third class of earth movements has obtained, lifting the plateaus abruptly to a considerable proportion of their height (six thousand feet, more or less) above the inner margin of the coastal plain, without greater deformation of their surface than that of the coastal plains themselves. This third movement seems to be a sort of squeezing up of great segments of the earth's crust, without tilting its surface by more than a few feet per mile; consequently, it implies a great dislocation and slip or fault along the margin of the table-land, since modified upon the surface by the atmospheric denudation. The analysis of these complex movements is far from complete, and, although we do not fully understand them, this ignorance of causes does not affect the evidence of the very recent elevation of the plateaus.

The Periods of Great Elevation.—The old geological formations of the plateaus are mostly buried beneath secondary accumulations; so that the present physical surface features are largely due to the atmospheric agents which have been at work since about the end of the Cretaceous period, as out of the formations of that date a large portion of the base levels of erosion have been molded. These great base levels required a long time for their development, which was provided for during the greater portion of the subsequent Tertiary period, when the present table-lands were mostly low continental plains interrupted by mountain ridges. In the meanwhile, the present coastal plains (now rising to seventeen hundred feet) were submerged and were receiving the older Tertiary accumulations under the waters of the Gulf of Mexico. The Tehuantepec Isthmus (Fig. 7, page 588) was throughout the late Miocene and Pliocene periods covered by deep water, as seen by the occurrence of such fossils in the horizontal formations accumulated there, thus showing that there was a strait or water way across the continental barrier, subsequent to the great physical dislocations and changes of level occurring in the earlier Miocene period.

Without considering the minor oscillations of land and sea which raised the coastal plains during the later Tertiary period, it has been found that these plains were covered with water about its close (end of the Pliocene period). Until about this time the present table-lands do not appear to have been elevated. The lavas and other similar rocks derived from Orizaba and sister volcanoes upon the present edge of the great plateau date back only to about the close of the Pliocene period, and appear to have originated with the elevation of the region. The excavation of the great valleys, such as that described back of Vera Cruz, has been subsequent to the commencement of this volcanic epoch, and consequently the elevation of the plateau can not date back prior to about the commencement of the Pleistocene period (or the beginning of the ice age). After the time of the first great elevation with the formation of the original valley, the region was more or less depressed, when gravels and muds were accumulated upon its floor during midglacial epochs; since when the table-lands have attained their great elevation, with the formation of the terrace steps already described, so recently that the streams have not yet removed these loose deposits, and are only in the early stages of making new cañons.

From all that has now been ascertained, it appears that the great elevation of Mexico and Central America was chiefly effected by the Pleistocene changes of level; and from the magnitude of continental movements in both directions and the excavation of large valleys out of very hard rocks, it would seem that this period must have been one of long duration.

THE GEOLOGICAL WATER WAY ACROSS THE TEHUANTEPEC ISTHMUS.—As has already been mentioned, the great continental table-lands are here broken down for a distance of perhaps eighty miles, with the resulting lower ranges for a length of twenty-five miles penetrated by numerous lower channel ways. The reduction of the width of the plateau is shown in map, Fig. 7, where the shaded portion represents the coastal plains setting into the highland mass, which is only about twenty-five miles across. While this district was a strait during the Pliocene period, in which deep water organisms were living, the existing gap in the Cordilleras was being widened so as in part to complete the great interruption in the American plateau.

Although the geological water way was open during this period (more recent than has generally been suggested), it was afterward closed for a time, and the subsequent connection between the Gulf of Mexico and the Pacific is the most interesting to us, as reaching down almost to the historic period. The date of the older strait was prior to the Lafayette epoch (about the close of the Pliocene or commencement of the Pleistocene period), while that of the later one obtained well on in the Pleistocene period. The separation of the seas was in part effected by gentle warpings of the district, but the low Cordilleras seem to have been further squeezed upward by a movement referred to on a preceding page. Out of the floor of the present divide, the rocky islands of the recent strait became prominent knobs (such as one shown in Fig. 9). The newly formed isthmus was only a mile or two across. Its once nearly level floor, composed of soft, earthy sandstone, has since been rounded into a succession of hummock-like hills by the subsequent action of rains and rills. This feature is shown in Figs. 8 and 9. For a time the narrow isthmus was penetrated by a geological canal, one hundred and fifty feet deep and less than a quarter of a mile wide, the features of which

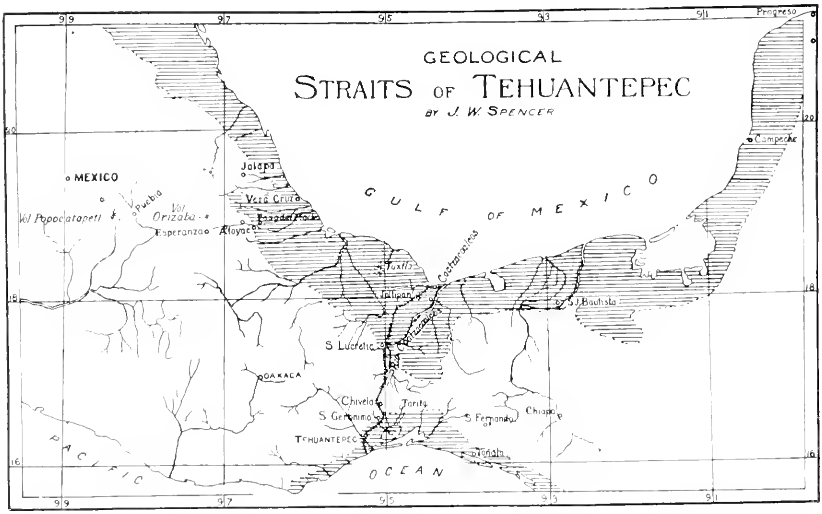

FIG. 7.—MAP OF THE ISTHMUS OF TEHUANTEPEC. The unshaded portion represents the high plateau region as indented by the coastal plains (shaded).

are now perfectly preserved in the channel, about a mile long, which dissects the hummocky divide of the Tehuantepec Isthmus. The northern end of this canal is shown in Fig. 9. The floor of this passageway is still covered with water-worn gravel, which was deposited by the former currents. Connected with this late channel and at the same level, gravel terraces mark the shores of the Gulf of Mexico when its waters were last connected with the Pacific Ocean, although the barrier has now been raised to seven hundred and seventy-six feet above the sea. Since the elevation of the land, which finally separated the Gulf of Mexico from the Pacific in post-

Fig. 8.—The Divide of the Isthmus of Tehuantepec at Chivela, eroded into hummocks, with a gravel plain in front (northern side).

Glacial times, the excavation by the streams has produced only narrow cañons, at most a mile or so in length and three hundred or four hundred feet in depth, while the gravel floors and terraces remain almost intact. Indeed, the final elevation seems to have been even later than the birth of Niagara Falls. Thus the separation of the Antillean and Pacific waters is found to have been much later than has hitherto been supposed. So recent is the geological canal of Tehuantepec, that it would be reasonable to suspect its existence even since the advent of man upon the earth, although the proof of his occupancy of the district and his utilization of the passage has not been found. Had the appearance of the barriers been retarded for only a little while longer (geologically speaking), the engineering difficulties of constructing interoceanic canals would have been avoided.

A sister canal to that described occurs a few miles toward the east, and probably similar narrow channels are found in the other half-dozen low passes of the region which have an altitude of about eight hundred feet.

The Atrato and other Water Ways.—The low country of the Atrato-San Juan Valley of Colombia has been mentioned as an important depression in the barrier between the Caribbean Sea and

Central America, and Dr. Maack and others have suggested a connection at some previous time. By Mr. F. C. Nicholas enough data have been gathered to make it appear that a geological strait and later a canal or canals obtained similar to that of Tehuantepec. The barrier between the low navigable waters on each side of the divide is only eleven miles across, and of this distance, the valley is so low that except for three miles of its course it is navigable for canoes at all times. During floods even the remaining three miles can be crossed in small boats. This passage is only about a hundred and fifty feet above the sea, but it is a narrow canal a hundred

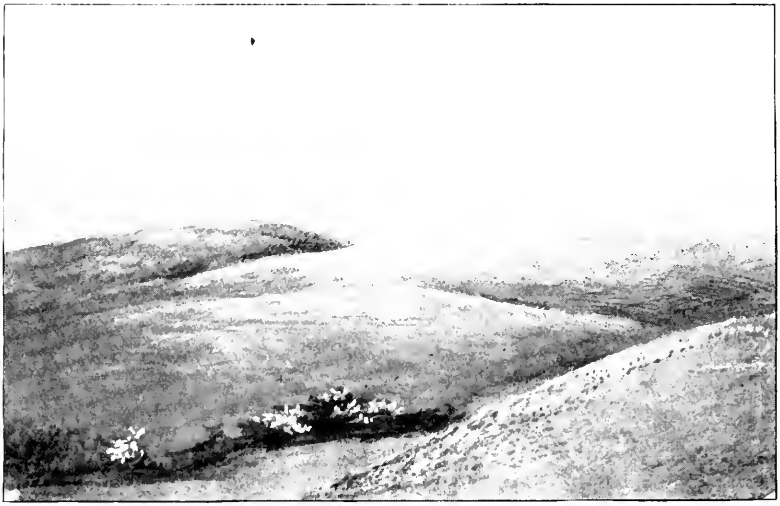

Fig. 9.—The Divide of the Isthmus of Tehuantepec (view on larger scale than in Fig. 8), showing the northern end of the geological canal dissecting the divide to a depth of about one hundred and fifty feet. Knob to the left represents the end of a ridge rising out of the old geological strait.

feet or more below the summit of the dividing ridge. The barrier in part appears to have been produced by the delta deposits brought down from the lateral mountains by the streams at a time when the valley was occupied by the waters of a great strait from twenty to forty miles wide, connecting the Caribbean Sea with the Pacific Ocean. Some of these gravels contain large quantities of gold. The gold-bearing gravels and other alluvial deposits which rise upon the hillsides and occur on the divide seem to mark the different changes of level corresponding to those in the Tehuantepec Isthmus.

Besides this Atrato Strait, connecting the Caribbean Sea with the Pacific Ocean, there was another connection by way of Nicaragua, as suggested by Mr. Crawford's studies, but the latest geological canals across this region have been obstructed by barriers rising to two hundred and thirty feet. The more open country of the Panama district is about four hundred and sixty feet above the sea, but it is dissected by valleys such as that followed by the railway, whose natural divide is two hundred and ninety-nine feet. It is only reasonable to suspect that here may have been a former strait or canal, but so far the terraces and gravel floors similar to those of the Tehuantepec divide have not been described, as this is a feature of only recent scientific inquiry. The interoceanic connections referred to by Dr. Maack belong to the older Tertiary period, preceding the sculpturing of the physical features of the region, which were long anterior to the water ways here described.

Biological Evidence of Interoceanic Connections.—The fishes, shells, sea urchins, and other organisms of the West Indian basins belong to modern types, which to a large extent seem to have migrated from the Atlantic Ocean. Their recent appearance suggests great changes in the physical history of the West Indian seas, which are only explicable on the theory of the Antillean bridge, as set forth in the May number of this journal, and extended in the present paper. For example, the West Indian region was a high continental mass with extensive plains where the sea basins now occur, draining into the Pacific Ocean across the central part of America. With the subsequent subsidence in the mid-Pleistocene epoch the Antillean basins became seas, into which the modern Atlantic forms of life gained access. The deep-sea fishes have absolutely no relationship with those living in the Pacific Ocean, thus showing that the American barrier obtained sufficient height for their exclusion; but the littoral or shallow-water fishes and shells of the Pacific Ocean, to a notable degree, are found in the West Indian waters. The term deep-sea fauna here used applies to those forms living at greater depths than from three hundred to five hundred feet, according to circumstances. Thus it would appear that there were shallow water connections with the Pacific Ocean in or since the mid-Pleistocene epoch, such as have been shown from the study of the physical features. But these water ways were either too small or of too short duration for the general admission and commingling of Pacific and Atlantic types. The modern characteristics of the deep-sea fishes of the West Indian basins suggest that the older forms of Antillean life had been expelled from the region, so as not to permit of the development of their successors, as should have occurred if the continental area, now drowned, had not been generally drained. The modern *facies* of the marine West Indian life thus supports the physical evidence of a great Antillean continent or connection between North and South America just prior to the introduction of modern species. There is no inconsiderable degree of satisfaction to the student in finding that the biological phenomena support the physical testimony of the recent great changes which have occurred in the Central American and West Indian regions.

On the Confirmation of the West Indian Continent by Central American Phenomena.—The Reconstruction of the Antillean Continent,* and The West Indian Bridge between North and South America,† have been largely based upon the testimony of the great river channels being traceable as drowned valleys of natural proportions across the submerged plateaus or margins of the land to the floors of the Gulf and Caribbean basins, which are characterized by large plains. This fundamental feature is supported by a great array of facts collected by the writer and described in the papers named. It was during the early part of the Pleistocene period that the West Indies were united into a high plateau and the floors of the sea basins were transformed into plains, to the margins of which the river valleys have been traced. The continuance of the river valleys to the floors of the sea basins is the result of their formation upon the surface of the land before the region was submerged beneath the oceanic waters. Satisfactory as was the evidence of the high continental elevation to the east, the Central American region now appears as a barrier against its former drainage to the Pacific, thus producing inclosed sea basins. On a smaller scale, there is a perfect analogy in the basin of Lake Ontario, which is only the valley of the St. Lawrence, mostly closed by warping of the earth's crust so as to raise up a barrier of several hundred feet in place of thousands of feet, as is the case in Central America. It was very significant that the depressions in the Mexican and Central American table-lands correspond only to the extensions of the West Indian basins, thus suggesting the location of their outlet. But the discovery of the recent general elevation of the American barrier to thousands of feet, and the preservation of the last water ways across the divide, are found to show that the barrier did not obtain at the time when the Antillean basins, according to the hypothesis, should have been drained into the Pacific. Thus the low altitude of Central America at the time of the high continental elevation to the east and the presence of the recent water ways to the Pacific Ocean, lately discovered, complete, in a manner, the story of the great oscillations of land and sea in the regions between North and South America.

Of the two miles or two miles and a half in height of the Central American barrier above the floor of the sea basins, probably half that amount has been produced by gentle warping of the earth's crust, amounting to only a few feet per mile, like that across the outlet

* Bulletin of the Geological Society of America, vol. vi, pp. 103–140, 1894.

† Appletons' Popular Science Monthly, vol. liii, pp. 10–30, 1898.

of Lake Ontario—so gently developed as not to produce bold features. On the other hand, portions of the barrier have been squeezed up by local movements, causing the plateaus, whether above or below the surface of the sea, to rise rather suddenly from the plains in front of them.

Thus the story of the West Indian bridge and the geological water ways across Central America * are only different chapters of the great changes of level of land and sea which have occurred in the most recent geological times, illustrating terrestrial movements now in progress, which have the power of completely altering the physical features of the earth, transposing tropical and arctic climates, and scattering or exterminating animal and plant life of continental regions.

CURIOSITIES OF AMERICAN COINAGE.†

By ALEXANDER E. OUTERBRIDGE, Jr.

IT is remarkable, in view of the universal desire of mankind to obtain money, that so few persons, comparatively, really know anything about the early history of money, or the social and industrial conditions which led, long ago, to the substitution of pieces of coined money for direct barter—in short, when, where, and how the art of coining and use of metallic money originated. These are interesting subjects for historical and archæological research, and they have a direct practical relation to the development of the modern science of money. Elsewhere I have gone over this classical ground, and I propose, on this occasion, to limit the field to be surveyed to that portion of the subject which relates particularly to the early history of American coinage and its modern developments. There are many curious and important facts relative to this coinage with which the people are either wholly or in part unacquainted.

My subject will be comprised under four heads—viz.: 1. The Functions of Money. 2. The Early Colonial Coinage. 3. The Coinage by Private Individuals or Companies. 4. The National Coinage.

* For further details, see Great Changes of Level in Mexico and the Interoceanic Connections. Bulletin of the Geological Society of America, vol. ix, pp. 13–34, 1897.

† An address delivered in the Museum of Science and Art, University of Pennsylvania, March 23, 1898. The illustrations of rare gold coins of the "private issues," accompanying this article, were made from the collection deposited in the museum of the university by Mr. R. C. H. Brock, of Philadelphia, and were furnished by the director to this magazine several weeks in advance of the publication of the address in a bulletin of the museum to be issued in the future, and containing many other communications of archæological interest.

The Functions of Money.—In Money and the Mechanism of Exchange, Professor Jevons relates an amusing experience of a Parisian singer who made a professional tour of the world some years ago. In crossing the Pacific Ocean the steamship was unexpectedly

$2.50 gold piece. T. Reid. Georgia gold, 1830.

$1 gold piece. North Carolina gold; 30 grains. C. Bechtler.

compelled to call at the Society Islands, where she was detained for a day or two. A few foreigners who were there invited the singer to give a concert, agreeing that she should receive one third of the gross proceeds. The lady accepted the invitation, and the concert was well attended by the natives, who came from all parts of the islands. When the receipts were counted the lady found that her share consisted of several pigs, fowls, goats, and a large quantity of bananas, cocoanuts, and other tropical fruit. There was very little money in circulation on the islands, and, as mademoiselle could not consume any considerable portion of her share of the proceeds of the concert, it became necessary to feed the live stock with the fruit.

This story is told to illustrate a difficulty which arose in the earliest commercial transactions from the want of a common medium of exchange, which difficulty led to the invention (about 700 b. c.) of coined money as a "go-between" or substitute for direct barter.

At the first glance it might appear a simple matter for the butcher, the farmer, or the miller to make due exchange of commodities without the intervention of the go-between called money, but a little reflection will soon reveal at least three great difficulties:

$1 gold piece. Carolina gold; 28 grains. Bechtler.

$1 gold piece. Carolina gold; 21 carats, 27 grains. A. Bechtler.

First, that of finding two persons whose disposable goods mutually suit each other's wants; second, the impracticability of subdividing many articles—for example, a tailor can not cut up a coat into small portions without destroying its value; third, the complexities involved in equitably adjusting the relative values of various commodities. These and other difficulties led to the selection, quite early in the history of civilization, of certain substances which, by common consent, were received by all persons in exchange for all commodities at certain rates by mutual agreement. A curious variety of materials have, at different times and in different countries, served this useful purpose, and it is evident that such substances would soon come to possess the two great functions of money, viz.:

$2.50 gold piece. Georgia gold; 22 carats, 64 grains. Bechtler.

1. A common medium of exchange.
2. A common measure of value.

In the most primitive age the skins of wild animals were usually selected, being both useful and portable. Even in the early part of this century the business of the Hudson Bay Trading Company was transacted with the North American Indians entirely on this basis; a gun, for example, was valued at "twenty beaver skins." In Massachusetts (and other colonies) prior to the Revolution specie was at times so scarce that laws were passed legalizing the payment of taxes in skins, cattle, and farm products.

It is said that in the mountainous districts of Kentucky skins are used even to this day as currency to a limited extent by the natives.

In Massachusetts a law was enacted, March 4, 1634, as follows: "It is likewise ordered that muskett bulletts, of a full boare, shall pass currantly for a farthing a-piece, provided that noe man be compelled to take above XII pence att a tyme in them."

Early Colonial Coinage.—The inconvenience experienced from the want of specie caused the colony of Massachusetts to establish a mint as long ago as the year 1652; this was exactly one hundred and forty years before the establishment of the National Mint in Philadelphia. The Massachusetts law provided for the coinage of "shillings," "6 pence," and "3 pence," all of sterling silver—that is, 925 parts of pure silver and 75 parts of copper; the law stipulated that the coins were "to be reduced in weight 2 pence in the shilling less than the English coin." A curious mistake occurred in the calculation whereby these shillings were made $5\frac{1}{2}$ grains too light, but they served a good purpose notwithstanding. The device upon the coins is a "pine tree," and the Massachusetts pine-tree shillings are now so rare that they are only to be found in cabinets of coins.

$5 gold piece. Georgia gold; 22 carats, 128 grains. C. Bechtler.

The British Government opposed the establishment of this mint, as it did in fact all manufacturing industries of every kind in the colonies, but the mint continued in active operation for over thirty years, and Maryland soon followed Massachusetts' example. These were the only silver coins issued before the Revolution, but several other American colonies issued copper coins. After the Revolution silver was coined by the different States, and even by private individuals, and very soon after peace was established Congress began agitating the subject of a national coinage. Robert Morris, the financier, was directed to present a scheme of coins and currency. His first report (prepared by the assistant financier) was presented in 1782, and it proposed a decimal system, which has been adopted, but all the other features were discarded, chiefly on account of the diminutiveness of the proposed "unit," which was only one tenth of a penny. Jefferson said in the discussion, "A horse or bullock of $80 value would require a notation of six figures, to wit: 115.200 units." A few years later Jefferson himself presented a report proposing the Spanish milled dollar as a suitable unit, as this coin was very familiar to the people and of a convenient size; these proceedings were under the "Confederation," and one of the articles of the original compact permitted coinage "by the respective States." Vermont, Connecticut, Massachusetts, and other States issued coins under this arrangement for a few years, until the Constitution in 1787 vested the right of coinage solely in the General Government.

$5 gold piece. Carolina gold; 20 carats, 140 grains. C. Bechtler, August 1, 1834.

$5 gold piece. Carolina gold; 21 carats, 134 grains. A. Bechtler.

For some reason, not known, the code of laws for establishing the National Mint was not formulated until five years later.

The act of April 2, 1792, provided for the establishment of a mint, and for the coining of ten, five, and two-and-a-half dollar gold pieces; also one dollar, one-half, one-quarter, one-tenth of a dollar in silver; one cent and half-cent in copper.

Pattern coins were struck at the Philadelphia Mint in 1792;* some of these bore the head of Washington on one side, but he dis-

* A rare pattern piece of 1792 was in the form of an annular ring of copper having a silver plug in the center. A large copper penny of 1792, with head of Liberty and an eagle resting on the globe, brought at public sale, in New York in 1890, the sum of two hundred

approved of the device, and suggested the substitution of the head of Liberty. Since that time no American coin has ever displayed the head of any individual.

Coinage by Private Individuals and Companies.—An exceedingly interesting, curious, and indeed inexplicable feature of the early history of coinage of money in America, regarding which there is but little accurate information available at the present day, is the issuing, on a large scale, of gold, silver, and copper coins (also "tokens") by private individuals and by trading companies. It will surprise many, no doubt, to learn the extent to which this practice was carried, and that it was permitted to exist until a comparatively recent period, notwithstanding the express prohibition in the Constitution of all such acts.

$5 gold piece. Carolina gold; 20 carats, 140 grains. C. Bechtler, August 1, 1834.

In a report made to Congress by the director of the Mint (Dr. Patterson) in 1840, these words may be found:

"Coinage of gold and silver, though withheld from the State, is freely permitted by individuals."

In 1850 the assayers of the Mint (Eckfeldt and Du Bois) reported: "There are several classes of gold coins which are struck within the national boundaries, but are not of the United States; these are Bechtler's coins of North Carolina and the California coins."

$5 gold piece. Carolina gold; 21 carats, 134 grains. C. Bechtler.

$5 gold piece. California gold. N. G. & N., 1849.

In 1851 the assayers reported that twenty-seven different kinds of gold coins, issued from fifteen private mints, had been received and assayed at the United States Mint in Philadelphia.

The earliest private coinage intended for use in the colonies of America (except the Bermuda "hog" coins) is known to numismatists under the general name "Rosa Americana," and the story con-

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and ten dollars. Silver "dismes" and "half-dismes," having a bust of Martha Washington, were struck in 1792, and are now highly valued.

nected therewith is most remarkable. In the year 1722, Mr. Wood, an iron founder of Wolverhampton, England, claimed to have discovered an alloy suitable for coins, consisting of copper, zinc, and a small proportion of silver. Through the influence of a favorite of

$5 gold piece. Native gold; 130 grains. Oregon Exchange Company, 1849.

$5 gold piece. Utah (Holiness to the Lord), 1850.

George I, known as the "Duchess of Kendall," a patent was issued by the king, dated July 12, 1722, together with a "royal licence," which was to continue for fourteen years, for coining "tokens" for Ireland and the colonies of North America to a large extent—viz., "three hundred tons"; the amount of the Irish coin was limited to £105,000, a great sum at that day.

A small royalty of £100 a year was to be paid into the king's exchequer and a salary of £200 to an officer of the Crown, called the "comptroller." Sir Isaac Newton, then the director of the Royal Mint, was chosen for this office, and he served for a short time, when he nominated a nephew, who succeeded him.

Thousands of Wood's base metal coins were struck for use in Ireland, and the issue would probably have been accepted by the people without question, had it not been that Dean Swift, then living in seclusion, saw in this scheme an opportunity to attack the English Government, and by his Drapier's Letters, his poems, and other writings, all anonymously published, in which he mercilessly lampooned the scheme and all those who were in any way connected with it, he aroused a storm of fury that is said to have been "indescribable." A writer of the day said: "All parties, Catholics and Protestants, Whigs, Tories, Orangemen, and Rapparees, were equally frantic. Merchants publicly announced that they would not accept the coin; the very hawkers and link-boys refused it, declaring it would buy neither ale, tobacco, nor brandy. Wood's effigy was dragged through the streets of Dublin and burned. . . .

$20 gold piece. Utah (Holiness to the Lord), 1849.

The Privy Council offered a reward of £300 for the discovery of the author of the Drapier's Letters."

The king then ordered the proposed issue to be reduced to £40,000, but this did not assuage the excitement in the least, and it finally became necessary, in order to restore peace, to buy back the royal license from Mr. Wood, by the payment to him of a pension of £3,000 a year for fourteen years.

This failure did not, apparently, kill the project for coining money for the American colonies, and the many pieces actually struck for that purpose are creditable specimens of the art at that period. On the obverse appears the head of the king and on the reverse a full-blown rose, with the legend "Rosa Americana," and the date "1722." On the later issues the head of George II appears, and the date 1733.

There is preserved in the Massachusetts archives a letter of instructions, dated October 29, 1725, from the Duke of New Castle to the Governor of Massachusetts, saying:

> "Sir, His Majesty having been pleased to graunt to Mr. Wood his letters patent for the coining of two pence and half pence pieces of the value of money of Great Britain for His Majesty's dominions in America, which said coin is to receive such additional value as shall be reasonable and agreeable according to the customary allowance of exchange in the several parts of His Majesty's dominions, as you will see more at large by the patent which will be laid before you by the person that delivers this letter to you, I am to signify to you His Majesty's pleasure that in pursuance of a clause in said patent by which all His Majesty's officers are to be aiding and assisting Mr. Wood in the due execution of what is therein directed and in the legal exercise of the several powers and enjoyment of the privileges and advantages thereby graunted to him, you are to give him all due encouragement and assistance, and that you and all such other of His Majesty's officers there, whom it may concern, do readily perform all legal acts that may be requisite for that purpose. This I am particularly to recommend to your care, and to desire your protection to Mr. Wood and to those whom he shall employ to transact this affair in the Provinces under your government. I am Sir, Yr Most Humble Servant,
>
> "New Castle."

If we may rely upon the statement of an English writer of the day, Mr. Wood's coin did not meet with a very cordial reception in America, for the pamphlet says:

> "Wood obtained a patent for coining small money for the English plantations in America, in which he had the conscience to make thirteen shillings out of one pound of brass; this money they rejected in a manner not so decent as that of Ireland."

In the year 1830 Mr. Templeton Reid, of Georgia, established a private mint, at which he coined $10, $5, and $2.50 gold pieces;

these circulated freely through the South, and they were brought to the United States Mint in Philadelphia for deposit and remelting in quantities. The assayer reported in 1842 that the $10 gold pieces of T. Reid weighed 248 grains, contained 942 parts of pure gold in 1,000 parts of metal, and the intrinsic value slightly exceeded the nominal value, being worth $10.06. These coins are now quite rare.

In 1831 Christopher Bechtler, of Rutherfordton, N. C., followed Mr. Reid's example on a larger scale, and in a few years he had issued several million dollars' worth of gold coins of denominations of $10, $5, $2.50, and $1.*

In 1842 the Mint assayers stated that "coining is still carried on by Bechtler, although there is a branch United States Mint less than eighty miles distant." This was located at Charlotte, N. C.

In 1851 the assayers reported that "several of the private issues of gold coins from California are close imitations of the national coin; some assay nearly up to the nominal value, but many fall be-

$5 gold piece. California gold. S. M. V., 1850.

$5 gold piece. Pike's Peak gold. Clark & Co., Denver, 1860.

low." A $10 piece of the Pacific Company only yielded $7.86 in gold. A lot of different denominations aggregating $562.50, nominal value, yielded at the Mint in Philadelphia $479.20.

One interesting gold coin, a $50 piece (some were octagonal), issued by Augustus Humbert, United States assayer at San Francisco, yielded the full nominal value. All of these private issues have now been stopped, and strict laws have been passed punishing any attempt to imitate the coins of the nation; even the toy money formerly made for children of gilded paper has been prohibited by the Government authorities.

The National Coinage.—The Mint was established in Philadelphia in 1792 and in its first year issued pattern pieces only; coining of copper cents and half cents commenced regularly in 1793, and stamping of the other denominations of money, as already named, in 1794 and 1795.

Many persons believe that the so-called "dollar of the daddies," weighing 412½ grains (nine tenths fine), having a ratio to gold of "16

* In 1840 Mr. Bechtler stated that the amount of his coinage to date was $2,241,840.

to 1" in value when first coined, was the original dollar of the Constitution. This is, however, erroneous. The 412½-grain silver dollar was not authorized until forty-five years later. The original silver dollar weighed 416 grains, and the ratio of silver to gold was 15 to 1, not 16 to 1.

Several modifications in weight and fineness of both gold and silver coins were made during the first few years, prior to the act of January 18, 1837, which greatly simplified the coinage by adopting the French decimal system, including a uniform "fineness," or proportion of 9 parts of gold to 1 part of copper for the gold coins, and the same proportion of silver and copper for the silver coins; the weights of the gold and silver coins were, at the same time, readjusted so as to make the ratio "16 to 1" between silver and gold.*

$5 gold piece. Pike's Peak gold. Clark, Gruber & Co., Denver, 1861.

The total issue of silver dollars coined under the acts of 1792 and 1837 until 1873, when the coinage was dropped, amounted to $8,031,238. When the Bland act was passed, in 1878, the silver in the silver dollar weighing 412½ grains was worth 89.1 cents; to-day the silver in the same dollar is worth about 42.5 cents. In the first four months after the Bland bill was passed 8,573,500 Bland dollars were coined, or more than the entire issue of the old silver dollars in eighty years. In the same year also the Mint coined 11,378,610 "trade dollars," which weighed 7½ grains more than the Bland dollars, but were not "legal tenders," † and, though issued by the United States Mint, were refused by the United States Government in payment for postage stamps, taxes, or for other dues, while the Bland dollar, of lesser intrinsic value, was a legal tender, and good for payment of all debts. The total issue of trade dollars between 1873 and 1879 was 35,965,924,

$2.50 gold piece. Clark, Gruber & Co., Denver, 1861.

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* The original silver dollar, authorized under the act of April 2, 1792, contained 892.4 parts of pure silver in 1,000 parts of metal and weighed 416 grains. The act of January 18, 1837, changed the proportion of silver to 900 parts in 1,000 and the weight to 412½ grains; the amount of pure silver thus remained unchanged.

† The act of February 12, 1873, made the trade dollar a "legal tender in sums not exceeding five dollars; this legal-tender quality was withdrawn by the joint resolution approved July 22, 1876, and the coinage was limited to such amount as the Secretary of the Treasury should consider sufficient to meet the export demands."—*United States Treasury Department, Circular No. 143.*

and the total issue of Bland dollars, from 1878 to the close of the fiscal year 1897, was 451,993,742.

The following table shows the total coinage value of all denominations of silver coin from the establishment of the United States Mint in 1792 to the end of the last fiscal year, June 30, 1897:

Dollars { 1792 to February 12, 1873	$8,031,238 00
Dollars { 1878 to June 30, 1897	451,993,742 00
Trade dollars	35,965,924 00
Half dollars	134,033,195 00
Columbian half dollars	2,501,052 50
Quarter dollars	52,395,052 00
Columbian quarter dollars	10,005 75
Twenty-cent pieces	271,000 00
Ten-cent pieces	29,428,613 90
Five-cent pieces	4,880,219 40
Three-cent pieces	1,282,087 20
Total	$720,792,129 75

It thus appears that the Bland dollars coined since 1877 exceed in coining value all the other issues of silver money from the establishment of the Mint in 1792 to the present day.

Although Congress appropriated a sum of money ($40,000) to "pay the freight" on Bland dollars from the mints or subtreasuries to any part of the country, the Government has never succeeded in getting more than a small proportion of the vast accumu-

$50 gold piece. Augustus Humbert, United States assayer of gold, California, 1855. (887 thousandths.)

lation of Bland dollars into circulation. It became necessary, therefore, to construct enormous storage vaults of steel, some of which will hold more than one hundred million of these dollars. The depreciation in market value of silver in the Bland dollars and uncoined bars is estimated to be about $200,000,000.

The dropping of the original 412½-grain silver dollar from the law of 1873 was purposely done in order to make a place for the new silver coin called the "trade dollar," ostensibly intended for foreign trade only, actually put into circulation to a large extent at home at a profit to silver owners. The "free coinage" privilege and falling market value of silver made these transactions remunerative.

$50 gold piece. Wass, Molitor & Co., 1855. (900 thousandths.)

Some people who accepted the trade dollars in good faith suffered loss.* This was the first entering wedge of the silver speculation which has attained such gigantic proportions.

The first coinage of the country was, in a measure, experimental; there were several different and very complicated finenesses, or proportions of precious metal and alloy, used. Then, in 1837, an admirably simple system of coinage proposed by Dr. Patterson was established. Later on various more or less absurd ideas were advanced and experiments were tried, such as the "goloid" dollars, consisting of silver and gold in proportions of $15\frac{1}{2}$ to 1 and 24 to 1, invented and patented by Dr. W. W. Hubbell. Specimens of these freak coins were struck at the Philadelphia Mint in 1878.†

At the time that Congress was engaged in formulating laws for the establishment of the Mint and the regulation of the coinage in

* Under the act of February 19, 1887, holders of trade dollars were permitted to exchange them for "Bland" dollars if presented at the Treasury, or any subtreasury, within six months from that date. Less than one fourth were thus redeemed (7,689,036), and since the expiration of the period of redemption trade dollars have been purchased as bullion, at the market price of silver, when presented at the mints. Although containing more silver than the Bland dollar, the trade dollar is worth less than half as much, owing to the low price of silver.

† Two different designs of goloid coins were struck:

1. The "goloid dollar," having the head of Liberty and motto "E Pluribus Unum" on the obverse, while on the reverse the following figures appear: 1 gold, 24 silver, .9 fine, 258 grains.

2. The "goloid metric dollar," having similar design on the obverse, and on the reverse the following figures: 15.3 gold, 236.7 silver, 28 copper, 14 grammes.

Proof specimens of these coins are preserved in the cabinet of the Mint in Philadelphia.

1792, the production of silver in this country was insignificant in amount. From 1845 to 1857 inclusive, the silver output is estimated to have been about $50,000 each year. As long ago as the year 1853 the production of gold amounted to $65,000,000, and the annual output has never equaled that amount since that time. In 1860 the silver product amounted in value to $150,000. In 1861 it jumped suddenly to $2,000,000, in the following year to $4,685,000, in the next year to $8,500,000, and so on, by leaps and bounds, until, in 1878, we were turning out about $45,000,000 worth of silver (commercial value) per annum. This was the real reason why the Bland bill for the restoration of the old silver dollar, weighing $412\frac{1}{2}$ grains, was introduced into Congress and passed over the President's veto. It was then supposed that a maximum output of silver had been attained, but this was far from the fact. Production increased amazingly, even in the face of falling prices.

$10 gold piece. Clark, Gruber & Co., Denver, 1861.

In 1878, the year the Bland bill became law, the average price of pure silver was $1.15 an ounce, and the output from American mines was less than 35,000,000 fine ounces. In 1896 the average value of an ounce of fine (pure) silver was 67 cents, but the output of silver had risen to nearly 59,000,000 fine ounces. Since that time the price of silver has fallen still lower; to-day it is about $55\frac{1}{2}$ cents per ounce.

In 1837, when the $412\frac{1}{2}$-grain silver dollar was authorized, the pure silver contained therein ($371\frac{1}{4}$ grains) was worth 100 cents in gold. To-day the pure silver in the Bland dollar is worth $42\frac{1}{2}$ cents.

The value of any raw product depends mainly upon the relation between the production and consumption; when this remains constant the price of the commodity varies but little.

The commercial ratio of silver to gold has been carefully determined by Dr. A. Soetbeer, the renowned statistician, from the years 1687 to 1832; by Pixley and Abell from 1832 to 1878; and after the latter date by the daily cablegrams from London to the Bureau of the Mint. These tables show that the ratio between silver and gold vibrated between the limits of a trifle below 15 to 1 and 16 to 1 for nearly two centuries. In 1873 the ratio was almost exactly 16 to 1; then the great flood of silver began to pour out from the famous Comstock lode and other mines in the West, so that production soon far exceeded consumption. The Government was compelled by the "Bland" act of February, 1878, to purchase silver at the rate of "not less than $2,000,000 worth per month." This continued without interruption for twelve years (from 1878 to 1890), during which time more than four hundred million silver dollars were coined. The Sherman act, repealing the coining of the Bland dollars, really made matters worse, in some respects, as it authorized the purchase by the Government of not less than 4,500,000 ounces of silver per month, and 168,674,682.53 fine ounces were purchased in four years (1891–1894) at a cost to the Government of $155,931,002.25, under the act of July 14, 1890. The average price paid for this silver was almost 92½ cents per ounce. At the present market price (55½ cents per ounce) there is a depreciation in value of $62,316,553.45 on the silver pigs purchased under this act. Notwithstanding these heroic efforts to sustain the price of silver through the compulsory purchase by the Government of such vast quantities of the metal, the flood continued rising higher and higher while the price descended lower and lower, thus proving that silver obeys the law of all commodities, and that any attempt to sustain the price by artificial means, even when backed by such a rich and powerful Government, and carried out on such a great scale, must surely fail.*

Coining of Gold.—If the question should now be asked you, "What denomination of gold money of the United States has been most largely coined since the establishment of the Mint in 1792?" you would probably say, "The gold dollar, of course." The answer would be wrong—very wrong. Less than twenty million gold dollars in all have been struck, and their coinage has been entirely discontinued for nearly ten years. If, on the other hand, the question should be asked, "Which denomination of gold money has been coined most sparingly?" you would probably say, "The double eagle." Again the answer would be wrong.

* Circular No. 143 (dated July 1, 1897), issued by the United States Treasury Department, says (page 63): "The stock of gold and silver in the world in 1873 and 1896 is estimated to have been as follows:

	1873.	1896.
Gold	$3,045,000,000	$4,100,000,000
Silver	1,817,000,000	4,200,000,000"

The commercial value of silver in 1896 was less than one half of its value per ounce fine in 1873; notwithstanding this great fall in price, the estimated value of silver in the world in 1896 exceeded the estimated value of gold at that time, while in 1873 the estimated value of silver was only 59½ per cent of the estimated value of the gold in the world. Stated in other terms, the gain in estimated value of gold is 34 65 per cent, while the gain in estimated value of silver in the same period is 131 per cent.

Although the double eagle was not authorized until 1849, fifty-seven years after the act which authorized the eagle, half eagle, and quarter eagle, more double eagles have been coined than of any other denomination of gold, and the intrinsic value thereof is more than twice that of all the other gold coins put together. The total value of all gold coined in the United States Mints, except the double eagles, from the organization of the Mint in 1792 to June 30, 1897, is $548,840,918. The value of the double eagles coined since 1850 (the first year of their coinage) to June 30, 1897, is $1,337,498,040.

A circular issued by the United States Treasury Department says, "The total coinage of gold by the mints of the United States from 1792 to June 30, 1897, is $1,886,338,958, of which it is estimated that $671,676,250 is now in existence as coin in the United States." The pamphlet explains in detail the basis upon which the estimate of the gold coin in the United States was established, and says, "It will be seen that more than two thirds of the gold coins struck at the mints of the United States have disappeared from circulation." This is an astounding statement. What has become of all this vast store of gold, amounting in value to $1,214,662,708, or more than ninety per cent of the value of the entire issue of double eagles?

It is not a mere theory of mine that the disappearance from circulation of about two thirds in value of all the gold coins struck at

$20 gold piece. Clark, Gruber & Co., Denver, 1861.

the mints of the United States is due in part to the preponderance of coinage of double eagles. Thirty-seven years ago the director of the Mint called attention to the matter in his official report as follows: "The chief design of a National Mint is to subserve the interests of the people at large preferably to a few large owners of bullion or coin. The interests of the public and of depositors are not always concurrent in the matter under discussion. . . . The plain effect of issuing gold coin of a large size is to keep down the circulation of specie, and increase the use of paper money."

In the director's report for the year 1880 I find the following: "In Great Britain the gold coinage consists almost wholly of sovereigns and half-sovereigns; in France, of twenty and ten franc pieces; and in Germany, of ten-mark pieces, all of these coins being of less value than five dollars. The absorption by France of $1,100,000,000 of gold imports into her circulation during the thirty years from 1850 to 1880 may in part be accounted for by the coinage of nearly all this gold into denominations of less than two and four dollars value."

$10 gold piece. Pike's Peak gold. Clark, Gruber & Co., Denver, 1860.

The average coinage value of double eagles during the past four years has been over $44,000,000 a year, as compared with a yearly average value during the same period of about $10,000,000 in eagles, $4,000,000 in half eagles, and $30,000 in quarter eagles! It thus appears that we are still coining two thirds of our gold into double eagles that never pass into circulation and disappear immediately.* If, instead of pursuing this short-sighted policy for so many years, the people had been encouraged, by the issue of small denominations, on the return to specie payments in 1879, to circulate gold instead of paper, the gold could not have been so readily drained away from this country to foreign lands as has unfortunately happened on a great scale during the past few years.

If these words shall produce any impression upon those in authority, and thus lead to a modification of our coinage laws or customs in this regard, the attempt I have here made to combine with an academical discussion of the curiosities of American coinage some practical suggestions for improvement therein may not prove altogether futile.

For nearly fifty years we have been coining double eagles (not to

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* The following table shows the gold coinage executed at the mints of the United States during the fiscal year ended June 30, 1897:

Denomination.	Number.	Value.
Double eagles	2,990,241	$59,804,820
Eagles	804,301	8,043,010
Half eagles	747,802	3,739,010
Quarter eagles	23,946	59,865
Total gold	4,566,290	$71,646,705

mention eagles) that are, as a rule, immediately shipped to Europe; there they go at once to the melting pot, and are converted into British sovereigns (having a different proportion of alloy) or into gold coins of other nations; as soon as the rate of exchange changes beyond a certain degree these brand-new foreign gold coins are to some extent shipped back to us, and they in turn go to the melting pot at the Mint, where the proportion of alloy is again changed to make the standard of the United States (nine tenths fine). The gold is then recoined, shipped back to Europe, and so the process is repeated indefinitely.

In addition to the large expense involved in this useless and endless work there is irrevocable loss of precious metal with each handling, melting, and coining. I believe that all this is unnecessary. It would be perfectly feasible for the nations to agree upon some simpler method of adjusting trade balances at a tithe of this cost; and even if the time shall not yet have come for making such settlements by a sort of international clearing house, a partial solution of the difficulty would be found in the adoption of an international gold coin, or in the more general employment for export of fine gold bars instead of coin, which have been assayed at the mints or United States assay offices and officially stamped with their weight and fineness. There is less risk of loss by robbery in transshipment of such bars, and counterfeiting is not likely to prove a dangerous impediment for several reasons, one of which is that such bars do not pass into general circulation.

It is, of course, necessary, before we can hope to interest foreign governments in any improvement in international monetary matters, that we should adopt a reform in our own currency, bringing order out of the present chaotic condition.

In conclusion, I desire to call your particular attention to the valuable collection of early American coins, as well as coins of other nations, deposited in this museum by Mr. Robert C. H. Brock, of Philadelphia, from which the director, Mr. Culin, has had the illustrations made. This collection is rich in specimens of all the issues mentioned, and they are in excellent preservation.

One of the entries in Sir Andrew Ramsay's diary, quoted by Sir Archibald Geikie in his memoir of that geologist, describes a meeting of the Geological Society in London, when "Buckland made a most witty speech. It was about crinoids; and he began by saying that the debate seemed to him to have more of a gastronomic than a paleontological character; for all that had been said bore upon the relation of the plates to the mouth and the mouth to the plates." At a subsequent meeting "Buckland was all in favor, but in attempting to quote Scripture made a great mull of it, greatly to the amusement of all, especially the Bishop of Oxford."

THE NATIONALIZATION OF THE RAILROADS IN SWITZERLAND.

By M. HORACE MICHELI.

ON the 20th of February, 1898, the Swiss people accepted by an overwhelming majority a law referred to them providing for the purchase and operation by the state of the railroads of the country. The vote marks the end in Switzerland of the system of private management of railroads, and the coming in of a new system of state management. The action is one of interest and importance to all people everywhere, because it evolves momentous political and financial as well as economical and social considerations.

The agitation of the question whether the railroads should be constructed and managed by the state began in Switzerland almost with the beginning of railroad building. The first railroad, from Basle to Baden (Switzerland), was opened in 1847. A plan for the construction of a system of railroads by the confederation and the cantons concurrently, prepared by the federal council at the suggestion of the national council, was rejected by the national council, which voted in July, 1852, by a large majority, in favor of construction by private companies, under charters issued by the cantons with the approval of the confederation. This condition was not satisfactory to the federal authorities, and a law was passed in 1872 enlarging the powers of the confederation and giving it the control of the concessions. That law, with supplementary provisions making it stronger, has continued in force till the present time.

All the concessions, both cantonal and federal, contained provisions looking to the ultimate repurchase of the railroads, opportunity for which was given at certain stated intervals (apparently every fifteen years) upon five years' previous notice. On the coming of the first of these periods of maturity, in 1883, the question of repurchase was raised in the federal council, but the financial condition of the railroads not being very good then, no action was taken. This opportunity having been allowed to pass, no other would be afforded till 1898. Still, the friends of the national system pushed their measures, urging that the state enter into friendly negotiations with the railroads for buying them in, or buy enough of their stock to secure control of the disposition. Tentatives were made in both these directions, but they all came to an end in one way or another before any material results were accomplished. Then the idea of expropriation was started, its advocates maintaining that the state was not bound by the limitations in the concessions, but could take the railroads at any time upon paying a just price. The federal council did not accept this view, and preparations were begun for exercising the right of purchase in 1898. The federal chambers in 1892 commissioned the federal council to consider measures looking to this end—that is, to prepare legislation that would give the confederation advantages in the transaction. In 1895, a law was passed requiring stockholders to register six months before voting in the company meetings. This, it was thought, would reduce the vote of the foreign stockholders, but it had the opposite effect, for the small Swiss holders would not take the trouble to register, while the large holders abroad did. The same law gave the confederation and the cantons the nomination of representatives who should have power to vote in the companies' directories. In the same year a bill was introduced requiring the railroad companies to present exact accounts of the condition of their lines and their management, with a provision suppressing the special tribunals provided for in some of the charters for the arbitration of differences between the state and the companies, and giving their jurisdiction to the federal tribunal. The purpose of this law of accountability was to meet the stipulation in the charters of the railroads that the state, in buying them in, should pay the companies twenty-five times the value of the net annual revenue of the roads as determined by the average of the preceding ten years, while it should in no case be less than the capitalized value of the plant of the company. It was sought to secure more accurate determinations of the "net annual revenue" and the "value of the plant" on which the amount paid on purchase was to be based. This bill was fought both by the adversaries of purchase and by those who insisted that the transaction should be carried through according to law and without violation of the rights that had been acquired by the existing proprietors of the railways. The latter objected that it modified all in favor of the state clauses of the charters—bilateral contracts that bore the signature of the state. The partisans of the bill denied that the concessions were of the nature of a bilateral contract. They held that a railway concession was a law, an act of the sovereignty of the state which created, it was true, acquired rights, but which the state could always modify so long as it did not violate the acquired rights; and that the proposed law of accountability violated no right. The majority of the chambers took this view, and the act was passed March 27, 1896. A referendum was called for, and the act was approved by the people after an exciting campaign, 223,228 electors voting *aye*, and 176,577 *no*, out of a total of 714,033 entitled to vote.

The acceptance by the people of the law of accountability opened the way for ultimately buying in the lines. While some persons probably voted for accountability who did not really favor purchase, but because they thought the law in itself a good measure, the result was in effect a moral victory for nationalization. Furthermore, the new law, of its own force, by suppressing some of the guarantees which had been given the companies in the concessions, improved the situation of the confederacy as to the measure of repurchase, and removed some of the difficulties that had stood in the way of the consummation of the scheme. Immediately upon the adoption of the law of accountability by the people, the party who had theretofore demanded the nationalization of the railroads by expropriation placed themselves on the side of repurchase on the basis of the concessions. In their opinion, there was no longer any danger of purchase on those terms being too advantageous to the shareholders or too onerous to the state, the law of accountability, as they believed, giving the state power enough in adjusting the cost of the transfer. Previous to the adoption of this law the socialistic party had issued a demand for the initiative toward expropriation of the railroads; but although more than fifty thousand signatures—the number constitutionally required for the referendum—had been secured for their petition, its authors withdrew it, in order that the partisans of nationalization might not be divided upon a question of methods.

As the next term when the state could take the railroads would fall, as to most of the companies, in the spring of 1898, the federal council had no time to lose if it would avail itself of a vote of the chambers and of the people in favor of purchase. The law of accountability went into force on the first day of November, 1896. On the 25th of March, 1897, the federal council laid before the federal chambers the draft of a law for the purchase and operation of the railroads by the confederation, with a long explanatory address.

This draft contemplated the repurchase at the earliest period named in the concessions, and the subsequent operation of the five principal Swiss railway systems—the Jura Simplon, the Central, the Northeastern, the Swiss Union, and the St. Gothard. The lines belonging to these five companies had an aggregate length of 2,578 kilometres, and represented all the principal constituents of the railway system of the country. Only a few secondary lines of normal gauge and the narrow gauge and mountain railroads would remain in the hands of their original proprietors. The bill provided for the accomplishment of the acquisition in conformity with the federal legislation and the concessions, and proposed that the federal council be likewise authorized, with the consent of the federal assembly, to buy the lines mentioned as excepted, in conformity with the regulations for determining the purchase price. The confederation should procure the funds necessary for the acquisition of the railroads and their operation by the issue of bonds redeemable in sixty years or in accordance with a previously arranged table of redemptions. The draft also provided that the accounts of the federal railroads should be kept distinct from the other branches of administration, so that the financial situation in respect to them could be exactly ascertained at any time. Their net revenue should be employed, first, for the payment of interest and the extinction of the railroad debt; thus serving to supplement the annual returns and making possible a reduction of rates for transportation.

It was provided that the management of the federal railroads should constitute a special division of the federal administration, and should be subject to the supervision and control of the federal authorities; but when it came to arranging the details under this category, the federal assembly made some important changes, which were embodied in the law as it passed.

To the federal assembly was reserved the power of examining and approving the annual accounts on the reports of the management; deciding, with the reservation of the referendum, concerning the construction of new lines and the acquisition of existing ones.

To the federal council was given authority to draft regulations for the execution of the present law; to name twenty-five members of the administrative council, the members of the general direction, and the members of the arrondissement directories; to approve the annual budget; and to present to the federal chambers the annual accounts and the reports of the management, as well as propositions relative to the construction of new lines and the acquisition of existing ones; and to continue the exercise of functions already possessed by it respecting private lines, so far as those functions are applicable to the federal railroads.

As special to the working of the railroads and with functions extending over the whole system, were instituted the administrative council and the general direction; the administrative council to be composed of fifty-five members appointed for three years: twenty-five by the federal council, twenty-five by the cantons, and five by the arrondissement councils—the federal council so to adjust its nominations that agriculture, commerce, and industry should be equitably represented in the body. This administrative council was given the supervision of the whole administration of the railroads and the functions of preparing the annual budget for submission to the federal council; of examining the annual accounts and reports of operation for submission to the federal council; of fixing rates, classifying merchandise, and making regulations for the time schedules; of satisfying all important agreements made with other railroad enterprises; of preparing the plans for new lines, expensive constructions, and the completion of important works in the system in operation; of approving contracts involving more than five hundred thousand francs; of ratifying the appointments of chiefs of service, and the fixing of their compensation within the limits of the law and the budget; of the determination of the general conditions on which persons employed shall be engaged; and of examining propositions relative to the construction of new lines and the modifications that may be needed in legislation respecting the federal railroads. It further had the naming of a permanent commission charged with the preliminary examination of affairs—of six members—of which its own president was the chairman.

The general direction was composed of from five to seven members to be named by the federal council, sitting at Berne, holding office for six years, and having its president and vice-president chosen by the federal council. To it, subordinate to the federal authorities and the administrative council, was given the work of management, the preparation of the annual budget, the establishment of the accounts, the making of the report of management, the preparation of the business to be submitted to the administrative council, the carrying out of the directions of that body, the preparation of regulations, tariffs, and time schedules; the control of the receipts from working and the material; with the making of agreements subject to the ratification of the administrative council, and the appointment of functionaries who are directly responsible to it.

The federal system was divided into five arrondissements, localized at Lausanne, Basle, Lucerne, Zurich, and St. Galle; with at the head of each arrondissement an arrondissement directory of three members appointed by the federal council, each administering the arrondissement of which it is in charge. These directories were each supplemented by an arrondissement council of four members appointed by the federal council and from eleven to sixteen members by the cantons constituting the council. The creation of these supplementary councils was a concession to the federalists, but more apparent than real, for the functions conferred upon them were extremely modest, and consisted in giving their opinion on questions relating to the railroad service, approving of the annual budgets and accounts prepared for submission to the general directory, determining upon all credits not exceeding one hundred thousand francs not provided for in the annual budget, approving the reports of the arrondissement directories, and the right conferred upon each of them to appoint one member of the administrative council.

The organization of the future federal railroads, therefore, notwithstanding the apparent concessions to the cantons, was strongly centralized. All important decisions were placed under the control of the general direction and the arrondissement directions, the members of all of which were directly dependent upon the federal council, which could appoint, control, and, on occasion, remove them.

Certain promises had to be made in the law to satisfy different regions having extensions of lines in view that their works would not be neglected. The most important of these extensions was the Simplon Tunnel, which the Jura Simplon road was just about to undertake, and in which French Switzerland was deeply interested. The law pledged the confederacy to complete this. The eastern cantons had extensions and passages of the Alps in view, and provision was made for these, a special guarantee being given to St. Galle for the construction of the Ricken line. To meet expressed fears that the secondary lines, if not cared for by the confederation, becoming unprofitable, would be abandoned, a stipulation was inserted providing for their purchase in the future without the necessity of a new referendum. The act as finally adopted by the chambers was regarded by those in favor of the purchase as a happy compromise which would rally all parts of the country to the support of the great national measure. The adversaries of the scheme regarded it as a great deal, intended not to improve the plan but to gain votes for it and make it acceptable to a coalition of interests. But it is certain that the object sought by the majority was obtained, and the amendments silenced the most active of the opposition. Party discipline was also brought to bear against dissent, and all the radical left except one deputy voted for it on its final passage. The majority by which it was accepted was further made up of the extreme socialistic left, a part of the center, and a small fraction of the left. The opposing minority was made up of the larger part of the Catholic and federalist left and a part of the liberal center.

The enactments relative to service on the railways make Swiss citizens residing in Switzerland alone admissible. The term is three years, and all in the service, together with the members of the administrative council, the general directory, and the arrondissement directories, are removable by those who appoint them.

A pension and assistance fund for the officers and men employed is provided for, to be kept up, half by the contributing members and half by appropriations from the management fund; its statutes to be established by the federal council. The existing pension and assistance funds may be continued if thought best, but their members can not at the same time be members of the general fund.

In a message accompanying the submission of its project to the federal chambers, the federal council presented as a first argument in its favor the saving it would effect of the time, labor, and absolutely useless expenditure involved in carrying separate transactions between five different companies and in maintaining their several special organizations and offices. Further, great advantages would be gained in the matter of support and supervision of the lines, the security of the traffic, easier adjustment of time schedules, and international relations, if a single administration was created. The local service would be ameliorated, for a single administration would be able to give the unproductive lines advantages realized on the productive ones, while private companies would naturally serve the productive lines first, and do no more than was indispensable—often, indeed, than the least provided for in the concessions—for the secondary lines.

To the advantages derived from consolidation would accrue those arising from administration by the state, which would look to securing a working advantageous to the whole public, while to private companies the advantage of stockholders would always be sought first. It would be able to effect desired reforms in rates, making them uniform where they were now various, often to a considerable degree, with inconvenient complications arising.

The necessity of gradually extinguishing the capitalized obligations of the railways was insisted upon. By about the middle of the next century the countries around Switzerland would be in possession of unincumbered systems, provisions to bring such a result about being already in operation in France, Prussia, Austria, etc. Switzerland ought to follow the example of these nations, else it would then find itself in an inferior position as to them. They would be able, among other things, to make great reductions in their tariffs, which, if Switzerland could not meet them, would expose it to disastrous competition. The extinction of the railroad debt should be attended to now. If it was put off till the next time purchase would be possible, or till 1913, there would be no possibility of completing the enterprise before the middle of the century. It was further held to be necessary to rid the railroads of the foreign influences to which they were subject because of so large a part of their stock and obligations being held by capitalists abroad, a condition politically mischievous and humiliating to the country; and the flow of money out of the country in dividends to these alien holders would be stopped.

Other arguments were addressed to particular classes, especially to the men employed on the lines, to whom the particular advantages of state service over private were held out in all their tempting aspects.

The law of repurchases having passed, October 15, 1897, the opposition to it canvassed all the cantons in order to obtain the thirty thousand signatures required by the Constitution of the republic to secure its reference to a direct vote of the people. Considerably more than that number were obtained, and the referendum was appointed to be made February 20, 1898. An active discussion of the merits of the scheme was going on all the time, and continued till the vote was taken. The several parties now took their positions on the subject.

The socialistic party had been for many years most ardent advocates of the nationalization of the railroads, but were not fully pleased with the plan of the chambers, because it gave too much control of the direction and too much power to the federal council. They would have preferred to have the administrative organs more independent of the political authority, and to have them, in part at least, named by the people. Yet they thought it would be contrary to their principles and their previous record to oppose a scheme which took so valuable a property from private companies to give it to the state. Assent to the measure was supported at the convention of the party in Zurich, November 14th, with strong arguments, by Mr. Wullschleger, of the national council, notwithstanding all the amendments he had offered in the council with a view to making the law more consonant with their ideas had been rejected; and a long resolution was unanimously adopted without discussion demanding the purchase as an essential article of the socialistic programme and a victory over capitalism, and an active propaganda in favor of the law was instituted.

The radical party, the party in power, controlling large majorities in both chambers, and responsible for the passage of this law, was committed to it by the very nature of the situation, and was especially strong in its favor in German Switzerland. Yet there was some opposition to it within the party, particularly in French Switzerland. But the mass of the radical opponents were ultimately won over to favor the purchase. M. Numa Droz, however, ex-president of the confederation, held out to the end, published a remarkable pamphlet, and spoke against the purchase in the principal towns of French Switzerland. He held a few adherents, but the radical meetings as a whole voted for purchase, and the general convention at Berne, December 12th, adopted an address of considerable length recommending it. The mass of the opponents of purchase in the chambers was composed of the Catholic right, and their attitude was dictated by motives of principle. They were adverse to a large extension of the functions of the confederation, opposed nationalization as a dangerous arm to put in the hands of the central power, and brought considerations of financial prudence to bear on the question. Still, some of them were gained over, and in two of the cantons they made an active campaign in favor of the measure.

The federal Catholics were also against purchase, and in their convention at Berne, December 16th, recommended the rejection of the scheme.

The conservative liberal party, alone of the more important Swiss parties, had no organization extending through all the cantons. It was composed of cantonal groups who found themselves in general agreement on federal questions, and were most numerous in the Protestant cantons. They made an energetic campaign against purchase.

Parties divide themselves, in Switzerland, on most questions, according to their centralistic or unitary, or their federalistic tendencies. The centralists seek the progressive unification of the nation, and would give the utmost power to the central authorities, at the expense of the cantons; while the federalists, regarding the historical traditions of Switzerland, would preserve to the cantons the power left them by the Constitution of 1874, and contend, step by step, against any rupture between the central power and the local authorities. These two tendencies were again ranged in conflict on the present occasion. Besides objections to any disturbance of the present relations between the cantons and the federal authority, other considerations were urged in the discussions before the people against the principle of the nationalization of railroads. The management of the railroads, some said, should not be committed to the state, because it is not one of its proper functions, and because of the wrong of exposing its finances to the risks inherent in such a combination. The state goes out of its sphere when it undertakes to manage transportation. Its mission is to defend the interests of the public by exercising an effective supervision over the administration of the private companies. Further, mischievous results were to be feared from the influence of politics over railroad management. State management might be a good thing if it was inspired solely by regard for the general interests of the country; the lines should be administered in a commercial spirit. With the railroads in the hands of the state, political influences would operate in the appointment of functionaries, the arrangement of time schedules, the adjustment of rates, and the construction of new lines, and their effects could only be disastrous. The control of so considerable a financial administration would also be detrimental to general politics. Entering into political discussions, it would make them more complicated and bitter; and the central power would be able to exercise a considerable pressure on the deputies in the chambers and on the electors themselves. Those who feared the effect of such influence on parliamentary independence and on the freedom of the vote of the people ought, therefore, to reject the project.

Economical and financial arguments were also extensively used by the opponents of purchase, and were brought forward with much force in two pamphlets which created much sensation in the country—one by ex-President Numa Droz, and the other by Dr. J. Steiger. The question was asked in these publications whether the railroads, in the hands of the confederation, would yield a financial return that would permit the realization of the hopes of improvement in the service without risk to other interests of the confederation to which the project of purchase had given rise. They reviewed the propositions which the federal council had emitted on this subject, and attempted to show that it had failed to take account of several items which might tend to increase the expenditure side of the budget. No allowance had been made for the expenses of improvement and construction and completion of the lines, which had cost the five companies thirteen million francs a year; or for the cost of tunneling the Simplon and making the eastern extensions that were promised; or for the loss of receipts that would be incurred through the promised reduction of rates. It seemed a probable result of the calculations made by the authors that the working-expense budget of the federal railroads would have to bear a considerable deficiency, which would not permit the extinction of the debt by the middle of the next century, but would rather tend to increase it. In order, therefore, to avoid too great annual deficits, the federal administration would have to work the railroads in a spirit of the strictest economy, and instead of reducing rates might have to raise them. There were no provisions in the law to prevent this, all propositions to insert them having been rejected.

MM. Droz, Steiger, and those who agreed with them held, therefore, that the purchase would be a bad financial operation for the state. And, then, would it not be dangerous for a small country like Switzerland to contract an enormous debt which it would be difficult to extinguish and of which it might at most only pay the interest? Might not the existence of considerable obligations, partly held abroad, compromise the financial independence of the confederation? Why run these risks when the necessity of economizing might prevent the confederation from fulfilling the promises of which the partisans of purchase had been lavish in its name?

Some of the other arguments urged in the discussion were less legitimate, and some appealed to prejudices which exist, it seems, in Switzerland as well as in America, against corporations and foreign bondholders. The campaign was one of the most exciting that had been witnessed for a long time in the republic. During January and February, 1898, public opinion was occupied with no other question. Numerous public meetings were held in all the cantons, pamphlets were freely circulated, and the newspapers took a very active part in the matter.

The vote was taken February 20th. Out of 734,000 citizens entitled to vote, 570,000 exercised their right. The result was a surprise to all. The measure was carried by a vote of 386,634 to 182,718, 200,000 majority, or by more than two to one, when few anticipated a difference of more than 50,000 or 80,000, and some persons considering themselves well informed thought, even the day before the voting, that the scheme would be rejected.

Only a year before—February 28, 1897—the Swiss people had voted against a project for a state bank which had been recommended to them by the same parties that advocated state railroads. Still, we can not infer from this that the people have reversed their position and favored a state socialism this year which they rejected last. The motives that determined their vote seem to be of a different order. The majority of the electors evidently regarded the railroads as a public service of the same kind as the post office, telegraph, etc., and sought to remove all private influences and sense of personal benefit from their management, as well as to free it from foreign influence. The mass of the people trusted to the promises held out of reduction in rates and improvements in all the features of the service. The men employed on the roads exerted a strong and solid influence in favor of the purchase, because they believed they would fare better in the hands of the state than under private owners.

By the vote of the 20th of February the Swiss people have made a decision of extreme importance, which will be certain to react upon the whole political, economical, and social life of the country. It is now for the federal council to see the law carried into effect. On the 22d of February it withdrew the concessions from a part of the Northeastern lines. If the repurchase goes on successively according to the terms of the concessions, the confederation will secure possession of the Jura Simplon, Central, Northeastern, and Swiss Union systems in 1903, and of the St. Gothard in 1909. For the purchase of the St. Gothard, negotiations will have to be gone into with Germany and Italy, which furnished considerable subsidies for the construction of the line; and it is further possible that the confederation will secure possession of the whole network before 1903 if it decides to negotiate with the companies, as the law authorizes it to do. If it does not do this, and does not succeed in coming to an understanding as to the price, the federal tribunal will be called upon to decide important questions relative to the calculation of the indemnities to be paid to the stockholders.

The experiment which Switzerland is trying is certainly very instructive. It will be interesting to observe how the confederation will manage to procure the capital required for its purchase and for running the railroads. It will be especially interesting to see whether it will be able to keep the promises that have been made in its name, and to compare private management under the control of the state with direct management by the state in a democratic country.—*Translated and abridged for the Popular Science Monthly from the Musée Social.*

THE EVOLUTION OF COLONIES.

By JAMES COLLIER.

III.—IMMIGRANTS AND INDIGENES.

FROM the simplest plant to the heart and brain of the world's chief denizen the organic kingdoms are the prey of a myriad parasites. These are outsiders and insiders, living in or upon the skin of their host, or burying themselves in its cavities and tissues, bones and vital organs. They are strongest and most numerous in the lower species, which can offer least resistance. If the *Epizoa* are sometimes accidentally useful, the class as a whole is injurious. But they are not less destructive to themselves. They sink in the scale of being through atrophy of their parts till they are no longer recognizable. What is the sociological significance of this strange blot on the face of Nature? It has been ingeniously suggested * that parasitism is the insurrection of the vanquished lowest species against the higher species that have supplanted them in the possession of the earth; and the view may be found as philosophical as it is picturesque.

Commensalism arises when, besides living by their means, if no longer at their cost, the inferior species render a service to the superior. Certain crustaceans eat the excrement of fishes, and thus purify the water. One species of birds hunts parasites in the crocodile's throat, another clears the elephant's back of them. The scavenger vulture and hyena banquet on the remains of the carnivore's feast. The struggle for existence between two species, direct in parasitism, is indirect in commensalism.

Rivalry gives place to coalition. Different species of birds ally for safety. The sentinel ostrich warns troops of gazelles, zebras, and quaggas. Conversely, the Abyssinian damon unconsciously protects the lizard and ichneumon. Mutualism is a prophecy of the coexistence of alien peoples.

These three types of relationship among animals—parasitism,

* By M. Alfred Espinas. Sociétés animales, first edition, pp. 21, 22.

commensalism, and mutualism—exhaust the possible forms of relationship between the immigrants who land in a new country and the indigenes whom they find there.

I. Desert islands or other unoccupied portions of the earth's surface having been at all times scarce, outside the books of Rousseau and Defoe, the would-be settlers in a promised or desired land have usually found themselves face to face with a native people in prior occupation of the soil. Like the penguins on the Auckland Islands, or the birds in the Australian forest, these peoples have no instinctive fear of the white man. They are not shy nor without provocation hostile. They are eager to trade, willing to sell their land, glad to have the foreigner in their midst. Things do not run smoothly very long. The natives, being still imperfectly initiated in the distinction between *meum* and *tuum*, "convey" the white man's coveted possessions. Harsh reprisals convert the black or the red man's passions into mere powder magazines. Or the rape of some red or black Helen fires another Troy. Realizing at last that it is *pro focis* they have to fight, they unite against the Yenghese or the Pakeha as they have never united against one another. The warfare has different fortunes in different ages. It was impossible before the invention of arms of precision, so that America could not have been colonized had there been an earlier Columbus. It was at its hardest in the sixteenth and seventeenth centuries, when the weapons of civilization were but little superior to those of barbarism. It is at its easiest now, when the breechloader has first made man the undisputed lord of creation, alike over wild beasts and wilder men. The issue grows daily more assured with every new invention, and Marconi's discovery hastens the advent of the era of omnipotent science imagined by Renan, when, like the mere gaze of the Brahman, the very approach or the most distant action of a scientifically equipped community will insure its victory over a barbaric race.

The resulting peace is sometimes enduring. The Massachusetts treaty with Massasoit was loyally observed for over half a century; the pacification of the Maoris lasted for twelve or fourteen years—an almost equal space of time in our swifter age. But it gets always broken sooner or later, and usually by one grand peace-breaker. When Chief-Justice Marshall ruled that the declaration of sovereignty over a territory carried with it, subject to the rights of prior occupancy, the paramount ownership of all land within that territory, he laid down a principle that has proved the fruitful mother of native wars in every quarter of the globe. Not that it has ever been universally accepted. Roger Williams disavowed it beforehand. The British Government has ostensibly acted on a very different canon. And there has been in every colony a strong minority, at times converting itself into a majority, to which the landed rights of the natives were sacred. None the less has Marshall's decision been the nerve of every colonizing advance. In the spirit of it the colonial legislatures pass laws and the courts make rules for the acquisition of native lands; doubtful sales are made by unauthorized members of tribes; not overscrupulous governments and altogether unscrupulous private individuals acquire wide tracts; the natives see their land slipping away from them; if they are not to become landless fugitives, they must make a final stand. Hence there is, almost always, in the relations with savage peoples, a second war; this time *pro aris*—for their right to keep the land which is, as it were, an extension of their tribal selves; to take which is to wound, dismember, or destroy them. Such was the cause of the native insurrections in North America in the first half of the eighteenth century, of the Maori war of the sixties, of the Matabele rising the other day, of a dozen different savage rebellions. The colonists summon up their power for a decisive struggle, and the natives are again beaten. On the colonial side there has been a profuse sacrifice of life, villages burned and towns destroyed; on the native side, a ruin still more terrible. Two thirds of the population may have been killed, as in Hispaniola; tribes have been broken up; the soul of a people has been slain.

The mother country has all this while not looked on at the spectacle with listless eyes or folded hands. In general it may be said that the degree of compassion felt for the natives is in exact proportion to the distance of the sympathizers from the objects of their sympathy. The colonists of the North Island of New Zealand, everywhere in peril from the Maoris and eager for their lands, have always been strongly anti-Maori; those of the South Island, perfectly disinterested and out of danger, are nobly philo-Maori; while the home Government, thirteen thousand miles away, has been from first to last the strenuous defender of the Maori. It is an "undoubted maxim," said Mr. Gladstone in 1846, "that the crown should stand in all matters between the colonists and the natives." Nine years earlier a committee of the House of Commons declared, possibly by the same eloquent voice, that England "will tolerate no scheme which implies violence or fraud in taking possession of . . . territory, will no longer subject itself to the guilt of conniving at oppression, and will take upon itself the task of defending those who are too weak and too ignorant to defend themselves." To this honorable line of action the British Government, outside of India, has, until lately, steadfastly adhered. It reluctantly annexed the islands of New Zealand, to save the natives from the settlers. It resisted the interested clamors of a powerful and avaricious company to annul the treaty of Waitangi, which secured the Maoris in possession of their lands. It appointed successive protectors of the aborigines—incorruptible officials like the late Walter Mantell. It sent out governors whose first duty was to the natives and only their second to the colonists; and the reality of the guardianship is shown by the facts that it led to the recall of one Governor, made a second resign, and got a third so constantly into hot water with his ministers that he too was recalled. Other governments have acted similarly. The wrongs of the Mexicans reached the tender heart of Isabella, who did the little that she could to modify the ferocity of her subjects; Las Casas was appointed protector of the Indians. Certain others have a more dubious record. M. de Varigny claims that merciless suppression and brutal repression are alike repugnant to the French character. Neither was always repugnant. It is barely half a century since Pelissier smoked the Arabs in Algerian caves. "The welfare of my service requires," commanded Louis XIV, "that the number of the Iroquois should be diminished as much as possible"; they were to be shipped for galley slaves. In 1736 the welfare of Louisiana required that the Chickasaws should be reduced, and two years were unsuccessfully given to that end. Severity is still less alien to the German character. In 1892 and 1897 two governors of German East Africa were recalled for applying too literally the avowed maxim of one of them that the lower races were to be governed by "the stick"; and a few months ago a third German administrator was called to account for cruelty to the Africans.

Public opinion in the mother country is usually divided; a single cross-section will show in what ways. "The agnostics don't send missionaries to Cochin China," cries the pulpit; North America was not colonized by the sensualistic school of philosophy, dogmatizes Bancroft. Yet the leaders of these very schools champion the cause of the oppressed. When Governor Eyre and his subordinates were prosecuted in 1866 for having suppressed a negro rebellion in Jamaica with needless cruelty, it was Mill, then at the height of his fame, who instituted the prosecution, and he was backed by Spencer, not yet at the meridian of a career that was to eclipse Mill's, and by Huxley, coiner of the word *agnostic*. Is it that there is a close connection between a belief in evolution and a fellow-feeling for the lower races from which we sprang? On the same side were the radicals, advocates of political freedom, the philanthropists, the "nonconformist conscience," and the evangelicals, who believe that negroes have souls. The opposite side was led by Carlyle, fresh from Frederick and his peculiar methods; Ruskin, with lance in rest against a new windmill; idolized Tennyson; Kingsley and

Froude at heart, if not in act—England's best and greatest on the spiritualistic side; men to whom the distance between the white and the colored races was infinite, investing the former with absolute rights. With them were the military and official classes, high churchmen and conservatives generally.

Sometimes there is a humanitarian sentiment in the air, as in that same year when a chief justice could charge violently against the Jamaica authorities, and the Tory leader (then Lord Robert Cecil) was so far carried away as to lament that white men held the lives of others cheap because they had a black skin. It is far otherwise now. High-handed modes of building up an empire enlist many defenders. "You can not make an omelette without breaking the eggs," cynically quotes M. Cherbuliez. Clive would find few calumniators in our days. Hastings would run no risk of impeachment. Dupleix would not be sacrificed. Frere would not be recalled. The protests of the Aborigines Protection Society against Stanley's "wading through slaughter to" Emin raise no echo. The humanitarian wave of the last generation is spent.

The devil's advocate has always plenty to say for himself. The savages practiced sanguinary rites, like the Ashantis and the Dahomans. They were the allies of our enemies, like the Hurons (say the English), like the Iroquois (say the French). They were already exterminating themselves, like the red Indians and Maoris, when we interposed and saved the remnant. They were being destroyed by strong drink and swindled by landsharks, like these same Maoris. They were a disturbing element on our frontier, like the Afridis. They were naked and bestial and a gang of murderers, like all the East Africans. They were a hindrance to the occupation of the soil—in short, they kept the land we wanted to take. "The starving white man must be satisfied," frankly confesses Mr. Stanley, "or he will grow ugly."

The would-be saint's advocate has some difficulty in replying. He condemns, even now, the fraud, injustice, and oppression that are the foundation stones of British India. At a far greater distance of time he still condemns the ruthless exterminating war against man and beast which the Hebrew's waged in Canaan. He listens with sympathy to Emerson's manly protest against the deportation of the Cherokees, and to Richard Howitt's and William Howitt's diatribes against colonization as giving the lie to Christianity. He reads (with an effort) the earnest *plaidoyer* in behalf of the Maoris which Mr. Rusden calls a History of New Zealand. He acknowledges it to be the glory of the sex that the three most powerful appeals ever made for justice to a native race have been made by women—in world-famous Uncle Tom's Cabin, Mrs. Helen Hunt Jackson's pathetic Ramona, and Olive Schreiner's thrilling story, Peter Halket. He notes with respect the attitude of the honest official who resigns his office because of unfulfilled promises to the natives of a whole island, or that of the private citizen who refuses to subscribe to the Imperial Institute because of unrepaired injustice to a single tribe. He is, nevertheless, obliged to admit, with the sage of Concord, that these things "look very differently to the centuries and to the years." The whole religious future of the world was bound up with the Hebrew conquest of Canaan, of which the ruthless barbarity may have been a necessary incident. The British occupation of India is a shining fact in history. The colonization of the savage-ridden spaces of the globe has swamped the inevitable accompanying crimes with a flood of benefits. A territory belongs by right divine to the race that can most profitably occupy it. But even in Nature's Jesuitism the end does not justify the means. Every step toward it must be just. All treaties must be honestly contracted and loyally observed, all promises kept, all rights respected. There shall be no personal injustice or oppression. Where the balance seems equally poised, the native scale shall be weighted. Pre-eminently, the surrender or confiscation of land shall correspond rather to the decline of the indigenes than to the increase of the colonists.

It would be easier to prove the converse and show that the decline of the natives has followed the loss of their lands. Yet history reveals a surprising amount of equity in transactions where the colonists were under no compulsion. In New England every acre was long scrupulously paid for; and this was the case in other States, as Parkman has shown. In New Zealand millions of acres have been purchased by the Government at a reasonable price. Laws were passed and courts set up in both countries to protect the natives. Where purchase was impracticable, as with the nomadic Australian blacks, the colonial Government has assumed a benevolent trusteeship. It has provided food and clothing, houses, implements and land, hospitals, doctors and medicine, schools and churches. The southern Maoris have been treated with less tardy and more compulsory benevolence. All such are parasites at the table of their invaders—interlopers on the lands they once freely roamed over or rudely cultivated. The more savage indigenes who live on the frontier of settlements, like many red Indian tribes so long, like the last integral fragment of the Maoris in the wild Uriwera country, like the blacks of the Australian north and northwest, have but rare relations with the colonists. They may swoop down from their fastnesses or crowd in from the forest, and threaten or imperil or destroy a colony, thus resembling epidemics of typhus and cholera, which are literally invasions of bacteria; but these descents become ever fewer as the natives grow weaker and the colonists are better able to cope with them. In a peaceful state they resemble the *Epizoa* and may even, like that class of animal parasites, render accidental services by teaching the colonists certain kinds of cultivation, as the Indians taught the New-Englanders to grow maize and the Maoris taught the New-Zealanders to grow sweet potatoes.

Some of these colonial parasites, having received a start, become self-supporting by tilling the lands that have been graciously left them. These become almost alien elements in the young society, slightly connected with it through government superintendence or missionary labor, as the Maoris or Blackfellows, or altogether unconnected with it, as the Arabs and Kabyles of Algeria. Their nomadic and more dependent kinsmen are true commensals in that they live, as in Australia, on the offal of animals newly killed by settlers, some milk given them, and the use of their dogs for hunting; or, as in South America, they receive from the Government used-up horses for food. They render services in return. The South American *rastreador*, the black police of Queensland, and the hundreds of black trackers who have followed criminals into the bush with extraordinary skill and no little courage, are the human parallels of many species of birds.

We rise to mutualism when the lower races are employed as troops, and this has its degrees. They are used as combatants in their own ways, like the red Indians during the wars between the French and English in North America in the last century, the tame South American Indians in the war against the wild Indians in 1832, and the Hottentots in South Africa in 1859. There is more organization in the Houssas and other African troops now enlisted on the Gold Coast. The Bengal Lancers and the once dangerous Sikh infantry are the pride of British India; and the ferocious Apaches have lately been trained into obedient and disciplined soldiers. All colored peoples are employed as carriers, and many as guides, boatmen, divers, and what not. The reciprocity or the rivalry of play is perhaps higher than that of work or fighting. The Australian blacks have defeated a white team at cricket, and the Maori footballer ranks high in a footballing colony.

II. The immediate effect of the contact with white immigrants is invariably disastrous and in certain cases fatal to the indigenes. The law has been correctly stated by Mr. Benjamin Kidd. Wherever the climate is so temperate that white men can not only reside and work but also multiply, the native race in occupation must inevitably disappear. An addendum is, however, needed. The limit of such residence is no hard-and-fast line, but a vanishing point, which is being driven ever nearer the equator and nearer the poles. French settlers accustom themselves to Lower Canada and to Algeria, American to Alaska and Texas, English to Nova Scotia and Guiana. Australian farmers are not deterred by 120° in New South Wales. Queensland sugar planters are multiplying in the tropics. Gold diggers rush equally to torrid Coolgardie and frozen Klondike. Within these wide limits the indigenous races are everywhere melting away. They are merely the last of the vanquished. The softer native grasses have been eaten out by the sturdy European grasses. Native plants have been exterminated by imported plants or driven to the hills. The Norway rat has expelled the native rat. The moa is to be found only in museums; the emu, the kangaroo, and the wallaby are in full retreat. None of them can make a living in competition with stronger species. It is not otherwise with man. The white man destroys the black man's game or cultivates the red man's land, and both are driven into the sterile interior. By some undiscovered correlation the birth rate adjusts itself to the food supply, and few children are born. Other causes are assigned, but they might be shown to be a continuation of causes in operation before the white immigration. The chief cause is the effect on the reproductive system. To it mainly is due the decline of the Hawaiians, Maoris, and Australian blacks during the present century, of which statistics have been kept. Even where food is supplied, the decline continues. Like the ancient Hebrews and other Eastern nationalities, like the inhabitants of mediæval villages, like Circassians and Cherokees—forcible dislocations which but continued their own involuntary migrations—the surviving Tasmanian aboriginals were transported to an island in Bass's Strait, the change apparently precipitating the decline, for children ceased to be born; the remnant was brought back to their native island, which, twelve years ago, witnessed the total extinction of a once vigorous race.

A people may disappear by absorption, aiding extinction. There was a time in the history of French Canada when it was on the point of realizing the Jesuit ideal of a continent inhabited by a mixed race of reds and whites. The missionaries Samuel Marsden and Lawry, the eminent governor, Sir George Grey, and a well-informed writer in the Edinburgh Review, believed that a blended race of Maoris and English would dwell in the islands of the Southern Cross. How far the colony is now from so undesirable a consummation will appear from the fact that fewer than five thousand half-castes are sown through a population of seven hundred and twenty thousand. There is, however, a steady advance in their numbers. While the pure-blooded Maoris have in five years declined by one eleventh, the number of half-castes has in the same period increased by nearly one sixth. The figures relating to the blacks of New South Wales are still more striking. There has been a continuous decrease of the full-bloods and a steady increase of the half-breeds, so that in the present year the latter have at length overtaken the former. The miscegenation has its picturesque incidents. The regal dignity of Montezuma clothes with barbaric grandeur two noble Spanish houses; the blood of Pocahontas flows proudly in Virginian veins; beauty visibly descends from the valor of Rauparaha, and prestige has not deserted the offspring of Te Heu Heu. It may be looked upon as the undesigned atonement which the immigrant makes to the aboriginal for robbing him of his country; and the amount of mixed blood is at length the aboriginal's sole share in the population of the land he once monopolized.

The agencies accelerating or retarding the inevitable progression toward the two *termini* have an interest melancholy or cheering, but superficial. The white man's drink, diseases, vices, and crimes are partly offset by the benefits of imperial trusteeship, missionary labor, and the contagion of white settlement. The first is real but distant; the value of the second is chiefly initial, and the action of the last is powerful but unconscious. The home government is beneficent when it protects the natives from the avarice of the settlers, and often maleficent in the guise of beneficence, as in the "insensate negrophilism" of the English at Sierra Leone, or in the sad comedy of conferring French citizenship on the blacks of Senegal and the Antilles. The utility of missionary work is much contested in the colonies, where it can not be denied that the missionaries have done well for themselves and their families. Even clergymen, from Sydney Smith to Canon Isaac Taylor, have exulted over "the great missionary failure." Whatever may be the case in India or Africa, throughout one wide colonizing region—that of the South Seas—this great failure has been an unquestionable success. A whole race, in a variety of families—Hawaiians, Tahitans, Tongans, Samoans, and Maoris—has been raised several degrees in the scale of civilization. Missionaries, and they alone, have done this great thing. Yet, as with the mocking finale to Heine's finest songs, one has to qualify this high eulogy by asking whether they have not smoothed the path of these people to the grave. They have paved the way for colonization by breaking down the resistance of the natives, and they have insured that a warlike race shall die ingloriously in its bed. The influence of the surrounding settlers begins where that of the missionaries leaves off. Governed by imitation, the natives procure seeds, implements, and cattle, and farm like whites. This stage lasts as long as they keep their land; when from misfortune it goes, the tribe is gone. At this stage there may be much mimicry of civilization: the younger members may distinguish themselves at colonial schools and colleges, the elder as legislators and bishops; there may be land works and water mills, printing presses and newspapers; they may even increase in numbers. When it passes, they sink into parasites. Like other parasites, they lose their original characteristics. The Talleyrands and Metternichs whom Bishop Hadfield was acquainted with in New Zealand, and the chiefs whom Maning found as great in their own world as Pompeius and Cæsar in theirs, have disappeared like those ancient worthies. The Maori can no longer wield the *merè* nor the Australian the boomerang.

III. The destructive effect of the parasite on its host has its parallel in the reaction on the individuals of higher races who come in contact with the indigenes. The residence of some of these precedes systematic colonization. Of one hundred and fifty *pakehas* scattered over the North Island of New Zealand before it was annexed—runaway sailors, escaped convicts, and other loose characters—the best known was one Rutherford, an English sailor, whom the Maoris forced to stay with them, tattooed, gave two daughters of a chief to wife, and kept among them for years, living in all outward respects like a savage, till at last he made his escape. That he did not quite sink spiritually to the level of his captors is shown by the interesting account of their habits and customs which he dictated to Prof. G. L. Craik, afterward incorporated by him in his valuable New-Zealanders of 1830. In every way the most remarkable was the famous Frederick Edward Maning. What motive—whim, disappointment, disgust with civilization, or latent savagery in himself—induced an educated man of superior abilities to cast in his lot with a race of cannibals has not transpired. A son of Anak, and possessing rare force of character, he was able for many years to hold his own in a community whose laws were more terrible than lawlessness. Such a man can never have been other than an alien at heart, but with his Maori wives, and conforming to Maori usages (cannibalism, it is to be hoped, excepted), he was outwardly a barbarian. He too broke away at last, and when colonization advanced, his knowledge and experience amply fitted him for the difficult post of a native land court judge. It fitted him still better for writing the most vivid account of a native race that has ever been thrown into literature. A more pathetic case is that of a professor of classics in Columbia College, New York, who, from disgust with the world, led a life of savage isolation in Queensland, where fifteen years ago he was speared by the blacks. The North American continent has seen crowds of such men. Daniel Boone was a type of the trapper who was half Indian. General Sam Houston, who had been adopted by the Cherokees as a boy, returned to his adopted father's tribe after he had made himself unpopular in Congress, assumed its dress, and lived with it for three years. Lewis Morgan naturalized himself as an Iroquois in order to study the social structure of that people. Parkman qualified himself to be the historian of the same dying race by the rough initiation of actual residence, and the story of miscegenation that he tells seems to borrow some of its fascination from observation at close quarters. There were remains of it when he wrote (in 1851), but its flourishing days belong to a full century earlier. Then the French immigrants gave prophetic confirmation of Bismarck's *mot*, "Scratch a Frenchman, and you come upon the red Indian." Red Indians they became. "The manners of savages," wrote one of them, "are perfectly agreeable to my palate." They were adopted members of Indian tribes, had squaws and reared a dusky brood, decorated and painted, danced, hunted, and took scalps; even Count Frontenac, Governor of Canada, plumed and painted, danced and yelled. Naturally, they sank to the moral level of their associates, caught their habits, imbibed their prejudices, drank in their superstitions. Frontenac burned Iroquois prisoners; Lovigny tortured Iroquois ambassadors to death. More tragical still, the fugitives from civilization, or those who had been captured by Indians, when found and brought back, sat sullen and angry, and escaped when they could to the free forest life. Women who had been carried off from New England villages in childhood were recovered and fêted, but soon fled to their warriors and Indian children. When we condemn the savages who have reverted to their old life after being inured to civilized ways we forget the hundreds of whites who have made a far greater drop. The deterioration resembles that of horses, cattle, and other domesticated animals that have been turned adrift or broken loose in a wild country. Its degree differs in different races. The instinctive repugnance which makes it so hard for an Englishman to govern sympathetically any race but his own is here his safeguard. He intermarries or worse, but does not so greatly sink. He either disentangles himself or raises his partner to his own level. His household then becomes a normal English home.

As the savage eats the heart of his slain enemy to acquire his courage, have we miscegenated the lower races unto ourselves to gain something of the unique qualities they possess? It is impossible that the infiltration of their blood into that of a colony, weeded out as it soon is, should not proportionately affect the sentiments, beliefs, and actions of the young community. There are even writers who maintain that there can be no real interracial influence without intermixture. What part has the alien element played in deeply Indianized Lower Canada? How much of his genius does the naturalist, psychologist, and novelist with whom Canada dowered England owe to the strain of Indian blood in him? The Spanish-American, Garcilasso de la Vega, is a unique example of a blend yielding a historian of the races blended.

Whether due to interbreeding or to mere coexistence, the part of the primitive races in contemporary civilization is being daily aggrandized. The so-called Aryan peoples are shown to be a mere prolongation of the neolithic races. A number of specialists adduce evidence from laws of succession, folklore, archaic customs, and archæological remains to prove that existing British institutions strike their roots down through Teutonic invaders and their Celtic forerunners to races that occupied the soil ages before.

The reactions of the lower indigenous peoples on their conquerors have been of a more spiritual sort. They have been phonographed in the vast literature bequeathed by the navigators and travelers, missionaries, military and naval officers, civil officers, and settlers who have visited or been resident among them. How extensive that literature is will appear from the fact that the bibliography of a single colony with less than sixty years of existence, and less than eight hundred thousand of a population, contains over twelve hundred articles. This great quarry is of incommensurable but unequal value: 1. It is often uncritical. The facts have not been accurately reported, as has been shown in detail of the Tasmanians; or they have been misinterpreted, as when a group of obscene songs have been published as Maori myths; or (as Mr. Taylor has proved) missionaries have imported their own theological beliefs into their accounts of the beliefs of savages. 2. Much of it is unsympathetic. Observers have not imported enough. They have failed to see in these peoples men with feelings and thoughts akin to their own. The savage's fetich worship and the barbarian's Nature worship are far from being the wild absurdities they are sometimes represented to be, but are as rational as the Calvinism and Wordsworthism which are their offspring. The more we know of the lower races, as of the lower animals, the more we discover that all organic Nature was made (as Newton put it) "at one cast." 3. It is not always scientific. There are few travelers like Humboldt or Darwin, few missionaries like Taylor or Callaway, few officials like Schoolcraft, nor in the absence of special researches do even these know what to look for or what questions to ask. Hence races perish or institutions disappear before their secret has been wrung from them. Perverse science is as mischievous as none. A foregone conclusion made of Lewis Morgan's ponderous volume on the classificatory system of Indian relationships a monument of misapplied ingenuity. Led astray by the same Will-o'-the-wisp, two instructed inquirers discovered among the Australian blacks the existence of polygamy on a scale that out-Solomons Solomon. Future researches will be better guided. Twenty years ago the British Association issued a list of queries, and students of special subjects have catechised missionaries and other residents abroad.

On these foundations has been reared what Max Müller disdainfully names agriology, what the late Mr. Freeman, the historian, invidiously styled "Mr. Taylor's science," and what is, in fact, the science of sociology. In its pre-scientific stage it consisted of premature generalizations on an insufficient basis of facts, such as are to be found in the still interesting works of Goguet and De Brosses, Monboddo and Kaimes. Sometimes it gave rise to a great idea in other sciences. Observing the poverty-stricken flora and fauna of Australia, Cook mused on the agencies which kept the Australians within the limits of subsistence. His speculations dropped in Malthus's pregnant mind the seed of the law of population. As is better known, that law put into Darwin's hands the key to organic evolution. Cook begat Malthus and Malthus begat Darwin—that is the genealogy of natural selection. Special researches began. Prof. John Millar's Origin of Ranks, of which the third edition was published so long ago as 1781, shows how near a man may be to a discovery without making it. Only after eighty years did his inchoate speculation issue in the most finished piece of inductive research that sociology has to show—McLennan's Primitive Marriage. Mr. Tylor, the best-equipped and most judicious of contemporary sociographers, has skillfully tracked social phenomena on a dozen different lines all round the globe. And these pioneers have been followed by a host of explorers, from Florence to Stockholm and from Moscow to San Francisco. Systematic science at last arrives. Comte named and rightly placed sociology in the circle, or the tree, of the sciences, and his prior treatise is enriched with a wealth of thought unequaled since Montesquieu. But his construction is vitiated by the mechanical conception of society that bore such Dead Sea fruit in the Politique; and without the indispensable foundations supplied by a study of primitive peoples it is a mere "Spanish castle," a structure in the air. A vital conception of society and the tracing of existing institutions, rites, and ideas to their roots in these peoples made Herbert Spencer the true founder of sociology. The carving out of the social subsciences—a task that baffled the keen intellect of Mill—was struck off by this great thinker at a heat. The classification which forms the skeleton of his Descriptive Sociology is an analytical masterpiece that evoked the enthusiasm of Taine. As it has already been made by two able assistants (Dr. Duncan and Dr. Scheppig) the framework of exhaustive descriptions of the savage and semicivilized races, so will it be the schema of all future sociological research.

Art as well as science has been born of the contact with indigenes.

A contemporary artist has happily cought the "idea" of the Indian maiden—so mysterious, so near to Nature, so remote from ourselves. Chateaubriand has embalmed in Atala the sentiment of the primitive forest; Longfellow, in Hiawatha, has distilled the romance of Indian life; and in Ranolf and Amohia Domett has transported to the Hot Lakes the loves of Juan and Haidee. A legion of novelists, from Saint-Pierre to Pierre Loti and Louis Becke, has described one side or other of the relationship. Governments and manners have been revolutionized by the contact. From travelers' tales, embellished at the start and further idealized by his own imagination, Rousseau drew "those oracles which set the world in flame." It is not unchristian to hope that the overlordship of the whole earth now first arrogated by the whites, with the high beneficent trusteeship in favor of its indigenes which that involves, will react on the sensibilities of the overlord and issue in a humaner evolution. Is it anti-Darwinism to expect that the mad rivalry and savage warfare of every man against his fellows—with its hecatombs of wrecked lives and broken hearts deadlier far than that elder warfare of spear and tomahawk—will at length give place to a co-operation that will be more zealous for the rights of others than solicitous for its own?

THE NATION'S CRISIS.

By A. B. Ronne.

"I THINK that, whatever difficulties they may have to surmount, and whatever tribulations they may have to pass through, the Americans may reasonably look forward to a time when they will have produced a civilization grander than any the world has known." These were some of the parting words with which Herbert Spencer bade this country farewell after his short visit in 1882; they form the concluding sentences in that memorable interview which he granted a representative of our press a few days before his departure.

It must still be fresh in the memories of Mr. Spencer's many friends on this side of the Atlantic that in this interview he freely discussed the numerous signs of an immense development of material civilization which everywhere confronted him here, without concealing the fact, however, that while the wealth and magnificence of our large cities had been a source of astonishment to him, these very evidences of a wonderful commercial activity and development of arts had constantly reminded him of the Italian republics of the middle ages, where the people under circumstances and conditions similar to ours were gradually losing their freedom.

It will also be remembered that Mr. Spencer's visit, owing to ill health, had been a hurried one, and that he offered his views as the result of his first impressions only. But of the symptoms in our public life which most impressed him as pointing toward the undermining of free institutions, he mentioned the tyranny of the political machine, under which the citizen, as a rule, had to use his political power according to the dictates of party managers, or else to throw it away; and in this connection he reminded his interviewer of the fact that "constitutions are not made, but grow," that the Americans got their form of government more by a happy accident than by a normal progress, and that here, as it has been elsewhere, it was becoming painfully evident that our political structure, as an artificially devised system, had been growing into something different from that intended. Yet, in spite of all this, Mr. Spencer did not seem to take a very doleful view of our future. From the size of our country and the heterogeneity of its components he thought it safe to predict that, as a nation, we would be long in evolving our ultimate form; but that this ultimate form would be high, considering all that we had accomplished and the troubles over which we had already triumphed, he saw no reason to doubt; and thus he dismissed his interviewer with the prophetic words quoted above.

Scarcely sixteen years have passed since this interview took place, but signs are not wanting to-day which show that during this brief period we have gone from bad to worse, not only in regard to those evils referred to, but to others of a like nature as well. From all our principal cities come startling disclosures of boss rule and its accompanying political corruption. Yet it is difficult to say which is the most startling—the corruption itself, or the apathy toward it evinced by the masses. In New York city the disclosures a few years ago were followed by a tidal wave of municipal reform, but after receding this wave seems to have left the great city in a condition little improved if any. The recent accounts from Pennsylvania furnished us by Mr. Wanamaker, whatever effect they may have on the elections in that State, are of far less interest to the average citizen than the news from Washington, although the dangers implied in the former threaten the most vital interests of the Commonwealth. But, if, in places, the Commonwealths are groaning under political corruption of the worst kind, the country as a whole is groaning under an industrial depression, the causes of which do not seem in any way to concern the professional politician, except perhaps when political capital may be made from taking up the question. As to these causes thoughtful men may differ. But upon this they all must agree: that corporate capital during the last sixteen years has become more and more tyrannical, while the wage-earners—

mechanic and laborer alike—once supposed to furnish the brains as well as the brawn of this republic, have become more and more dependent. And here, again, we meet with the same apathy among those not directly interested. Gigantic strikes, one after the other, this country has witnessed since 1882, in which public sympathy at the beginning has been with the striking workingman, only to be transferred to the side of the rapacious corporation—already backed by the executive and judicial branches of the Government—just as soon as the inconvenience of the situation began to make itself felt by all: the result of it all being a large middle class, insensible to the encroachments on their personal freedom on the one hand, and a dissatisfied, disgruntled working element without faith or confidence in our political institutions on the other.

Under such conditions this war with Spain may truly be said to have found us unprepared, not so much from the lack of an adequate navy or standing army as from the absence of a real national unity. It is generally held that—war having commenced—it is unpatriotic to discuss now whether it was justifiable or not; it certainly is useless, and we may as well accept the situation as unavoidable and the war as a righteous one. It may seem strange, therefore, perhaps unkind, to speak of the absence of national unity in the face of the vigorous preparations made by the administration and the willing response to its call for volunteers by our young men in all parts of the country. Yet the thoughtful man can not shut his eyes or ears to the chaotic state of opinion concerning the war and its causes, and for the sake of the future of this nation it is well to take a sober look at the situation. A war is always a crisis in a nation's history, especially so when its traditional policy has been one of peace. Earnest appeals to patriotism and humanitarian principles have not been wanting; but side by side with the many responses to these appeals, grumblings and bitter fault-findings have been heard. The professional politician, as might be expected, has come in for his share of alleged responsibility—his supposed aim being personal gain or glory—though, strangely enough, the political leaders who usually are the targets for the attacks of the professional reformer were the most anxious to avert the conflict. No more satisfying is the charge that our politicians in Washington, who were chiefly instrumental in working up the war feeling, were actuated only by a desire to stem the tide of Bryanism by diverting public attention from this movement—seeing that its brilliant leader and some of his henchmen were as clamorous for war and military glory as any of the rest; while the silver organs did not hesitate in stigmatizing the President's efforts toward settling the difficulty through diplomacy as being in the interest of Wall Street.

But the strongest proof of the absence of the genuine national unity which should characterize a righteous war is, perhaps, the indifference noticed among the working people. This has been commented on in several newspapers, and an explanation has been sought in the fact that a large part of our foreign population has not as yet sufficiently imbibed the spirit of our institutions to make them good Americans. The real explanation, however, is the fact that through actual experience they are learning that war can only result in making their struggle for existence still harder, partly by the paralyzing of many industries and partly by enhancing their cost of living. Can a lofty and self-sacrificing patriotism be expected from those who, in their struggles with aggressive capital intrenched behind governmental protection, have invariably suffered the fate of the vanquished? And they who have learned that it is less against foreign aggressions that eternal vigilance is required than against the insidious growth of domestic interferences with personal liberty—should they blame them so very much?

It being granted that this war was unavoidable, that humanitarian principles no less than self-interest compelled this country to make this departure from a time-honored policy, this allusion to its unfavorable internal conditions is made only for the sake of pointing out the real danger of the hour. As already remarked, this war presents a crisis—we stand at a crossway, and it is now that we must choose whether our destination is to be that higher civilization predicted for us by Mr. Spencer, or whether we shall turn back toward a purely military *régime*. That there is grave danger of choosing the latter is seen in the changed sentiments throughout the country. Many well-meaning people who a short time ago deprecated the idea of war altogether, and who rejected with scorn and indignation the insinuation or open charges by European powers that our real object was one of conquest, have been, through the first success in the East, carried away by the alluring spectacle of the United States assuming the position of the greatest naval power of the earth, and as entering upon a new career as "a fulfillment of its appointed mission." It was truly said at the time by a New York journal: "The American spirit is stirred and its imagination inflamed by the opportunities now offered this country to extend the sphere of its power and influence." But what does all this mean? It means that, when the war is over and victory ours, then the people, drunk with military success, will be ready to sell their birthright for a mess of pottage. In their delirium they will have no adequate idea of the cost of maintaining a standing army and a navy second to none. So far from being frightened by the strong centralized government made necessary by these changed conditions, they will hail with loud acclamations the military hero with the most picturesque trappings as the man sent by a special providence to lead and to guide us, and thus a long step forward—or backward—to monarchical institutions will have been taken.

Is this picture overdrawn? Will it be said that this is the prediction of a warped, a fretful and pessimistic mind? Not by the sober and the thoughtful. Signs pointing that way are too numerous, sentiments of such a nature abound in the daily press; even the religious sentiment here and there is prone to lend encouragement to the idea of special providence in this matter of a new mission for the United States—that of spreading the light of civilization among semibarbarous people, east and west, by the help of fire and the sword. Who this "man on horseback" is to be is now and then clearly indicated. That he may be a man of high attainments, of personal integrity and nobility of mind, does not help the case; he is a relic of a chivalric, it may be, but still a barbaric past. Only such a man can fearlessly advocate, in season and out of season, the necessity of a navy equal or superior to that of Great Britain, knowing as he must that the resultant national self-consciousness of brute strength is ever prone to lead a government to aggressive acts both at home and abroad. And what is to pay us for this sacrifice of personal liberty? Is it the increased trade with foreign nations? Is it the increased industrial activity, made necessary by caring for distant colonies? Too late will it be learned that the only way to national prosperity lies in attending, as far as possible, to our own affairs; in guarding faithfully the rights of every citizen; and in encouraging, first and last, friendly relations with foreign powers. The nation, doing all this, will soon find itself strong enough in the internal unity, resulting from the contentment among all of its citizens and through the moral effect this must have on others, to defy any encroachments and to ward off any insults or impositions from the outside, though it may not have a gigantic army or navy sapping its very life blood.

It is held by some who are aware of the possible dangers here alluded to, that there is really no serious cause for alarm—the great merit of a democracy like ours, according to such, being the assured fact that "out of its multitudes, who have all had a chance for development, there will always arise, when occasion demands it, stronger and wiser men than any class-governed societies have ever bred." This, however, is begging the very question at issue. For now has the critical time arrived, when it is to be ascertained how far the insidious growth of class government has affected our nation. Strong men we have, and wise men, too; the first are already coming to the front, but—and this is one of the ominous symptoms—there is a disposition whenever the latter are heard to cry them down as traitors. Yet, it is only by heeding the warnings from these sober-minded men, in whatever station of life we may find them, that we shall be able to choose the right road to follow. Do we wish to show the monarchies of Europe that they were wrong in charging us with base and selfish motives? Do we really wish to show the world that in this republic individual character—that which Herbert Spencer told us, sixteen years ago, is the first essential in fitting men for free institutions—is not wanting; that the average American citizen "has a sufficiently quick sense of his own claims, and at the same time, as a necessary consequence, a sufficiently quick sense of the claims of others"? If we do, let us heed the voice of those who bid us beware of the false glamour of military glory. In the history of every young nation, as well as of the individual, there is always sure to come a time when its destiny is to be decided forever; when success in choosing the right means further growth toward a higher and fuller life, and failure means nothing but eventual decay. At such a time this nation has now arrived—

"At the crossway stand'st thou; choose!"

THE PHILOSOPHY OF MANUAL TRAINING.

By C. HANFORD HENDERSON,

DIRECTOR OF THE HIGH SCHOOL DEPARTMENT, PRATT INSTITUTE, BROOKLYN, N. Y.

IV.—THE RESULTS OF MANUAL TRAINING.

IN looking at the actual and possible results of manual training, I come to one of the most attractive aspects of my subject. I find these results, in the main, to be very favorable, but I should be unwilling to use this as an argument for manual training unless it could be shown at the same time that there was an organic relation between these results and the underlying principles. Many of our current social and economic fallacies owe their too long life to just such an appeal to results. The underlying philosophy of manual training might be quite false, and its methods quite unpsychological, and yet the entire scheme in the hands of devoted men and women might be so far modified and colored as to give admirable results. And I am the less willing to use this argument because I should not admit the propriety of its application in the case of unfavorable results. Could the actual results of manual training be shown to be poor, or at least indifferent, I should conclude that it had missed its mark, and had been badly carried out, and not that manual training itself was a poor scheme. It would be quite possible for manual training to be a perfectly sound scheme of education, and the one best qualified to develop the individual and national life, and yet in the hands of men and women who did not understand its end and purpose, to give results so meager and undesirable as to make the whole scheme seem to stand self-convicted.

And I find lurking somewhere in the corner of my mind a second reason for this disclaimer. I should be unwilling to have the manual training movement, which seems to me so full of seriousness and of promise, suffer in your esteem by reason of the aberrations of any of its less enlightened exponents. We are sometimes murdered in the houses of our friends. And manual training, sloyd, and the kindergarten have suffered much at the hands of their friends. The real justification for manual training, let me repeat, is to be found, not in any aspect of its practice or results, but in a far deeper sense in that system of social ethics which grows out of an evolved philosophy of life. If this has seemed to you sound ground, the results flowing out of it must be equally sound. This may seem a somewhat sophisticated way of escaping a dilemma, but, believe me, it is nothing so trivial as that. It is a strong desire that your judgment should be on the essential and not on the accidental features of manual training, righteous judgment and not judgment according to appearances.

The human race is very old and human effort is very old; and education, whether systematic or unconscious, has been going on ever since the hand of man fashioned the little black tablet recently found by Dr. Hilprecht in Babylonia, and dating back to the sixth millennium before Christ. Education is a very old process, certainly eight or ten thousand years old, and probably very much older. It is, therefore, I think, entirely modest and reasonable, in speaking of anything so very modern as manual training, which in America can not yet claim a score of years in the matter of age, to speak both of the actual and possible results, since manual training has not been in existence long enough to have come to anything like its full powers. And yet these actual results have already attained very respectable dimensions. I feel constrained to add still one more word of caution. Not only has manual training not yet perfected itself as a tool, but even as an imperfect tool its term of service is at present limited to about three years, and the actual results, under the most favorable conditions, can not be regarded as more than a mere fragment of the possible results.

Knowledge is a perception of relations. We have agreed upon this, I think, as a sound definition. The coming into knowledge is the coming into a perception of these relations. The coming into life is a coming into a realization of self, and of one's relation to all that is not self—to other individuals, to the social order, to Nature, and to the Supreme Intelligence of the world. All that helps on this perception of relations among outer things, and helps on the realization of one's own relation with the world that is not self, is in the highest degree educative. The process of education being the conscious direction of evolution, the creation of a definite environment in order to realize definite moral and æsthetic ends, must produce results, if any, just along these lines, must bring one into a perception of relations, must help one to realize self, and not less materially must help one to realize one's relation with a world that is not self. The results of manual training, so far as they are educational, must be along some such lines as these. Let us look at the results so far as knowledge is concerned—a perception of relations.

We can know about a thing, and we can know the thing itself. There is a tremendous difference. We can know about verbs and adverbs, nouns and adjectives, and all the rest of the nine parts of speech, and we can decline, compare, conjugate, analyze, parse. But we can never know the parts of speech themselves until we know them as a reality of use, until we experience them either in literature or in our own efforts at expression. We can know about the world and about foreign countries, and can form vague mental images to correspond to them, but we can not know the world itself or other lands except through travel, through actual experience. We can know about the world of matter, about rocks and minerals and animals and plants, and be well read in regard to their appearance and qualities, but we can only know this world of matter by personal contact. It is the same in a less material world. We can know about the emotions, about love and friendship and conscience and duty and hate and remorse, but we can not know the emotions themselves until we ourselves have felt. It is a very unreal world that is built upon the report of others, rather than upon the report of our own senses, a world in which books take the place of life, in which maps take the place of lands, in which pictures and drawings take the place of Nature and of art—a flat world of two dimensions, lacking the third dimension of solid reality. Those only can know who live in a world of reality and of direct sensational experience.

I am stating one of the actual results of manual training when I say that it not only attempts to bring boys and girls into touch with reality in thoughts and things, but that it truly does so. And it does so by letting them alone, by providing an environment rich in its invitations to action, but one in which the action must be self-directed. Furthermore, it is an environment in which the world is very meagerly reported, only so much as is absolutely necessary, but in which the boy is thrown back upon the reports of his own senses and must taste life at first hand. One can not live in such a world, can not be constantly doing things with one's hands and eyes, without coming more and more to adapt means to end, without growing more and more into a realizing sense of the principle of cause and effect. In a manual training school there are, of course, stupid boys who never come into a full measure of knowledge, and there are clever boys who quite of their own self-activity would have come into a full measure of knowledge. Better than any training is it to be well born. But the average boy, neither stupid nor clever, is certainly aroused to a keener perception of relations—that is, into a deeper knowledge. The realization of self, the coming into possession and control of one's self, is a large developmental process which means many things. Take a boy as he is. Picture him as he might be. The realization of self means nothing less than the spanning of this considerable chasm. I do not for a moment believe that manual training accomplishes all of this, but I do believe that one of the actual results is to bring a boy out of his smaller into his larger self, and so points toward the realization of this ideal. The necessity for adapting means to ends forced on a boy by his manual work, the presence both of the principle and the idea of cause and effect which he meets at every turn, conspire to give him a very practical habit of mind, a habit which brings about a more complete adjustment of acts to ends than you will find in boys who have not had this special form of judgment training. And this complete adjustment, as we have seen, is the mark of highly evolved conduct. This result ought to follow from manual training, and I should in any case count it among the possible results, but our experience is now large enough to enable me to say that it does actually follow, and that it follows in large measure. I have watched the boys very carefully inside the schools themselves, have watched their habit of dealing with problems and facts, and I have followed their careers and kept in correspondence with hundreds of them after graduation, and I find them marked by a power of thought and action that quite differentiates them from ordinary boys.

I have been the head master in schools where manual training was taught and where it was not taught, and have had an opportunity, therefore, to come in contact with both classes of boys; and I have come to separate the two very distinctly in my mind, because I detect in them a marked difference of quality.

But while this nice adjustment of acts to ends constitutes highly evolved conduct, it is only touched with morality when the ends are moral—that is, are happiness-producing in a very deep and genuine sense. This disposes of an objection which is sometimes urged against the moral claims of manual training, and quite naturally urged, I think, that skillful workmen are not always good men, are indeed often men of quite impeachable moral habits. Without knowing in any statistical sense—and it would be almost impossible to collect such statistics—I am nevertheless disposed to believe that an essentially good workman is also a good man, for a love of good workmanship must beget a love for all else that is good and true. But without insisting on this view, it is enough to point out that manual training teaches the adjustment of acts to distinctly ethical ends—ends that involve the most complete self-realization, the full development of all the powers and faculties, and consequently to that full measure of life and happiness that is the goal of morality. And manual training leads to this result by a very direct path. All the manual work is undertaken for the sake of its mental reactions, and these reactions have a very definite character. The manual occupations are so arranged physiologically as to strengthen the brain centers controlling the extremities, and thus secure general increase of brain power. They are made as varied as possible in order to stimulate a many-sided interest. A greater number of boys remain to graduate in manual training schools than in the ordinary high schools. The general interest in life awakened in these boys is somewhat akin to the freshness and enthusiasm that you find in young children. The schools stimulate curiosity, and I use the word as Arnold used it, to mean intellectual interest. This result seems to me of large importance. We all have this curiosity when we are young. If the emotional life be strong, if desires grow apace with their gratification, we retain it to the end. Life remains a beautiful laboratory in which the invitation to investigate is forever strong. The drying up of the emotions, the loss of this curiosity, is the tragedy of old age. You have doubtless seen old men and women in whom the physical life is still sufficiently strong to keep them in motion, but in whom the psychical life, the desires and feelings and interests are completely dead. Do you know anything more tragic than this? I do not. It is one of the saddest sights of Europe to see the elderly men and women, many of them our compatriots, who are enduring Europe rather than enjoying it, who are dragging themselves from place to place in the vain thought that they are on the road to pleasure, men who have given their strength and manhood to money-getting, and who have let go, only to find that they have no interest and no genuine capacity for pleasure left to fall back upon; and women whose prime has been given to triviality, and who show in their faces the bitterness and *ennui* of old age. If I did not hate commercialism for its own sake as something quite unsocial and quite unworthy of the human spirit, I should hate it for the sake of these, its pitiful products. Who can not recall a succession of elderly men who have given up their business pursuits at the solicitation of their friends, and who have been rewarded in a very few years by death? You know why they died. It was because the spirit was already dead. And who has not heard it said that Mr. Smith or Mr. Brown or Mr. Jones is kept alive by his business? In view of what men might be interested in, it seems to me a very poor and bare and altogether a pitiable thing to be kept alive on.

Manual training is still too new to have seen its generations of schoolboys grow gray-haired, and it may easily turn out that when gray hairs do come, the disintegrating forces will have done their perfect work, and the boys now so full of promise will be found among the sad company that I have been picturing. As Thoreau says, we begin to gather the materials for a palace, and end by building a hut. But I do know that at least they start out in life warm and eager, that they are aglow with interest and vitality, and that they find life very full and rich.

The session of the manual training school ends between two and three. In those schools where that spirit of the complete life most prevails, where that spirit of radiancy is dominant, you will find boys and masters still at work at four, at five, and even at six o'clock. And it is not uncommon for it to be necessary to make a rule when the boys must leave the building, in order to give the women a chance to make things clean and tidy for the next day. In the morning the boys begin coming at eight; they would come earlier if they were allowed. This voluntary devotion to the school is not to me without a deep significance. It shows that boys are happy at their work, that they are alive and interested. It indicates a measure of self-realization.

The increase of health which comes from the bodily exercise, and particularly the increase of muscular power that the manual work engenders—I mean muscular power not in an athletic sense so much as in a general organic sense—make the organism finer and better adapted to the work of the spirit, if I may use this dualistic phraseology without misleading any one. We can not make bricks without straw, and we can not build up emotional and intellectual power in the air. Like the energy which is the subject-matter of physics, this power is always associated with matter, may indeed be called the spiritual energy in matter, but with matter of a certain quality, highly organized, sensitive, sound. Dr. Johnson said that sick men were rascals, and I believe that he was more than half right. This statement will at once call to mind a goodly company of men and women, world heroes in fact, who were half invalids or wholly invalids, and who yet accomplished marvels in art, in science, and in humanity. But in no case can it be shown that this invalidism was in the brain tissue. The malady was of some special organ, and was perhaps a mortal malady, and yet for a time the brain centers remained sound and intact. But even here the question is legitimate as to how much greater heroes they might have been had the weaknesses of the flesh not weighed so heavily. Such a statement, too, is apt to call up another and quite a different company of people, rosy-cheeked and bright-eyed, and as stupid as they make them. George Eliot's heroines, when they are beautiful, nearly all come to some bad end; and when they are plain, end by making you love them. Charlotte Brontë is given to the same association between outer ugliness and inner beauty. Even the genial Thackeray makes Amelia somewhat empty-headed. You may also be led to reflect that college athletes are not always the intellectual giants of later life. The honors still fall in part to the shabby, ill-favored men.

It would be easy to multiply this contradictory evidence, but my sole purpose is to make it clear that the problem is double-faced. How shall we get at the truth?

A favorite maxim of mine applies here very well. It is this, that what is true at all, is true in the extreme. It is a convenient practical process for testing all sorts of conclusions, and I recommend it to those who may, like myself, have little skill for more subtle processes. Applied to the case in hand, it would lead us to pass from the normal to both extremes of society. Let us then ask what is the motor sensibility of the beautiful but empty-headed heroines: do they play music that any one cares to hear; do they paint pictures that any one cares to look at; do they make fancywork that any one cares to receive; in a word, do they show any quickness of motion, do they do anything that would lead you to suspect a high degree of organization along with the anatomical perfectness? If your experience has been like mine, you have found them statuesque and clumsy. They make beautiful photographs, for it is perfectly natural for them to sit still. And you can quite as readily recall a series of men, handsome and dull, a delight to look at and a bore to talk to.

But going a step further from the normal, let us inquire into the mental capacity of rickety children. The testimony here is very sad. The inco-ordinated movements of the body are not a physical defect alone. They are a mental defect. There is the same lack of co-ordination in their mental processes. You know what secrets are let out in a simple handshake—the firm, strong grasp of the strong; the weak, flabby, repulsive touch of the weak. There are few teachers who have not wept bitter tears in spirit, if not in fact, over the little people whom they have come to care for, but in whom they have had to recognize that a deficient organism would forever bar the way to the highest achievements—children for whom there seemed but this one hope, that they might one day be born over again. I have known with some degree of intimacy about fifteen hundred boys, and over periods ranging from a few months to as many years, and one can not know them and be interested in them without reaching a number of generalizations about them. I have come to be very fearful of the development of any boy who is markedly clumsy, and I have come as the result of experience to mistrust the reliability of his mental processes.

I am not fond of Calvin. I think he did little to set free the spirit of man. But I find in the limitations imposed by the bodily organism a predestination as real and as bitter as any that Calvin taught.

If we go one step further toward the extreme of acknowledged deficiency, we shall meet still more striking testimony. This pathological region is a most depressing one and to be entered unwillingly, but health has undoubtedly gained much by a study of disease. The localization of brain action has been established for psychologists by the study of abnormal cases and by accidents. Where death or the necessity for some surgical operation has made it possible to examine into the brain structure, the most intimate connection has always been found between function and organ, and between special function and special organ. A failure in the power of speech, or the loss of any special faculty brought about by sudden accident, can always be traced to the injury of some part of the brain tissue. Sometimes the injury is so vital that the tissue is completely impaired, and in that case I believe there is no hope of recovering the lost faculty. But sometimes an operation can restore the normal order. A clot of blood has perhaps been formed and presses against some center. When the clot is removed, and with it the undue pressure, the lost faculty is restored. You will find many such instances recorded in the pages of experimental psychologies. But the application for us, in studying the results of manual training, lies in the thought that the poor, undeveloped brain centers in the deficient might be strengthened by exercise brought about at the extremities. It is a logical suggestion. The bodily faculties are peripheral, the brain central. As a matter of experience, and as a necessary inference from our philosophy, the interaction between them is complete. The health of one means the health of the other.

Following this thought, manual training has been introduced as a therapeutic agent in the treatment of feeble-minded and deficient children, as at Elwyn, Pennsylvania, and in the treatment of the morally oblique, as at the Elmira Reformatory, New York. The results are now matters of statistics, and are probably in part known to you all. Nothing has been found quite so effective in concentrating the wandering attention of the feeble-minded and in co-ordinating their mental and bodily movements as just this manual activity. In the treatment of the morally oblique, manual training has proved a veritable redeeming force. Dr. Barr, the chief physician at Elwyn, writes me: "The secret of the development of the imbecile lies undoubtedly in manual training. The schools for the feeble-minded in England and on the Continent, recognizing this, have gone far along this line, while we have wasted years in trying to force abstract theories upon mental defectives. Surely a truer thing was never said than 'The working hand makes strong the working brain.'" Mr. Bates, the director of manual training at the Elmira Reformatory, sends me the following striking letter:

"The influence of manual training processes upon the originally selected defectives was so marked that the Board of Managers unanimously decided to increase it so as to take five hundred of the special defectives, classed as follows:

"Group 1 are those mathematically defective, those who fail continuously in arithmetic, failures beginning with 'evening kindergarten,' and continuing into Set 1 and Set 2, in which advanced problems in percentage are taught.

"We find that by manual processes judiciously selected and properly taught, keeping the object in view in each case, we are able to assist men to acquire the necessary proficiency in elementary mathematics to pass in their respective arithmetic sets. I give you in advance of our 1898 yearbook, statistics on that point as follows:

"Out of an actual number of pupils—viz., fifty-eight in Group 1—we have to show graduation of thirty-four, which is fifty-eight per cent—that is, returned to the usual reformatory treatment as susceptible to the conditions governing their release.

"Our second group deals with the men who are assigned for the development of 'self-control,' which comprises by far our largest assignment—viz., two hundred pupils, made up of men who are intellectually bright in most cases, but this intellectuality runs riot, so that they are habitually breaking the demeanor regulations in the institution, and so must regularly be depressed in grade and their time of commitment correspondingly lengthened. We select for such men manual processes calculated to overcome, by the concentration of mind and regularity of muscular movement, the defective element in their nature.

"We are able to show out of an actual number of pupils—viz., one hundred and seven—twenty-three per cent as having been returned susceptible to the reformatory treatment. The moral influence of the manual training department is better observed from this group than any other. We note a particular instance of a man assigned to the manual training from the third grade (incorrigibles), who had committed almost all the crimes known to prison life. After seven months of treatment in Group 2 he was graduated, and has for the past three months been filling one of the most honorable positions attainable in the walls of the prison, and is on a fair road to ultimate parole release.

"Our third division, Group 3, is one to which men are assigned for general 'mental quickening.' These pupils are nonsusceptible to our parole regulations. They have failed habitually in trade school, school of letters, and in some cases in demeanor markings. For this group, out of fifty-one actual pupils we can show twenty-nine per cent who have been sufficiently awakened mentally and physically to be susceptible to reformatory measures and conditions governing their parole release."

According to the philosophy of life which I have tried to present to you, evil is the absence of goodness, cold as opposed to heat, ignorance as contrasted with knowledge. It is a negative quality, and is to be fought as such—not something to be met and dealt with in itself, but something to be met and dealt with through its opposites. This was the view of Socrates, as it was later of Emerson and many other earnest souls. When carried out in any thoroughgoing way, it changes the whole aspect of things. Evil ceases to be the great central fact of philosophy and religion. Ahriman gives up his eternal conflict with Ormuzd. The dualism of the moral world becomes a strict monism; the one force of religion and morality is seen to be righteousness. The voice of religion directs itself less and less against evil—with only the good listening—and more and more to the realization of good. Morality concerns itself less with the things we must not do, and more with the things we must do. It gives us no longer the chill pictures of renunciation, of Anthony, and Simon Stylites, and the rest, living in caves and standing on pillars and doing other useless and foolish things, but glowing pictures of a positive life, warmed with wholesome human passion, and directed to wholesome human ends.

"Whom man delights in, God delights in, too."

And when this morality becomes touched with emotion, when this passion for the perfect life has mixed with it the sentiment of reverence for that goodly company of men and women who have passed toward the same ideal, has mixed with it a sublime faith in the unseen world, in the eternal things that are yet to be—a faith still more the child of knowledge and insight than of ignorance and superstition—then morality becomes religion and the human heart finds peace.

It is in this spirit that manual training accomplishes its moral work. It fights disease by setting free the forces that are health-giving. It conquers evil by the establishment of good. Such a moral betterment results from the betterment of the organic tissue of the brain. If you will look at the faces of the children and the men and women published in such a record as the Elmira yearbook, first when they enter the institution, and then six months, twelve months, or eighteen months later, after they have felt the force of self-activity directed to some good end, you will be convinced, I am sure, that Ormuzd has been at work. And this intellectual betterment of the feeble-minded, and this straightening up of the morally oblique, are the result of definite reactions brought about in the brain tissue, in the tool itself; are organic, and as such are permanent and nonforfeitable.

What is true at all is true in the extreme. We have taken the extreme at the minus end of humanity; let us take now, somewhat more briefly, the extreme at the plus end. Never before, I think, was there such a keen interest as now in the popular and experimental study of the mind. Francis Galton opened the way in such books as Inquiries into Human Faculty and its Development, and Hereditary Genius. There is wide interest in the experimental work of psychologists. Even such morbid books as Lombroso's Man of Genius and Max Nordau's Degeneration attract thousands of readers, as well as the reply that Dr. Hirsch has made in Genius and Degeneration. These studies have concerned themselves quite as much with genius as with the normal and deficient. There is the reservation that the material for study is not so abundant. At Elwyn there are about one thousand deficient children. I think you could not find the same number of geniuses brought together at any one place, perhaps not even at Harvard. The results are, therefore, more meager and more uncertain. There has always been thought to be an intimate connection between genius and insanity, and, as you know, one extreme view is that genius is only a beneficent form of insanity. In most of our State institutions the insane and the deficient are put into the same general class, but in reality they represent the organic extremes. But while insanity and genius stand at the same end of mentality they are not, in spite of Lombroso and Nordau, to be in any way confounded. Both represent an excess of organization, a delicate bit of machinery capable of doing the finest work or of getting the most seriously out of repair. The very fact of genius seems to be made possible only by the disproportionate development of some part of the brain. If this take place and leave the other portions at least normally active, the result is beneficent, and there is no affiliation with insanity. But if such an overdevelopment take place at the expense of neighboring centers, sooner or later there comes an occultation of some of the other powers, and insanity results. In a rough way this explains, I think, the relation between genius and insanity. Both are an overbalance. They have this in common. But genius is an overbalance between the special gift and normal powers, while insanity is an overbalance between high organization on the one hand and deficiency on the other. The examination of brain power shows it to be dependent upon two factors, size and quality. A large brain, full of gray and white matter of low organization, may belong to an intellectual infant. A small brain, composed of highly organized matter, may be the tool of an intellectual giant. In a general way intellectual power seems to be physiologically a function of brain surface. The heightening of organization and increase of surface do not come about as the result of any and every sort of activity. The repetition of an act creates a path of least resistance, until at last seemingly difficult acts become far easier than simple ones that are new and untried. If the repetition proceed far enough, the mental reactions cease almost entirely, and we have automatic action. It is this consideration that makes us spend so much time upon the models used in sloyd and manual training. It is very important to have them properly graded, so that succeeding exercises shall present increasing difficulties. This constitutes a vital difference between industrial and educational training. Industrial work is only practicable where skill is so far automatic as to be utilized with economy of time. But when this takes place, education ends. And this is one of the great reasons why I so warmly disparage industrialism as an ideal of life. It produces, and must produce, fragments of men and women, automatic machines, instead of complete men and women open and ever open to new influences. I mean some time to develop this thought, and to show that in our choice of vocations, even intellectual, and the tenacity with which we stick to them, we practically put an end to our own growth, and rob ourselves of the most complete manhood and womanhood. And I mean to recommend that we make life itself educational, and that we undertake a rotation of related vocations just as our farmers do a rotation of crops. They could undoubtedly hoe corn more economically if they did nothing else, but the thing is that the ground would not stand it, and the crops would get smaller and smaller while the hoeing was growing more and more efficient. We can work more economically by sticking to our last, but the thing is that the spirit will not stand it, and the good that flows out of our shoemaking grows less and less, even though our rate increases.

There is a striking parallel between these reactions and the reactions that follow upon pain and pleasure. Those of you who have experienced grief and suffering know that the terrible thing about it is its monotony, its dull monotony, a monotony so terrible that if it continues too long it leads to despair and to the paralysis of feeling and action and thought. But the main characteristic of joy is its diversity, the wide range of its expression. To the lover—I am told—earth and air, sea and sky, reflect his happiness, and out of the quickening power of the greater sentiment have come the greater works. To fancied pain we owe the morbid and sickly pictures of our literature, but to satisfied love such delights as the Spring Symphony.

And so I believe in happiness, not alone as the only defensible ethical end, but also I believe in it organically, educationally, as an element essential to the best educational training, for out of it spring life and performance, and the fullness of life. In an age of too great pain and suffering, we do not want the gospel of endurance. We want the gospel of joy and health, the gospel of *good* tidings. It seems to me a ghastly thing, psychologically, morally, emotionally, to offer the deadening ideals of renunciation in place of the quickening ideals of a noble self-realization; in place of life, paltry excuses, buried talents wrapped up in the napkins of resignation.

But to return to our genius, who has been wondering, I am afraid, what was to become of him. I have wanted to point out that monotony and unhappiness do not make for that brain structure which is the tool of genius. In the genius we have the other extreme, a highly sensitive and highly organized brain tissue, and along with this complete organism, as an essential part of it, a marvelous power of movement. I doubt if there is such a thing as dormant genius. It is bound to express itself, to do something. This expression has to be in terms of the outer world, has to be through the medium of the bodily faculties. Genius means, in fact, the seeing eye, the feeling hand, the hearing ear. It means infinite patience exerted through action. Genius expresses itself through art, whether it be the art of action, in engineering, exploration, statesmanship, or the art of creative work, in painting, sculpture, architecture, music, and literature. This requires a high degree of activity on the part of the senses, and a very true and sound activity. Even the most immaterial of these expression forms of genius, literature, is dependent for its triumphs very largely upon the accurate report of the senses. Think of the alertness and the power of observation shown by Homer and Shakespeare. Nature has by no one been so accurately reported as by the poet and the *littérateur*. Do you remember that touching little scene in Cranford, where the old ladies go to see the yeoman farmer, and he shows them his garden, and tells them that he never knew the ash bud was black until it was pointed out to him by a young poet, a certain Mr. Tennyson? And here in our midst, Thoreau and Burroughs and John Muir have brought Nature nearer home than all the microscopes imported from Germany.

In most of the expression forms of genius the senses play an all-important part. They must not only report accurately, they must operate together accurately. Think of the part played by the eye, the hand, the ear in the fine arts of painting, sculpture, architecture, music. These artists of whatever field, these men of genius, can do things that other men can not, things finer, truer, quicker.

The biography of genius makes it very clear that along with the highly sensitive brain organization goes a power of co-ordinated bodily movement not found in those less favored of the gods, just as a study of the deficient classes makes it very clear that along with a poorly developed brain tissue goes a pitiful lack of co-ordination in the bodily movement.

One can not, I think, look these results squarely in the face—results from both extremes of the intellectual scale—without accepting the middle ground as well. A well-developed brain organism is always accompanied by well-developed sense powers, and the senses can not be well developed without a corresponding increase of brain power. It is then both an actual and a possible result of manual training that through the cultivation of the sense faculties comes an increased power of the organism; and through this one comes into more complete control and possession of one's self—becomes, in fact, a more evolved and more moral being.

I would not claim too much for manual training. It does not pretend to make deficient boys clever, or average boys geniuses; but it does make deficient boys less deficient, and average boys more clever.

From this renovated self spring enlarged ideas of one's relations to other individuals. Manual training fosters individualism, and I have long suspected this to be the only *social* creed, despite the taunting cry of the opposition, "Every man for himself." Increased personality, deepened individuality, mean increased and deepened respect for the personality and individuality of others. I find as an actual result of manual training that one is less and less willing to enjoy things at the expense of others or to be waited on by others; less willing, too, to serve others in ways that are not worthy; quite willing to show others how to serve themselves. Increase of personal power means increase of self-poise and self-sufficiency. It does not, however, mean a smaller sympathy. On the contrary, the more evolved imagination makes possible a larger sympathy. Mr. Fiske has successfully shown that much of the cruelty and inhumanity of the world is due to lack of imagination, and inability to picture another's point of view or to put one's self in another's place. But I want you to mark especially that the quality of the sympathy fostered by manual training, or by individualism, whichever you choose to call it, is somewhat different from the current ideal of sympathy. It is sympathy with joy and strength rather than with pain and defeat. In this it is somewhat stoical. I do not mean that individualism is indifferent to the woe of the world, or that it is insensible to the too real *Weltschmerz*, but it is more given to set to work to cure the woe than to drop a tear over it. A thoroughgoing individualist—and I detect in manual training a tendency to produce these—does not ask sympathy for himself in suffering. If it is preventable, as much of the suffering caused by illness is, he finds better consolation in the attempt to lead a saner life. If it is not preventable, if it is suffering that in the present order of things must be, such as the loss of a dear friend by death, the coming on of old age, the gradual decay of one's powers—and these are real tragedies—he would endure these things in silence, and ask rather that you rejoice with him over the good that is universal and eternal; and what he would ask for himself he would naturally give to others—comradeship and broad sympathy, but seldom tears.

There is another result of manual training which I may perhaps only hint at, but which I believe to be very real. It is the social conscience which springs out of individualism. Do you know that in this free land of ours we have millions of people who are only nominally free? The suffrage does not make one free, and the women, I am sorry to say, have not even the suffrage. There are millions of people, domestic servants, laborers of the field and mine, the factory and store, who are, as Helen Campbell has well called them, the prisoners of poverty. And these men and women, and too often children, are leading bare and stunted lives that no amount of well-being on the part of the upper classes and no amount of public achievement can socially defend or justify. A great blot upon the glorious civilization of Greece was that it was built up on human slavery. Our own civilization rests upon foundations too similar. We have a small privileged class, cultured, or pleasure-seeking, or both, living upon the Grecian foundation, upon the labor of others. Through interest, rent, taxes, royalties, land tenures, and monopolies of many names, these people are removed from productive labor. But they must all be fed and clothed and housed, and this luxuriously. Do you realize how this is done; what it signifies in human flesh and blood? It means, my friends, that some one else is doing it for them, that for each man and woman and child living in idleness, men and women and children, with needs as exigent, and capabilities ultimately as great, and hearts as hungry, are getting less than human allowance. I should be sorry to make this picture more pitiful than it is, or come anywhere near the boundaries of the melodramatic, but I can not walk the streets of our great cities, I can not turn north, or south, or east, or west, without confronting faces and figures that speak so hungrily of unappeased human need, that tell me plainer than any words could ever do that we are living in an age of low social ideals, that the social sensitiveness and the social conscience have yet to be aroused. I used to lay comfort to my heart by contemplating those great and glorious economic laws of supply and demand, production and consumption, the division of labor, and the other gods of wood and stone and brass that society has reared its altars to. I fancied that it was the function of the more fortunate classes to think for the rest and to lead. But it was an impious thought. One could as logically defend the most complete priestcraft. Why should men pray to God if this company of better-versed supplicants stand ready to pray for them?

It was this thought of what I myself might become, this picture of the complete man that might be aroused in me, that awakened me to the needs and the capabilities and the hunger of others. And I count it as one of the most precious of the actual results of manual training that in developing a most intense individuality in those who come under its influence, it fosters no less surely a sincere respect for the sacredness and individuality of others. I can not say that manual training has developed any specific social creed. But it has done this: it has created a profound and rational discontent with the present social *régime*, and has prompted a practical desire to set men free. It is not revolutionary. It sees in the present enginery of society a means for its liberation. In time this thought will flower into beneficent action.

The process of evolution is the rationalization of the world. With the passing of the centuries what is capricious, grotesque, impossible, slowly falls away, and there emerges a world of rationality and of order. The transforming power has been the continuous growth of the idea of causation. As this power lays firmer and firmer hold upon the minds of men, they become as gods, knowing good and evil, and pressing nearer and nearer to the life that is immortal. One can not live in such an unfolding world, revealed to him through the experiences of his own inner life, without feeling anew the sentiment of wonder and of worship, without possessing a sublime faith in the things that are and are to be. It is not a specific creed, but in it abides the essence of all religion, and in it one's relations to Nature and to the Supreme Intelligence are to be sought and found.

It has been the custom of many of the manual training schools to preserve a careful record of their graduates, and you will find in these records the most practical testimony available of the actual results of manual training. Dr. Woodward, the director of the St. Louis school, and one of the fathers of manual training in America, has given many individual records in his two books, The Manual Training School and Manual Training, especially in the former. The results quoted are mainly industrial, but they are nevertheless of high interest from an educational point of view. Some of the schools publish records of their graduates in their current yearbooks. I found, for example, in my own school that one third of the graduates were in universities and other institutions of higher learning; that one third were engaged in technical work opened to them by the special training of the school; and that the remaining third had gone into trade, had taken miscellaneous posts, or were still unsettled as to a career. The latter number was always small, and there were particular moments when less than one per cent of them were unoccupied. The records made by the graduates at college have been excellent. Three of the Philadelphia boys have held fellowships at Harvard, one in philosophy and two on the Hector Tyndale foundation in physics. It was noticeable, as I mentioned before, that the colored boys seldom graduated. They worked under many disadvantages of poverty, and later of race prejudice outside the school, and I should therefore not wish to draw any unfavorable conclusions from their failures. Those of mixed blood, especially Indian or West Indian, were sometimes very clever, and became quite skillful; but the full-blooded Africans were less successful, and I have come to think that they ought to be taught apart and at less speed.

It was also noticeable that the Jewish children were quite clumsy with their hands. So much was this the case that the instructors in the manual departments came to make allowance and to set a different standard for their work. It is quite explainable, I think, since the Jews as a people have been forced by circumstances into commerce and banking, and have been for centuries practically excluded from manual occupations. I mention it as an interesting racial result, and not at all by way of discouragement. I feel that the Jewish people would be very wise to persevere in their present brave attempt at manual development. Nor was the best manual work always done by the children of mechanics. Often it was done by the sons of musicians and other professional people, and even by the sons of business men. It would, I think, be more to the point to inquire into heredity on the mother's side, since boys more frequently resemble their mothers, but this is less practicable.

The Chicago Manual Training School, the oldest independent manual training school in America, publishes an interesting summary of the occupations of its graduates. Out of a total of 568, 158 are in college or higher schools, 66 are in manufacturing establishments, 48 are engineers, 52 are superintendents and managers, 33 are lawyers, teachers, or architects, 133 are in trade, and the rest at miscellaneous work, unknown, or dead.

The catalogue of the Philadelphia Central School contains the following paragraph:

"An examination of the records of the six hundred and fifty graduates reveals the fact that the claims made by the school as to its practical value in gaining a livelihood are fully substantiated—about seventy per cent being engaged in those pursuits in which a high order of intelligence as well as skill of hand are required. Already a large number occupy positions of trust and responsibility—as superintendents, managers, foremen, etc. That the school fosters a desire for higher education is shown in the fact that about twenty-five per cent of the graduates are students in colleges, universities, or technical schools."

These actual results are much the same in every manual training school in the land. They show increased power on the part of the graduates, and a practical ability to take care of themselves. And yet in quoting these results I am reminded of the little girl who said, when her drawings were highly praised, that they were not her best. She was urged so warmly to show the rest that she finally explained that her best drawings had not yet been made. These actual results of manual training are good, practical results and are most encouraging, but the best results of which it is capable have not yet been brought out. We stand only on the threshold. But in these large possible results I believe just as firmly, and I do so because I believe in cause and effect, believe that what you sow you reap, that beneficent causes are surely followed by beneficent effects.

Mr. Dewar has succeeded in liquefying hydrogen at a temperature of $-205°$ C., under a pressure of one hundred and eighty atmospheres, obtaining the liquid in considerable quantities. Previous to his experiment, M. Cailletet had reduced hydrogen to the condition of a fog, and another experimenter had obtained a few drops of the liquid, but had never been able to perceive a meniscus separating the liquid from the gas. In Mr. Dewar's experiment the liquid flowed and was collected in specially constructed vessels, to the amount of fifty cubic centimetres. Liquid hydrogen is colorless and very transparent, with a considerable index of refraction and a density superior to the theoretical value. It presented no absorption spectrum, and condensed air, which at the temperature of the experiment passed into the solid state, and fell as a snow to the bottom of the liquid. Wadding dipped in the liquid and exposed to a flame burned without deflagration. Placing a tube filled with helium gas in the liquid, Mr. Dewar obtained liquid helium.

THE CASE MOTHS.

By MARGARET T. D. BADENOCH.

IT seems an incontrovertible fact in natural history that there is not a single character which has been used to distinguish any group of considerable extent from which some one or more of the members thereof may not depart. In that great division of the animal kingdom characterized by the possession of articulated limbs, many species are met which are entirely wanting in those organs, and, similarly, the secondary division of the *Annulosa*, marked by the presence of wings in the final state—the *Ptilota* of Aristotle—contains species that, throughout life, never acquire instruments of flight. Of wingless insects, indeed, examples might be drawn from most of the orders, and in the majority of cases the females only are thus deprived. Rarely, however, both the great characteristics are absent. Yet certain moths do not possess articulated feet in the wingless state.

Consequently, if we took into consideration merely the adults of these females, this group must be regarded as among the most degraded instances of apiropodous insects. But such a conclusion can not be maintained, as shown by an examination of the early stages of the moths, for these, we find, exhibit as high an amount of organization as those of any of the other insects appertaining to the order. The truth is, these females have become degenerate—very different from the creatures they once were. Their peculiarity consists in this, that whereas, as a whole, winged insects always undergo a gradual evolution of structure, by which ultimately legs and wings are developed, these individuals gradually lose their powers of evolution, and not only this, but suffer a process of deterioration, by which the limbs which they at first possess diminish, and at length dwindle altogether away, until the animal becomes a mere short, inert vermiform bag, having not only no distinct trace of legs and wings, but also the sense-organs, the antennæ, and the organs of the mouth are almost or entirely obliterated, and even the articulated condition of the body has almost disappeared. In these extreme forms it is hardly possible for the degeneration of the female to proceed further, and in all, doubtless, the change has occupied an immense period.

Than these extraordinary moths, familiar to German entomologists under the name of *Sackträgers*, perhaps no more curious and interesting examples occur among the whole of the insect races; certainly in structure of the female, and in habit, they are the strangest and most abnormal of all *Lepidoptera*. They belong to the *Psychidæ*, a portion of the remarkable silk-spinning family of the *Bombycidæ*, but offer many points distinct in themselves, which entitle them to rank, as recent lepidopterists agree, as a separate and well-defined tribe.

Their geographical distribution is extensive, since they are found in Europe, in North and South America, the West Indies and Mexico, in northern India and Ceylon, in China, the South Sea Isles, and Australia, being most abundant in subtropical regions. Wonderfully few species are described as natives of the United States, while in California, unfortunately, three have been discovered solely in the larval state, the more mature conditions of the species as yet eluding detection. But there, as in various other parts of the globe, probably greater numbers await the industry of observers.

Among English-speaking folk, the common appellations for the moths originate in the same circumstance as the popular term in Germany — house-builders, sack-bearers, basket-carriers, basket-worms, case moths; by these names they pass in England, America, and Australia, on account of the singular habitations or sacks they weave for the well-being of the caterpillars in the early stages of their growth. Through the whole of their larval life they carry the protecting structure about with them; and as regards the apterous female, she never leaves this home in which she dwelt while in larva—one of the oddest incidents in this odd economy—but reaching maturity, and bringing forth her young, dies at last, without once quitting her self-constructed prison. She deposits her ova, an immense number, within the body of the case, closely enveloped in some species in a short silky down, and almost as soon as hatched the larvæ force their way out of the puparium which had served for the defense of the eggs, deserting their early abode, and going into the world to follow independent lives. Escaping in crowds from the lower end of the tube, to some twig or leaf, they immediately commence to prepare for themselves each a separate case, arranged in every respect as the larger ones, even before they have taken food.

Particles of wood or bark, leaves, sticks, straws, lichens, mosses, and other vegetable substances form, among the different species, the outer covering or decorative fortification of the house; the interior is lined with soft silk, and interwoven silky threads likewise bind together the external fragments. In the building materials chosen, and their arrangement, *Metura elongata* is a most interesting architect. Strengthening the large elongate ovate bag of silk, and worked into it, irregularly, numerous rows of short sticks appear, rather distantly separated, and about half an inch long, generally speaking, but toward the lower end there are usually several sticks from one to four inches long, in the center of which the lower end of the silken bag protrudes, free from sticks and very flexible; it has a charming silky softness, and is of a gray, ash, or mouse color; of this beautiful tissue the upper or head extremity is also composed, forming a tube half an inch wide.

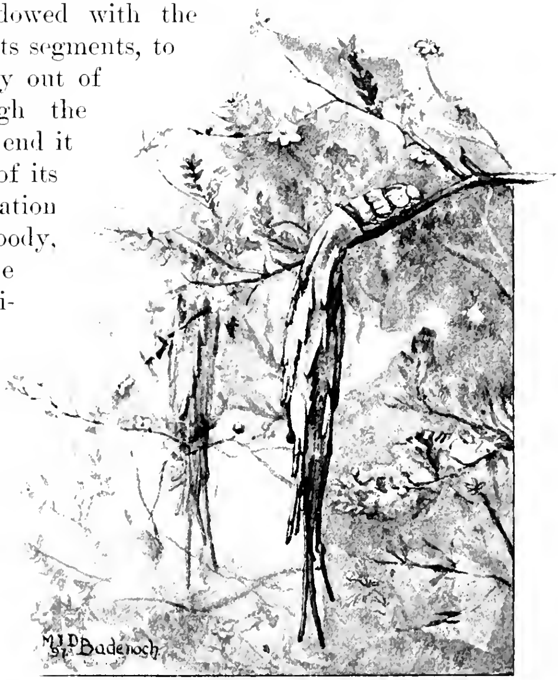
As a larva grows, needing more accommodation, it splits the habitation at the sides, weaving into the opening portions of the vegetable substances selected, and adding to the exterior fresh pieces of stick, straw, or leaves, as it requires. So with Saunders's case moth, when any accident happens to the nest, the caterpillar, with incredible expedition, repairs the damage received, employing the same silky stuff to fill up the hole, and with a nicety so perfect that the severest scrutiny can not detect what was the extent of the injury.

Under the protection, then, of the substantial and somewhat formidable case the larva lives. At each end there is an opening, and through the anterior one it emerges to feed and change its position. Commonly it only protrudes the head and the first three or four segments of the body, or sufficient to use its six true legs for locomotion when feeding; and if wishful to remain quiet, it usually takes the precaution of fastening a portion of the edge of the aperture by fibers of silk temporarily to the branch upon which it is, that, if alarmed, it can suddenly recede completely into the case, very rapidly drawing in the flexible part after it, by means of its mandibles and fore legs, and contracting the aperture, so as to exclude all enemies; thus hid, it stays in security, suspended only by a few threads. Were the nature of the hanging, tight-closed, strong, tough sack unknown, it would never be suspected of containing an active, voracious larva. Exceedingly wary and timid are these insects in retreating at the approach of danger. On a desire for removal the suspending threads are bitten off close to the case.

As long as the caterpillar is small, and the house of no great weight, it is borne nearly erect; but soon, as a rule, the incumbent mass lies flat, owing to increased weight, and is dragged along in that attitude. The abdominal and anal legs of the larva are furnished with a series of small points or hooks, with which it moves in the tube, laying hold of the interior of the lining, to which it can adhere with great pertinacity; so firm the hold retained, it is impossible to remove the creature without injury.

Having attained full growth, and being about to change to pupa, the larva of *Metura Saundersii* firmly fixes itself, by means of silken fibers spun for the purpose, to a branch or trunk of a tree, or paling, drawing together and permanently closing the head opening. It reverses its position in the case, so that the head is where the tail used to be—pointed toward the posterior or unattached end—and envelops itself in a soft silken cocoon of a yellowish color; allowing itself to hang perpendicularly, head downward, it awaits the pupal sleep.

From the facts just stated it need hardly be said that, when the time arrives, the perfect insect emerges from the posterior portion of the tube. At this particular time the male pupa becomes endowed with the power of stretching out its segments, to enable it to work its way out of the extremity. Through the opening of the posterior end it pushes the anterior half of its length, by a slight elongation and contraction of the body, which, with the assistance of a transverse series of minute sharp spines or hooks, directed backward, on some of the segments, is in this way forced out head foremost, in like manner as the pupæ of the goat moths and the large swifts are made to emerge from timber and the earth when the moth is ready to escape. The pupæ are prevented from being thrust entirely out of the case by two strong anal hooks. After the issue of the imago the segments remain in their stretched-out condition; cases having belonged to males are often seen with the empty pupa skin sticking rather more than half out of the lower aperture, hanging head downward, as left by the moth.



The males of these moths are swift fliers, of extraordinary activity, dashing themselves wildly, almost to pieces, among the branches of the trees. A fiery little creature has no sooner arisen from his pupal slumber than he begins his violent fluttering, and as the wings are delicate in structure, in many instances nearly transparent, his beauty has generally disappeared before the entomologist can secure him; therefore specimens in good order are rare in collections.

With slight exception, we find no homogeneousness in the perfect state of the insects of this group, but much variation of form presented by the different species. The general shape of the body varies from one greatly elongated, as in *Metura elongata*, to a short and robust as well as to a short and slender form. In like manner the wings vary from a long, narrow, and sharp-pointed wing, as in *Metura*, to those of short, broad, and ample proportions; and, again,

may either be densely squamose, or colorless, of beautiful hyaline texture, almost or completely destitute of scales or hairs. The antennæ may be deeply pectinated only at the base, in others they are feathered to the tip, and in the number of joints offer striking variations. But the males of nearly all *Psychidæ* are characterized by a uniform dull dark color, of a brown or gray tint; there is an almost total absence of bright color or of pattern. Yet these moths are in nearly all cases day-flying. Probably the beauty of the males disappears when the females become degenerate, and the conditions which produced it are then at an end.

The larval cases of these moths are among the "common objects" in Australia, meeting the eye everywhere suspended to trees and shrubs, such as the different kinds of *Leptospernum*, *Melaleuca*, etc., by their anterior end, and swinging loose otherwise. When unusually abundant, so as to look like a good crop of some seed or fruit, the pendent berths are particularly conspicuous, and attract the attention of the least curious of mortals. The most striking examples of the group belong to *Metura Saundersii*, whose cases are sometimes over five inches long; those of the male are one third smaller.

Considering this abundance, the insects are singularly rare in the moth state; not one case in a hundred will be found to produce a moth, owing partly to the destructive effects of attacks on the larvæ of ichneumonideous and dipterous parasites. From the same cause, nothing is harder, nay, more nearly impossible, than to rear these creatures in confinement; the caterpillars of a species may be collected persistently for years, and watched with incessant care, and yet never reach the perfect stage; hence there are already imperfectly known species of which the more mature conditions await discovery; and when success does attend our efforts at protection, many examples are probably observed of the depredations of the insidious parasites. Not that failure to attain perfection is always due to infestation of parasitic insects, as undoubtedly the somewhat ponderous houses of the larvæ render them to a high degree impervious to the onslaughts of insect enemies; the cause of death must be looked for elsewhere. Death usually occurs after the larva has undergone metamorphosis, the pupa gradually shriveling up after assuming its proper form, nor can anything be done, apparently, to avert the calamity.

To return to the case moth's metamorphoses. The female insect, as we have seen, unlike the male, is destined never to desert the larval home. For her no hour of emergence ever comes. When the pupa has slept the appointed time, the unwieldy and almost motionless moth feels little of the movement of oncoming life then experienced by her lithe and lively partner; the animal, still resident within the habitaculum formed by the larva, splits asunder the pupa skin, and her transformations are complete; in some, at least, of the species the female imago is continually inclosed in the pupa case. Here, therefore, we have an insect which in its adult state is forever excluded from the light, and never even beholds its mate.

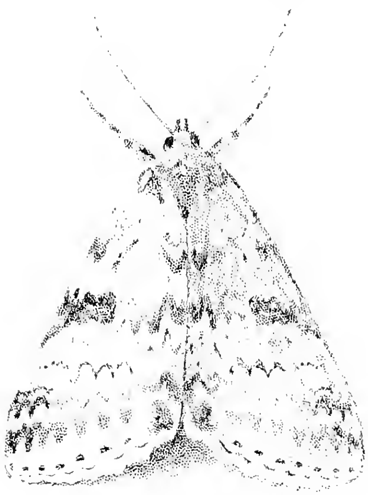
Having filled the bottom of their puparium with their ova, packed in the down rubbed from their own body, these females do not long survive. The moth is then literally nothing but thin skin. Reduced to a shriveled, dried, and scarcely animated morsel of this matter, she either presses herself through the opening of the case or, exhausted, the last feeble flicker of life burned out, expires within.

A GAME OF HIDE AND SEEK.

By CLARENCE MOORES WEED.

NOTHING illustrates more vividly the change which has taken place during the present century in the attitude of naturalists toward the objects of their study than the colors of plants and animals. To the dried-specimen systematist of a hundred years ago color was an immutable factor in Nature. The delicate beauty of the butterfly, the iridescent hues of the paradise bird, the tawny stripes of the tiger, the somber shades of the reptile, the whiteness of the lily and the redness of the rose—these and the myriad other color phases in the living world were believed to exist now as the Creator designed them a few thousand years ago. To the naturalist they were chiefly valuable in enabling him to separate species from species in dreary Latin tomes. To the theologian they served to show the goodness of God in adorning man's passing abode. To the artist beauty was its own excuse for being.

But there were not wanting interpreters of Nature who saw that in many cases colors were useful to the organisms possessing them. Sprengel expressed his belief that the colors of flowers served to attract insects which aided in the fertilization of the seeds. Other observers showed that dull hues in animals might assist a persecuted species to escape from enemies, or a persecuting species to steal upon prey. Such views were at once utilized by the promoters of the celebrated "argument from design," who contended that these creatures were so made when created, the useful coloring being conclusive evidence of a designing intelligence on the part of the Creator. In those days all paths in the fields of science led to the domains of theology, where it was unsafe to wander without the guidance of a keeper appointed by the church. To this individual puzzling problems were easy of solution: "God intended it so, and who shall dare to question the actions of Infinity?" Natural phenomena were given supernatural explanations which were accepted in a way that seems incredible to us to-day. But gradually the law of parsimony in logic—the law which in this case directed that when a phenomenon can be explained in natural terms, we must not appeal to supernatural ones—became accepted, and reasons that had long held good were rejected as worthless. The hold of dogmatism and priestcraft upon science gradually relaxed as the church meddled less in secular matters and religion became an affair of the heart rather than of the intellect.

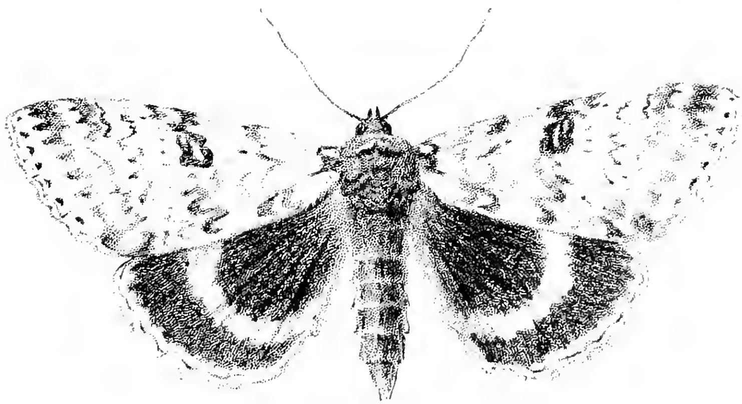


Catocala Moth at Rest.

It is one of the triumphs of biology—the youngest of sciences—that she has already given an adequate explanation for the existence of most of the phases of animate color. We all now know that the colors of flowers exist, as Sprengel believed, to attract insects, and that insects are attracted to insure cross-fertilization—a fact of which Sprengel was not aware. All the world is familiar with accounts of mimicry—"the imposture of Nature"—as well as of protective and aggressive resemblance. Nearly every one has seen pictures of the kallima insect, which when in motion is a gaudy butterfly, and at rest becomes a dry and withered leaf; or of the various leaf insects and stick insects of the tropics. Many of us have seen in imagination the puff adder which Professor Drummond did not sit upon in the wilds of Africa, or have watched with Forbes the bird's-dropping mimicking spider of the eastern archipelago. We have also followed Bates and Wallace along the Amazon, or Belt in the wilds of Nicaragua, as they studied the tropical butterflies which mimic each other so strangely.

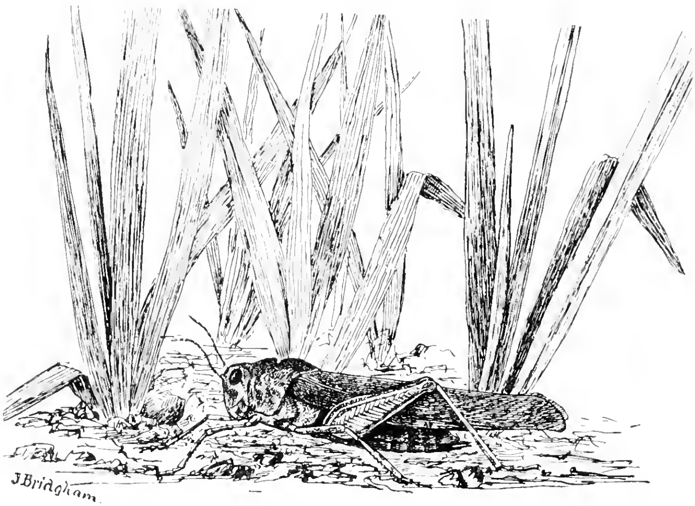
The fact that most published accounts of mimicry and protective resemblance deal with animals of tropical countries has led to a general impression that to observe these curious color phenomena one must travel to out-of-the-way places; that the creatures about us are commonplace and uninteresting. But to the seeing eye and the attentive mind there are as many facts of interest in a stroll through northern woods as through the Everglades. Richard Jeffries and John Burroughs found in England and New York most interesting phases of tropical life, and had besides the exhaustless treasures of their temperate out-of-doors to draw upon. The tropics are full of strangeness to northern eyes, and possess many phases of life that seem wonderful to unaccustomed minds. But the luxuriance of vegetable life is almost oppressive; it is always in full glory; one does not see the bursting buds and the greening leaves because the full foliage overshadows all else.

The animals of the north show numberless color phases of interest. One of the most curious of these is exhibited by several families of insects in which the outer wings are protectively colored in dull



Catocala Moth in Flight.

hues and the under wings brightly colored. For example, there are many species of moths belonging to the genus *Catocala* found throughout the United States. These are insects of good size, the larger ones measuring three inches in expanse of wings, and the majority of them being at least two thirds that size. Most of them live during the day on the bark of trees, with their front wings folded together over the back. The colors and markings of these wings, as well as of the rest of the exposed portions of the body, are such as to assimilate closely with the bark of the tree upon which the insect rests. In such a situation it requires a sharp eye to detect the presence of the moth, which, unless disturbed, flies only at night, remaining all day exposed to the attacks of many enemies. Probably



CAROLINA LOCUST AT REST.

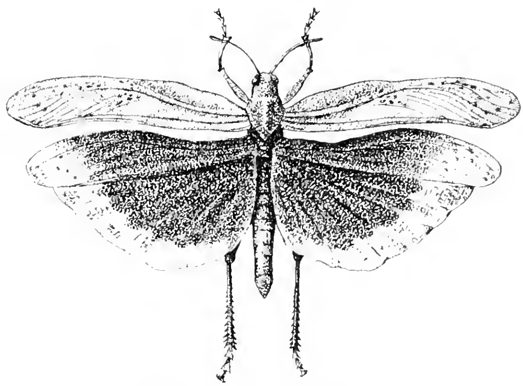
the most important of these are the birds, especially species like the woodpeckers, which are constantly exploring all portions of the trunks of trees.

The chief beauty of these *Catocalas* as they are seen spread out in the museum cabinet lies in the fact that the hind wings, which, when the moth is at rest in life, are concealed by the front ones, are brightly colored in contrasting hues of black, red, and white in various brilliant combinations. These colors, in connection with the soft and blended tones of the front wings, make a very handsome insect.

To explain these colors many suggestions have been made. The protective hues of the upper wings are easy to account for by accepted biological theories, but the bright colors of the under wings have presented more difficulties. Some biologists have supposed that the latter were without special significance, being produced by the tendencies of the insect to bright colors—the tendency not being kept down by the eliminating factors which would operate in the case of exposed portions of the body. On this principle Mr. Beddard would "expect that bright coloration would be the rule rather than the exception among nocturnal insects, for, however bright and varied, the colors would be invisible at night and could do their possessors no harm or good," an ingenuous assumption characteristic of many of the pages of that naturalist's recent book, in which the attempt to keep on both sides of the Darwinistic fence has left the author very much astraddle. Another English naturalist, Professor Poulton, has suggested that the bright under wings lead the pursuing bird to catch the insect by them, the wing membrane giving way without serious injury to the moth. But this seems to me a strained and inadequate explanation, much less satisfactory than the one afforded by the suggestion of another celebrated English entomologist, Lord Walsingham, who in a presidential address before the Entomological Society of London delivered the following passages:

"My attention was lately drawn to a passage in Herbert Spencer's Essay on the Morals of Trade. He writes: 'As when tasting different foods or wines the palate is disabled by something strongly flavored from appreciating the more delicate flavor of another thing afterward taken, so with the other organs of sense a temporary disability follows an excessive stimulation. This holds not only with the eyes in judging of colors, but also with the fingers in judging of texture.'

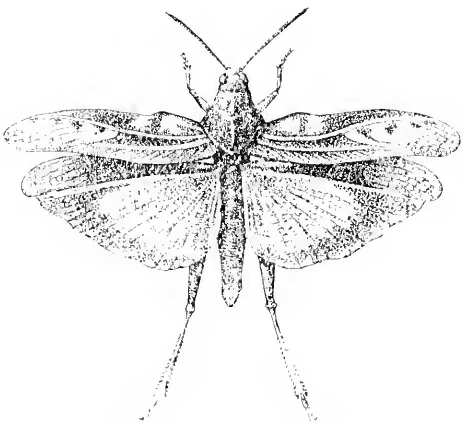
"Here I think we have an explanation of the principle on which protection is undoubtedly afforded to certain insects by the possession of bright coloring on such parts of their wings or bodies as can be instantly covered and concealed at will. It is an undoubted fact, and one which must have been observed by nearly all collectors of insects abroad, and perhaps also in our own country, that it is more easy to follow with the eye the rapid movements of a more conspicuous insect soberly and uniformly colored than those of an insect capable of changing in an instant the appearance it presents. The eye, having once fixed itself upon an object of a certain form and color, conveys to the mind a corresponding impression, and, if that impression is suddenly found to be unreliable, the instruction which the mind conveys to the eye becomes also unreliable, and the rapidity with which the impression and consequent instruction can be changed can not always compete successfully with the rapid transformation effected by the insect in its effort to escape."


CAROLINA LOCUST IN FLIGHT.

Lord Walsingham goes on to suggest that this intermittent display of bright coloring probably has as confusing an effect upon birds and other predaceous vertebrates as upon man; and that on this hypothesis such colors can be more satisfactorily accounted for than upon any other yet suggested.

This explanation is easy to understand and gives renewed emphasis to the oft-repeated statement that nothing in Nature is without significance. In the case of the *Catocala* moths one readily perceives that when driven to flight by a woodpecker or other bark-searching bird a moth which shows during a rapid irregular flight bright colors, and then alights, hiding the colors and instantly assuming entirely different hues, blending with the surroundings, would stand a better chance of escaping from a pursuing bird than a moth which had no bright colors with which to confuse the bird and prevent its seeing the place where the insect alights.

These insects are excellent illustrations of the combined action of the various forces which Darwin classed together under the term "natural selection." The factors involved are three—multiplication, variation, elimination. In nearly all organisms more young are produced than can mature. In these young there are infinite variations in all directions. Some of these variations fit the individuals possessing them better to the conditions of life than variations in other directions. Consequently, the possessors of the latter will be eliminated in the struggle for existence and the former will escape elimination, and mature to reproduce. Their young will in part at least inherit the favorable variations, and thus have an advantage which will lead to their reproduction. Thus there is an ever-increasing tendency to a more perfect adaptation to environment.



CORAL-WINGED LOCUST IN FLIGHT.

On the rocky hills and sandy plains of New England there are several species of grasshoppers or locusts that also illustrate these principles. If you walk along a strip of sandy land in summer, you start to flight certain locusts which soon alight, and when searched for will be found closely to assimilate in color the sand upon which they rest. On a neighboring granite-ribbed hill you will find few if any of this species of locust, but instead there occur two or three quite different species, which when at rest closely resemble the lichen-covered rocks. This resemblance is very striking, and is found in all stages of the insect's existence. If now you go to a lowland meadow, still another color phase will be found to prevail—the green grass is swarming with the so-called "long-horned" grasshoppers, which are green throughout, with linear bodies and long, slender legs and antennæ.

Each of these three groups of insects is adapted to its particular habitat. All are constantly persecuted by birds, and have been so persecuted for unnumbered ages in the past. In every generation the individuals have varied, some toward a closer resemblance to environment, others in an opposite direction. The more conspicuous insects have been constantly taken, and the least conspicuous as constantly left to reproduce. Were the three groups to change places to-day, the green grasshoppers from the meadows going to sandy surfaces, the sand-colored locusts going to rocky hills, and the "mossbacks" from the hills to the lowland meadows, each would become conspicuous, and the birds would have such a feast as is seldom spread before them.

The species living on sand and rocks are often "flushed" by birds. Those which flew but a few feet would be likely to be captured by the pursuing bird; those which flew farther would stand a better chance of escaping. Similarly, those which flew slowly and in a straight line would be more likely to be caught than those which flew rapidly and took a zigzag course. As a consequence of the selection thus brought about through the elimination of those which flew slowly along the straight and narrow way that led to death, you will find that most locusts living in exposed situations when startled fly some distance in a rapid, zigzag manner.

But still another element of safety has been introduced by some species of these locusts through the adoption of the color tactics of the *Catocala* moths. The under wings of the common Carolina locust—the species most abundant along the highway—are black, bordered with yellowish white. The base of the hind wings of a related species living on the Western plains is bluish, while in the large coral-winged locust of the Eastern States the hind wings are red, bordered with black. In nearly all of the species of these locusts frequenting open localities where they are liable to disturbance by birds or other animals, the hind wings exhibit contrasting colors in flight. Most of them also fly in a zigzag line, and alight in a most erratic manner. Many times I have had difficulty in determining the exact landfall of one of these peculiar creatures, and I believe Lord Walsingham's suggestion is well exemplified in them.

CHRISTIANIZED MEGALITHIC MONUMENTS.

By M. ADRIEN DE MORTILLET.

WE possess now more precise and more scientific data concerning megalithic monuments than those which we had before they were studied and explored methodically. We know that the dolmens, whether still covered with a tumulus or stripped of the envelope of stone or earth which formerly covered them, are simply sepulchral caverns, that they were built in the polished stone age, and that that mode of burial was abandoned at the beginning of the bronze age. While we do not know so exactly for what purpose the menhirs were erected, we have every reason to believe that they were for the most part contemporary with the dolmens. The great antiquity of these rude constructions—monoliths sometimes of imposing dimensions—seems to be confirmed by their being often the subject of very ancient and deep-rooted legends, which have been preserved through ages without material alterations. The recollection of the real purpose of these stones was lost at the beginning of the Christian era, and probably a long time before. Marvelous tales then began to be current, assuming to explain their existence, form, and arrangement. The habit gradually was developed of resorting to them to perform curious rites which have continued or are remembered to the present day. A considerable number of them were held in such veneration that they became clothed in a sort of sacred character, of which it has not always been possible to divest them.

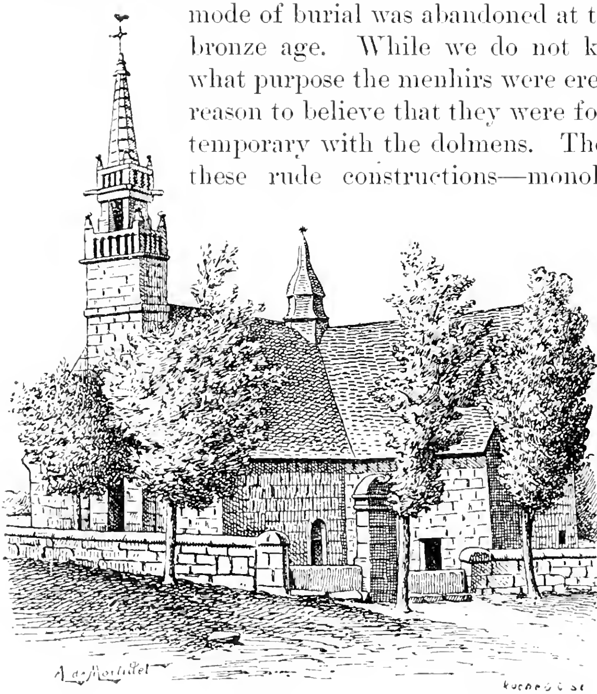


Fig. 1.—Church of the Seven Saints. From the southwest.

When Christianity was introduced into France, it had of course to contend against the old beliefs. A bitter war was declared against everything that might tend to cast the new religion into the shade. Vigorous attacks were made upon superstitions which by their antiquity or the strength of the popular attachment to them seemed dangerous to the early Christians, and in particular against the devotion it had been customary to give to certain stones. A council held at Arles in 452 notified the bishops in districts where this cult prevailed that if they neglected to destroy it they would be guilty of sacrilege. A council at Tours in 567 advised the clergy to exclude from the church all who performed before certain stones rites strange to it. A century afterward, in 668, the Council of Nantes, calling the attention of the bishops and their servitors to venerated stones in retired and woody spots where vows were made and offerings brought, enjoined them to throw the stones where their worshipers would never be able to find them. The Council of Rouen in 689 denounced those who made vows at stones as if they were altars, or who offered candles and presents before them as if some power resided within them that could dispense good and harm. Two councils at Toledo, in 681 and 693, threatened "the venerators of stones" with various penalties. The worship of stones figured in a list of superstitions still in use at that period drawn up in 743 by a council at Leptines, near Mons. These customs were also denounced in royal ordinances and episcopal instructions. A decree of Chilperic in the second half of the sixth century ordered the stone monuments standing in the fields to be destroyed. In the middle of the next century, St. Eloi, Bishop of Noyon, prohibited Christians from performing vows or diabolical ceremonies around stones. We read in the Capitulary of Charlemagne, which was drawn up at Aix-la-Chapelle in 789, "On the subject of stones to which some foolish people come and give themselves up to superstitious practices, we order that this abuse so detestable and so execrable to God be abolished and destroyed." Similar measures were adopted in England. A decree of Edgar in 967 threatened with terrible punishments those who should perform before certain stones practices savoring of their ancient consecration, or who should omit to destroy them. The decree does not seem, however, to have been of much effect. Canute was obliged to renew it in an edict which characterized such worship of stones as barbarous.

The effect of these ordinances and threats was far from complete. The people kept on in their old ways. The church, not succeeding in destroying the reverence in which the megalithic monuments were held, and fearing the wrath of the people if they overthrew them, decided to sanctify them, to put them under the care of the Virgin, and to derive some profit from the worship paid them. It was necessary, as Fréminville says, to resort to pious frauds and senseless modifications.

A considerable number of menhirs have preserved evident traces of efforts made at different times to Christianize them. The Christians were satisfied at first to scratch rude crosses upon their faces. Sometimes, however, more regularity was first given to their shapes by rounding off their tops or marking rough panels on them, and adding to the cross other figures and inscriptions. Many monuments thus treated may be found in Morbihan. The crosses cut upon these stones, particularly in Brittany, generally have the four branches equal. They are Maltese crosses, furnished with feet or braces at the bottom, of very ancient forms—some seeming to be earlier than of the ninth century, and possibly, with their ornaments too, dating from the Merovingian period. Some menhirs have been cut so as to give them a more or less regular form of a cross, and have curious designs sculptured in their faces in intaglio or relief, of certainly quite as remote an epoch.

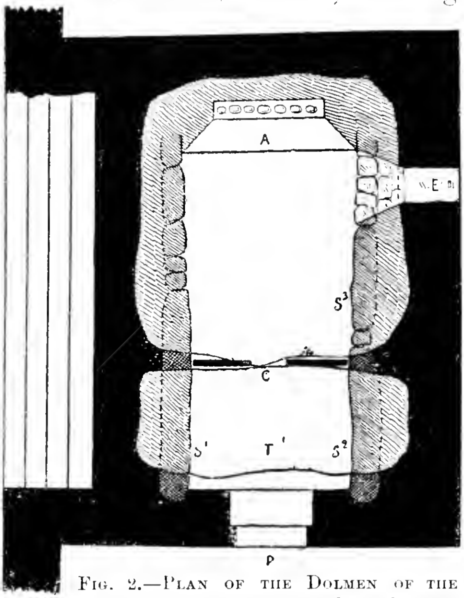


Fig. 2.—Plan of the Dolmen of the Seven Saints. Scale, 1 to 100. A, altar; C, open-work partition; E, ventilator; P, entrance door to the dolmen; S¹, S², S³, supports; T¹, T², tables.

More frequently a cross has simply been planted on a monolith, and instances of the kind are not rare in France. Of these, a cross on the Great Stone at La Rigandière, in the commune of Tour-Landy, (Maine-et-Loire), was erected as recently as 1862. These crosses are of stone or wood; a large wooden cross with a Christ on the *Pierre de Champs Dolent*—a regularly shaped stone more than twenty feet high—has been renewed several times. A number of menhirs dedicated to the Virgin or to saints have been adorned with statues. A menhir in the Isle of Hoëdic, Morbihan, thirteen feet high, which has become an object of pilgrimage, has a niche hollowed in one of its faces to accommodate a statue of the Virgin. The *Pierre Fritte*, in the department of Maine-et-Loire, has a niche containing an ancient statue of the Virgin in painted faïence, inclosed with an iron grating. A large painted wooden statue representing St. Peter, patron of the parish, was placed in 1878 on a granite block twenty-five feet high, in the parish of Pedernec. In the same department of Côtes-du-Nord is a stone picturesquely decorated with a wooden statue of the Virgin reposing, attended by three other less modern statues representing a man and two saints. Numerous chapels have been built at menhirs to receive the offerings of pilgrims visiting them.

The most remarkable of all the menhirs on which the Roman Catholic religion has placed its seal, and at the same time one of the least known of them, is that of Pleumeur-Bodou, department of Côtes-du-Nord—a handsome granite block, solidly planted in the ground, roughly rectangular, about twenty feet high, and topping in an obtuse point. It is rendered particularly interesting by the religious imagery that covers its southern face. The whole upper third of this face is occupied by quaint sculptures in relief, colored in red, yellow, white, and black, representing a complete series of the attributes of the passion of Jesus Christ. There are the purse, red, containing the thirty pieces of silver which Judas received for his treason, and eight of the pieces shown; the cup, yellow, which Jesus handed round to his apostles at the last supper; the sword, white with a yellow hilt, indicating the arms borne by the persons who came to arrest him; the lantern carried by Judas at the betrayal; the sword with which Peter cut off the ear of Malchus; the cock that crowed three times; the post at which Jesus was scourged, with the scourge and rods; the reed which the soldiers derisively put in Jesus' hand as a scepter; the vessel in which Pontius Pilate washed his hands before giving Jesus up to the mob; St. Veronica's handkerchief; the hammer and three of the nails with which Jesus was nailed to the cross; the dice which the soldiers cast for his robe, and the robe; Mary Magdalene praying; the sun and the moon, which were obscured; the sponge with which Jesus was given vinegar, and the lance that was thrust into his side; a skull and bones symbolizing the opening of the tombs when Jesus expired; the pincers and the ladder by the aid of which Joseph of Arimathea took him down from the cross; and the glove in which Nicodemus caught a few drops of Jesus' blood while burying him. Beneath these figures was depicted a large Christ fixed on a red cross, with a dark background standing for a cloth, five feet by eight. The

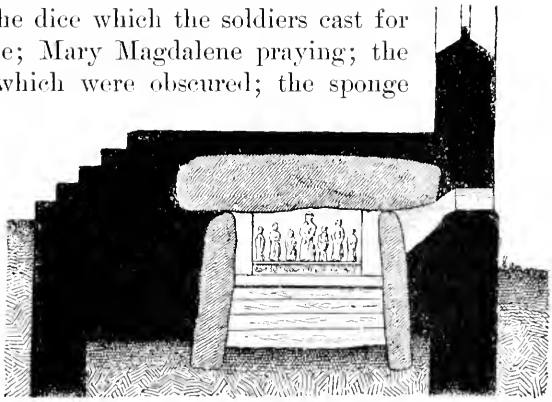


Fig. 3.—Transversal Section of the Dolmen of the Seven Saints. Scale, 1 to 100.

top of the decorated face of the stone has been shaped into a pediment rising to a kind of base supporting a cross on which is sculptured in bold relief a Christ holding a cup in each hand. The execution of these figures is rude, but the style of some of the designs relates them to the age of Louis XIII, or the beginning of the seventeenth century. The paint with which they are colored can not but suffer from the weather and has to be renewed at times. It looks now comparatively fresh.

Among the dolmens that have been sanctified by the church, some have been used as supports for the cross, and others have been transformed into altars or converted into chapels. Besides the cathedrals of Chartres and Puy, which according to local traditions were built over dolmens very anciently held in reverence, many examples may be cited of megalithic structures which bear the marks of the more or less important modifications they have suffered in view of their changed destination. The partly fallen dolmen of Cruz-Molten, not far from Carnac, bears a very simple stone cross that takes the place of an ancient historical one, of which a view appears on a picture made in 1845. Another monument consists of a slab which is supposed to have belonged to a dolmen, that rests upon four pillars supposed to have been borrowed from neighboring ruins, and supports a cross apparently more recent. The monument supposed to be the tomb of St. Ethbin at Port Mort, which people having kidney troubles pass under on certain days to be cured, was a dolmen, for which a table supported by four small columns was substituted about 1875. So probably was the *Grosse Pierre* of Ymase, a roughly squared slab with a cross cut in one of its corners, sustained by two stone supports, and under which people passed to be cured of various diseases. A rectangular slab resting on four large square pillars at the entrance of the cemetery of Arcy-Saint-Restitue came from a dolmen and is the scene of a sort of religious ceremony. St. Margaret's stone in the commune of Petit Lessac is a large, heavy slab of rough granite resting on four columns of the eleventh or twelfth century, with a stone altar underneath. It was once covered by a chapel, the walls of which could till recently be traced on the surface of the ground.

At Canges de Onis, near Oviedo, in the northeast of Spain, is a little church, built probably in the tenth or eleventh century upon a tumulus of broken stones covering a dolmen. The dolmen, in the shape of a circular chamber with a passage leading to it, is composed of fifteen supports and four tables. It constitutes a part of the church, and was formerly used as a crypt. It has been explored at different times, and a few articles of stone and copper have been found in it. Père Carvallo, a writer of the seventeenth century, says that in his time devotees regarded grottoes of this sort as the burial places of holy bodies, and scratched up the ground in them for the cure of their diseases.

A megalithic monument in France of similar character is represented by the church of *Sept Saints* (of Seven Saints), in the hamlet of that name, which was built between 1702 and 1744, probably on the site of an older chapel. There is nothing remarkable in the church itself, which is in the form of a Latin cross, oriented in the orthodox direction, with a simple rustic steeple of some beauty. The arms of the cross constitute two chapels, in one of which is the sacristy, while the other one covers the crypt, which gives the church all its interest. On going down into this crypt one may realize without difficulty that he is in a real dolmen which has been converted into a place of worship. Two large granite tables resting on vertical slabs appertain to the primitive monument. A fourth support, now masked, apparently closes the end of the chamber. The chamber is rectangular, and its walls are filled in with stonework. It is divided by an openwork wooden partition provided with a door into two unequal parts, of which the front one is a sort of vestibule, and the other, with a floor sunk about a foot, is the chapel proper. It is dimly lighted, and at the end is a stone altar planked in front, over which is a niche containing seven small statues in a line, made in the most rudimentary style, and painted in colors tarnished with age. These represent the seven saints whose remains tradition says were found in the dolmen, and in honor of whom the church is named. These personages are likewise represented in the church by more imposing and more freshly colored wooden statues, but pilgrims prefer to pay their devotions to the old, faded, miraculously discovered statuettes below. The dolmen has probably, as Luzel affirms, been a cherished holy place from antiquity, and Christianity has simply given a sort of consecration to the pagan tradition. It is the subject of numerous legends, the most famous of which is the Breton story of the *Gwerz des Sept Saints*, which makes it of divine origin, and is in other respects almost the exact counterpart of the legend of the Seven Sleepers of Ephesus.—*Translated for the Popular Science Monthly from the Revue Mensuelle de l'Ecole d'Anthropologie.*

The English Physical Society visited Eton in February, and were welcomed by Prof. T. C. Porter, who spoke of the value of the classics, on which Eton College prides itself, in education; and expressed the belief that others as well as himself desired that this reverent tradition of the classics should be preserved at the school; "at the same time they would agree with him that there was no better supplement to classics than a fair knowledge of the natural sciences."

COLLEGE WOMEN AND THE NEW SCIENCE.

By CHARLOTTE SMITH ANGSTMAN.

It is only after many years of earnest work on the part of comparatively few that it is beginning to be understood that domestic science is something definite, reducible to forms, capable of being studied comprehensively, and worthy of a place beside the other sciences in the curriculum of important universities and colleges.

Women have gone to college and heard lectures on physiology in an atmosphere of eighty-five degrees, heavy with carbonic-acid gas, and then passed to others where the thermometer read sixty-five degrees and the chill air from without blew upon their heads, wondering that such things could be side by side with perfect theoretical instruction.

They have gone from new knowledge of bacteria to a certainty of the existence of unwholesome germs in the improperly-cared-for furnishings of their student apartments.

They have learned the composition of the blood, bone, and muscle of human beings, and what substances contain their chemical elements, and then have asked what better use could be made of this knowledge than in securing diets which should perfectly nourish.

They have studied political economy and sociology, and have returned to reflect and observe that their principles are applicable to the social and domestic problems which are now before their eyes.

In the study of mathematics they have learned that nothing wrong can be righted without going to its root, and so have naturally turned their minds to the causes of the complications in domestic machinery which are apparent on every hand.

The study of history has made them realize that any plan for improvement in any condition of things, in order to rest upon a sure foundation, must be based upon a knowledge of the past.

Returned to find herself face to face with practical problems and having her logic still in mind, the college woman asks why such a foundation as she finds has been laid by Miss Juliet Corson in a knowledge of toothsome cookery should not be utilized as a foundation for scientific cookery.

In a four-years' contact with professors and students, she has learned the value of definite knowledge, and now sees as few else could its necessity in order to make any headway with the vexed questions lying nearest her, for to her especially belongs the solution of home problems through daily contact with their minute details, through her woman's nature which nothing can efface, and on account of her special opportunities.

With the thirty thousand girls who have already graduated from colleges, according to Alice Freeman Palmer, carrying these reasonings into innumerable towns and hamlets, the outcome must be something definite, and it is no source of surprise to find that some of them have gradually collected the present knowledge on all topics relating to the welfare of the home, under the comprehensive title of household economics or domestic science, and that great numbers of them are working hard in various lines of this subject.

Let us examine this work of some of our college graduates who have done most in this direction.

The active interest of college women in the subject of household economics was shown as long ago as 1883, when the Boston branch of the Collegiate Alumnæ organized its Sanitary Science Club, the first organization of distinctively college women for the study of any branch of household economics. The report at the end of its first year's work says: "The members of the Sanitary Science Club can not too strongly urge upon the Association of Collegiate Alumnæ the importance of giving thought and attention to the hygiene of the home. This duty falls more or less upon all women, but with none should it be more exacting than with college graduates."

The efforts of this club for science in the home have been productive of great results, as we shall see.

After five years' study, a manual for housekeepers, called Home Sanitation, was prepared by this club and edited by two of its members, Mrs. Ellen H. Richards and Miss Marion Talbot. This manual has been for some time one of the standard works upon the subject, and used as a basis for study in home science clubs.

One of these editors, Miss Marion Talbot, who has the degrees of A. B. and A. M. from Boston University, and of S. B. from the Massachusetts Institute of Technology, after having first realized the importance of the subject in this club, began lecturing regularly upon domestic science in 1886 at La Salle Seminary, and continued till 1890, when she took charge of this department at Wellesley College. In 1892 she was called to the University of Chicago as dean of the woman's department, where she is now carrying on courses in sanitation and the study of foods.

The first interest of the other editor of Home Sanitation, Mrs. Ellen H. Richards, in domestic science dated from a much earlier period. Having graduated at Vassar in 1870, she went to the Massachusetts Institute of Technology to work in the chemical laboratory preparatory to taking the degree of S. B., which she received from that institution, as well as the degree of M. A. from Vassar, in 1873. While working in the chemical laboratory in 1871, a prominent educator, now deceased, made the sneering remark to her, "What good do you expect all this will do you in the kitchen?" "As if," as she says, "I was necessarily to spend my life in the kitchen, or as if there was no chemistry to be used in the kitchen!"

Even sneers have their value, since, as we shall see in this case, they are often the spurs to great achievements.

Shortly after the culmination of the work of the Sanitary Science Club in Home Sanitation, in the fall of 1889, Mrs. Mary Hinman Abel, a graduate of Elmira College, returned from a six-years' residence in different European cities with the idea that something might be done toward the better nourishment of the working people, such as she had seen in Germany and Austria in the *Volksküche*, and in the *Fourneau Économique* in France.

During her husband's prolonged absence in Europe, she went for six months to stay with Mrs. Ellen H. Richards, now professor of sanitary chemistry in the Massachusetts Institute of Technology, who had become especially interested in her through being one of the judges in the matter of the prize of five hundred dollars offered by Mr. Lomb, of Rochester, N. Y., for the best essay on practical sanitary and economic cooking. Mrs. Abel won this prize, and her little volume bearing this title is considered the simplest and still the most scientific presentation of the subject yet made.

The fruit of this six-months' companionship was the now famous New England Kitchen, started under Mrs. Abel's direct charge. Even the first meeting of these two women foreshadowed the future developments along this line, for then, in mentioning the needs of the working people in this country, Mrs. Richards remarked that Mrs. Quincy A. Shaw, of Boston, and a daughter of the scientist Louis Agassiz, had been ready for some time with the money which might be necessary for such an experiment, she having especially in mind the establishment of a place which, by furnishing cheap and good food, should help to keep laboring men from the saloons.

Mrs. Shaw, having only the benevolent idea in mind, relied entirely upon her friend Mrs. Richards as to ways and means, but agreed with both her and Mrs. Abel that much experiment and the gathering of information must underlie true philanthropy in this direction.

The principles upon which this experiment rested were, then, as they said, the necessity of finding out "how people live, how they cook, and what they buy ready cooked, in order to lay out any satisfactory plan of reform," and the value of bringing absolute accuracy into certain departments of food preparation, so that a physician in ordering an article of diet—beef broth, for instance—might know just what unvarying nutrients it would contain.

In accordance with these ideas and plans, a first-floor room and cellar were rented at 142 Pleasant Street, "a respectable part of the city, consisting mostly of small shops and of houses let out in flats or rooms, and occupied by people who follow various trades."

By January 24, 1890, the kitchen was opened for the sale of food, it offering at that time beef broth, vegetable soup, pea soup, corn mush, boiled hominy, oatmeal mush, cracked wheat, and spiced beef. Since then other preparations have been added.

Every dish offered by the kitchen is what would be known as a standard dish as compared with one suited only to occasional times. In order to be able to offer standard dishes, the requirements which they must meet were several. "First, the cost of material must not go beyond a certain limit. Second, the labor of making it must not be too great. Third, it must be really nutritious and healthful. Fourth, it must be in a form that it could be easily served, and kept hot without loss of flavor. Fifth, it must suit the popular taste enough to be salable."

One of the first things accomplished by the New England Kitchen was the making of beef broth from the cheaper cuts of meat which was unvarying in nutriment and flavor. To this end the broth was frequently analyzed under the supervision of Mrs. Richards at the Massachusetts Institute of Technology.

More than twenty experiments were tried in its preparation, and one gets the best idea of the care which these college women took to have every scientific principle of soup-making carried out by quoting from the first report published: "The old-fashioned method of making soup in a pot on the stove was tried, and given up; the use of a Papin soup digester was no more satisfactory, the difficulty of regulating the heat and of retaining the flavors of the meat being found to be insurmountable. Gas or oil used under a pot gave little better satisfaction, the bottom being always hotter than the top, and the loss of heat from the whole surface proving wasteful. The labor of making soup by these methods was considerable, and it required the constant supervision of an experienced hand; moreover, no way could be devised for making large quantities at a time. Along with these experiments went others with the Aladdin oven, which were so promising in their results that we had tin-lined copper vessels made to utilize the entire capacity of the oven—i. e., thirty quarts—and settled on this method for making the broth. It was found to have these advantages: First, it made the scientific requirements for soup-making possible—i. e., (*a*) long, slow heating before the coagulating point was reached; (*b*) the continuation of the cooking at a temperature slightly below the boiling point, and long enough to get from the bones and tendons that proportion of gelatin which we knew to be desirable; (*c*) the retention of the full flavor; and (*d*) the production of a soup almost invariable in quality. Second, the greatest possible amount of broth was in this way obtained from a given quantity of meat and bones, no other process approaching it in this respect. Third, the labor involved was very small; nothing, in fact, between the placing of the vessel in the oven and removing it for straining. It suited our convenience also, in that the cooking could be done at night, the meat being prepared during the day; and although the lamp under the oven went out some hours before the soup could be strained, the nonconducting character of the apparatus kept the heat, and prevented any deterioration of the soup. Fourth, the cost of fuel was reduced to a minimum, twenty-five quarts of soup being made with three pints of kerosene, at a cost of less than five cents."

Mrs. Abel says in her little pamphlet, The Story of the New England Kitchen, after giving an account of their experience in soup-making, and final use of the Aladdin oven for that purpose: "This method, with very slight changes, has been in constant use in the kitchen, and has proved perfectly satisfactory. We consider it a real discovery of great value, and we hope it will in time be adopted in large institutions. Its success, like that of every other method we have used, is based upon the most careful study of every detail, and constant vigilance to see that every part is carried out."

This outline of the basis upon which all food is prepared in the New England Kitchen gives us a fair idea of the training which was necessary to these women before they could inaugurate such a work, and to what eminently practical and philanthropic use they have put it.

After the first seven months during which Mrs. Abel was there, the kitchen has been in charge of Miss Sarah E. Wentworth, a graduate of Vassar College, Mrs. Richards continuing her supervision.

That the success of the kitchen is acknowledged is shown by the "procession of pitchers, pails, and cans brought by men, women, and children of many nationalities, for pea soup or beef stew, as a witness to the fact that a really good food is appreciated and will be purchased." It is also shown by the respect and authority which it has attained in scientific circles as well as others. The Board of Education of Boston requested that the kitchen furnish the luncheons at the nine high schools, which it has done for some time, with the most marked results in the cultivation of proper appetites. The boy who formerly brought a lunch prepared with much maternal devotion, of mince pie, pickles, and cake, now of his own accord pays five cents for four large slices of bread and butter and a cup of cocoa.

The Institute of Technology lunch room is also supplied from this place, making in all about sixteen hundred people who are daily supplied with standard foods as defined by Mrs. Richards and Mrs. Abel, while those who buy from the counter and eat at the lunch room of the kitchen will easily make the number two thousand.

Other kitchens have already been started upon the plan of the New England Kitchen—Chicago, Philadelphia, and New York each having similar ones.

It is not too much to expect to see in a few years such kitchens in every large city in our Union, all the outcome of the practical application of the scientific training of two college women to the betterment of, primarily, the physical condition of their fellow-creatures, and, secondarily, their mental and moral condition.

In October, 1890, while yet busy with the development of scientific principles in connection with the New England Kitchen, Mrs. Richards wrote a forceful paper urging upon college women the study of domestic science. In this paper, which was published for the Association of Collegiate Alumnæ, she says: "What is our education worth to us if we can not order our houses in peace and comfort? You say, 'Modern life makes so many demands upon us.' True; but no demand can supersede that of home. . . . Let each young college graduate begin her housekeeping in a simple way, feeling keenly that all her future happiness and the welfare of her family depend on the thoroughness with which she masters at the very beginning the essentials of a home.

"But not only in her own home is there a call for this knowledge of the fundamental principles of healthful living and domestic economy. In all work for the amelioration of the condition of mankind, philanthropic and practical, there must be a basis of knowledge of the laws and forces which science has discovered and harnessed for our use."

In alluding to the New England Kitchen she says: "In this experiment the training of the college woman showed. No mere enthusiasm would have patiently waited, understanding that success is reached only through failure and after a most careful study of every detail, and is maintained only by constant vigilance."

Urging the study of domestic science in colleges, she says: "First, the subject should be put in the college curriculum on a par with the other sciences, and as a summing up of all the science teaching of the course, for chemistry, physics, physiology, biology, and especially bacteriology, are all only the stepping-stones of sanitary science.

"Therefore, in the junior or senior year, after the student has a good groundwork of these sciences, there should be given a course of at least two lectures a week, and four hours of practical work.

"The lectures should treat of—

"1. The house and its foundations and surroundings from a sanitary as well as an architectural standpoint.

"2. The mechanical apparatus of the house, heating, lighting, ventilation, drainage, etc., including methods of testing their efficiency.

"3. Furnishing and general care of a house, including what might be called applied physiology, chemistry of food and nutrition, and the chemistry of cleaning.

"4. Food and clothing of a family.

"5. Relation of domestic service to the general question of labor, with a discussion of present conditions and proposed reforms.

"The practical work should include:—

"1. Visits of inspection, accompanied by the instructor, to houses in process of construction, of good and bad types, both old and new.

"2. Visits to homes where the housekeeper has put in practice some or all of the theories of modern sanitary and economic living.

"3. Conferences with successful and progressive housekeepers.

"4. Practical work and original investigation in the laboratory of sanitary chemistry."

This was the outline originally prepared by Miss Talbot, and describes the course as she gave it at Wellesley in 1891 and 1892, entering upon her work there at about this time.

To show the respect which Mrs. Richards's attainments as a scholar and scientist have won with the world, as well as giving added significance to the fact of her doing so much in the field of domestic science, The Outlook for September, 1897, is quoted: "Her contributions to science have placed her at the head of the domestic science department of one of the leading educational institutions of the country, and have established her as an authority in her own field, a woman whose advice, investigations, and decisions are accepted by the leading scientists and authorities."

Mrs. Richards and Miss Talbot have made themselves felt in connection with this work in still another direction. In the University of Chicago, domestic science is not only taught but practiced. When Mrs. Alice Freeman Palmer and Miss Marion Talbot consented to go there as deans of the woman's department, it was with the understanding that they should have an opportunity to carry out their convictions that college trustees and professors have done their whole duty by their students only when they see that they are properly fed as well as properly taught. Accordingly, when the three halls for the accommodation of the women students were completed, they undertook, with Mrs. Ellen H. Richards as expert adviser, to furnish a dietary which should be kept within a certain cost, be of the best quality, prepared in the best manner, and at the same time furnish the known scientific requirements of proper nutrition. To this end an analysis was made of every article of food proposed, and a careful record kept of the number of pounds purchased, its price, and chemical value in proteids, or the nitrogen and tissue furnishing properties; the fats needed for fatty tissues and fuel; and the carbohydrates serving principally as fuel, but all three furnishing energy in the form of heat and capacity for work estimated carefully as so many calories.

Every day's *menu* was planned with direct reference to supplying the chemical requirements in their proper proportions, at the same time meeting the other stated requirements.

The results have been most satisfactory in that the family were well fed, and that nearly all gained in weight and in general physical condition while expressing great interest and approval of the experiment. Financially the experiment was also most satisfactory, showing how the price fixed for board, three dollars and a half, is proportioned among the different items entering into its cost. The tables prepared during the long and careful scientific investigation concerning this dietary are also a most valuable contribution as a basis for further experiment, both public and private.

The most of this work has been and is now continuing under the direction of Dean Marion Talbot.

The other dean of the woman's department of Chicago University, Alice Freeman Palmer, a graduate of Michigan University, and later the honored president of Wellesley College, afterward, as one of its trustees, was chiefly instrumental in having the new science introduced there. Later she has been lending her strength to this subject as a member of the Massachusetts State Board of Education; as president of the Woman's Education Association of Boston, which last year had an important exhibit of domestic art and science, and which now has a strong committee on domestic science; as a member of the committee on domestic service investigation of the Boston branch of the Association of Collegiate Alumnæ; in introducing something of this work into the vacation schools in Cambridge. She is also identified with the movement in Boston to introduce domestic science into public and private schools and colleges, and which last fall established a school of domestic service to attack the problem in another way. That band of twelve college women who organized the Sanitary Science Club in November, 1883, builded better than they knew.

While some of our college women have given so much thought and effort to secure nutritious and attractive diet for those under their charge, who in turn will go out and preach this new gospel of right living, other college women are teaching scientific cookery directly.

Miss Lucy C. Andrews, a B. A. from Michigan University, studied cooking at Purdue University and the New York Cooking School, and has taught the subject for the last seven years by giving demonstration lectures and holding practice classes for ladies, house servants, shop girls, and children. She has also worked to promote the interests of domestic science in schools.

Dr. Helen Putnam, president of the Collegiate Alumnæ of the woman's department of Brown University, gave in November, 1893, a series of lectures on Cooking for the Sick, at the first food exhibition ever held in Providence. The Collegiate Alumnæ of her university attended as special guests, as also undergraduates (women), with professors and friends, the superintendent of nurses with a corps of nurses from the Rhode Island Hospital, and many of the school committee of the city and members of the State Board of Education.

Who can overestimate the results when this college woman so clothed her subject with dignity and interest that it commanded the attention of such a body of distinguished listeners? Still others are teaching cooking in schools and colleges in connection with other branches of the subject.

The agricultural colleges are making rapid strides in developing this science. The Agricultural College of Kansas has been one of the pioneers in this direction.

Mrs. Nellie Sawyer Kedzie, a daughter-in-law of the eminent chemist, Prof. Robert Kedzie of the Agricultural College of Michigan, first graduated from the college to which she returned to inaugurate the department of domestic science, remaining for fifteen years. She has now been called to continue the same work in the Bradley Polytechnic Institute of Peoria, Illinois, an institution liberally endowed and wide in its scope.

The Kansas Agricultural College has had its department of domestic science so well equipped and so ably conducted by Mrs. Kedzie since 1882 that it has furnished the model for many Western colleges. The work has been so popular there that the Kansas Legislature has appropriated sixteen thousand dollars for a special domestic economy building, which is shortly to be completed.

Mrs. Helen Campbell goes to take Mrs. Kedzie's place from the University of Wisconsin, where she had already done brilliant work as a teacher in household economics. During many years she had given the brilliancy of her pen to books in this field, as well as in others. Some of them are: The Easiest Way in Housekeeping and Cooking, In Foreign Kitchens, The What-to-do Club, a story for girls, Woman Wage Earners, and her twelve lectures called Household Economics, given at the University of Wisconsin, have been published and most warmly received.

Other agricultural colleges are working along these lines. Iowa has a fine equipment in the food laboratory or kitchen in charge of Miss Gertrude Coburn, a graduate of the Kansas Agricultural College. North and South Dakota have valuable courses in domestic science; also Fort Collins, Colorado; the Storrs Agricultural College, Connecticut; and the Michigan Agricultural College, where the course is in charge of Miss Edith F. McDermott, a graduate of Drexel Institute.

Quite possibly they have done so much in the direction of this science, realizing the criticism of Mrs. Ellen H. Richards. She says there are some fifty agricultural colleges and experiment stations in the United States, costing many millions of money, for the study of the food of pigs, cows, and horses. A cow is worth, perhaps, on an average, fifty dollars. It is important that she should be well fed, so that the most may be made of her capabilities. A man is worth three thousand dollars to three hundred thousand dollars, measured by his capabilities, salary, etc. (Five per cent of three thousand dollars equals one hundred and fifty dollars, the salary of a very ignorant man; five per cent of thirty thousand dollars equals fifteen hundred dollars, a common salary of teachers; while fifteen thousand dollars is the common salary of a skilled engineer.) We send our young men to college to be fitted for thirty-thousand-dollar teachers and three-hundred-thousand-dollar engineers, and we take less care of their food than does the farmer of his fifty-dollar cow.

That there is a strong demand for courses in which the study of chemistry shall be applied to food, economics of the household, and its kindred subjects, is evinced by the number of colleges where these subjects are now taught. This age is awakening to the fact that women need special opportunities as *women;* and after the first blind rush for equal opportunities with men for higher education, it is demanding courses of instruction which shall include full credit-earning courses in that combination of sciences which is woman's own.

Important coeducational institutions besides Chicago University give instruction now in domestic science, while others are considering the matter. Wisconsin State University has already been mentioned. The Leland Stanford, Jr., University has lately done admirable work under the able direction of Mrs. Mary Roberts Smith, a graduate of Cornell, and for some years professor of history at Wellesley College. These, with the Boston Institute of Technology and Ohio State University, are a few which have already been teaching the subject, while inquiries are continually coming from many more, as well as from large seminaries.

Many collegiate institutions, such as Drexel Institute, Pratt Institute, and Armour Institute, have given the subject careful attention for a number of years. Even in high schools and grammar schools this work is making its way. To-day a study of cooking is required of every girl in the Boston common schools, as well as in other schools in Massachusetts. In the Providence Manual Training High School, Miss Abbie L. Marlatt, a graduate of the Kansas Agricultural College, conducts a most admirable course in domestic science, covering a period of four years. In the Brookline (Massachusetts) public schools, Mrs. Alice P. Norton, a graduate of Smith College, has arranged and conducts a comprehensive course of study in this department, beginning with the sixth grade and continuing through the high school. This course, as arranged and conducted by her, is a good example of what might be done in the public schools of every city, without crowding out anything of importance or overburdening the pupils. In the sixth grade, where it begins, it only occupies one hour per week; in the seventh and eighth grades, two hours per week; and in the ninth, one hour per week.

The course is systematic and comprehensive, beginnnig with the general care of the house in the sixth grade and progressing to food principles taught with practical tests in a way to become ineradicably fixed in the young mind. For instance, the effect of different temperatures upon albuminous foods and upon starchy foods, with practical illustrations of albuminous cookery and starch cookery, are given, as also tests for proteid, starch, and sugar. Each step forward in the study of the chemistry of foods is always illustrated by the cooking of some dish.

In Brookline, when the pupil reaches the high school, she has already been instructed in many more things concerning the house and the preparation of food, with the reason *why*, than the majority of young ladies know when they enter upon the life occupation of mistress of a home.

In the high school this instruction is still further continued to include general chemistry, with special reference to its household application, sanitation, domestic art, clothing, household biology, problems of the home, including the place of the home in society, household management, and domestic service.

Thus this college woman is impressing herself upon the future by realizing in a practical, comprehensive way that the time and place to get a right knowledge of home making, based upon the latest and best gleaned from many fields, is at that time of their lives when our future home makers are to be reached collectively, and when they are at a good age to receive such instruction, being comparatively undistracted by other occupations and preconceived ideas.

Acting upon these convictions, other college women have been active in the attempt to introduce various branches of the new science into the public schools of their cities, among which may be mentioned Buffalo, Cambridge, and Detroit.

In Boston, college women have applied sanitary science directly to the public schools, as well as helping to secure it in the course of instruction. During 1895 a committee of five, constituted by the Boston branch of the Association of Collegiate Alumnæ, investigated the sanitary conditions of the public schools and achieved most noteworthy results. This committee consisted of Mrs. Alice Upton Pearmain, then president of the Boston branch, and now president of the general association; Mrs. Ellen H. Richards, Mrs. Alice P Norton, Miss E. May Dame, and Miss Helena S. Dudley, then head worker of the Boston College Settlement.

One hundred and ninety-three schools of the different grades were investigated. Among them some were found to be entirely unfit for school purposes, a number being unworthy the expense of repairs, others being hired rooms in old dwellings, and one school even being in the basement of a grocery store.

While a grant had been asked and obtained from the Legislature for two million dollars for new buildings, it was found that there were already about seven thousand unoccupied seats in the schools.

In one school the lighting was found to be so bad that eight cases of inflammation of the eyes were sent to the hospital for treatment in one month, while ventilation from within was unworthy of mention, and impossible from without, because of the constant noise from chopping in the wood yard close by, and because of odors from the old-style vaults in the yard and from a near stable containing eighty or ninety horses.

Such conditions were by no means exceptional. Indeed, inadequate heating apparatus, lack of ventilation (eighty per cent of the methods of ventilation not working well), bad odors, and insufficient light were found to exist in the majority of buildings.

Very indefinite rules were also found regulating janitors' duties, with the result that in nearly half of the buildings rooms were dusted only once a week with a feather duster, disinfectants were used in only fifty-seven schools, and the floors in fifty-nine schools had never been washed since built in a period of years ranging from fifty to five years.

This committee has had the satisfaction of securing reform in nearly every instance which was a matter of domestic science, while others requiring legislative enactment are pending.

Such and many more similar instances of the unsanitary conditions of the schools, brought to the attention of those in authority and the public, prove the painstaking thoroughness with which these women applied this branch of the domestic science to their great task.

College women are working along the lines of the new science in organizations not distinctively their own, such as the Boston Woman's Educational and Industrial Union, which depends upon them for the strength and inspiration to make its work effective. A college woman is upon its board of directors, a graduate of Wellesley has made the investigations in shops and factories regarding the relation of domestic service to work in those places, a Radcliffe student represents its Domestic Reform League in the Domestic Bureau, while its School of Housekeeping has lectures from Prof. Lucy M. Salmon, of Vassar College, Mrs. Alice P. Norton, and Prof. Katherine Coman, of Wellesley College.

So naturally and forcefully do the problems of the house and home appeal to college women, first because they are women, and secondly because their training makes them ready to attack problems in a scientific way, that one of them, Miss Lucy M. Salmon, an M. A. from Michigan University, lent the particular trend of her mind as professor of history in Vassar College to the historical side of the subject. The painstaking labor given is shown in that the basis of her book was the information obtained through answers to five thousand blanks sent out by her during 1889 and 1890. Her valuable volume, Domestic Service, was finally published in the spring of 1897.

Her hope that "the tabulation and presentation of the facts will afford a broader basis for a general discussion than has been possible without them; that a knowledge of the conditions of domestic service beyond their own localities and households will enable some housekeepers in time to decide more easily the economic questions arising within every home; that it will do a little something to stimulate discussion of the subject on other bases than the purely personal one," has been promptly realized in one distinguished instance at least, since the Boston branch of the Association of Collegiate Alumnæ has been making this year a scientific study of the subject of domestic service, with her book as the basis for preliminary work, recommending it as "the most careful scientific investigation of the subject up to date."

The American Kitchen Magazine shows how college women are giving of their best to put before the public scientific and practical knowledge upon all matters pertaining to the home. Home is the magnet to which their thoughts and efforts are continually drawn. Frequent contributors to this publication are Mrs. Mary Roberts Smith, Mrs. Ellen H. Richards, Miss Lucy C. Andrews, Dr. Mary E. Greene, president of the National Household Economic Association, Mrs. Helen Campbell, Mrs. Mary Hinman Abel, Miss Edith F. McDermott, Mrs. Alice P. Norton, and others, in such papers as Household Labor as Exercise, Chemistry of Cooking and Cleaning, Southern Prize Recipes, and an appeal to girls to learn housework rather than shop or factory work.

The idea of duty and obligation to give to others less fortunate something from the riches of opportunity and training enjoyed by college women so impressed itself upon the mind of a graduate of Smith College, Miss Vida D. Scudder, that she succeeded in imbuing the minds of six other graduates of that institution with her own conviction. Her plan was to establish a home in the midst of a densely populated, ignorant, and wicked district, from which they could reach the homes of their neighbors and add something of pleasure and knowledge to their dull lives full of ignorance and vice.

To these young college girls, the value of a home appeared so great as a nucleus for far-reaching philanthropic work, as the most practical kind of a starting point for anything of value which they could give or receive, that they determined to make one in the worst part of New York city.

Upon maturing their plans, they moved into quarters at 95 Rivington Street in September, 1889, a locality, according to Frances J. Dyer, "said to be more densely populated than any part of London. One half of all arrests for gambling and one tenth of all arrests for crime in New York come within the limits of the election precinct in which they (the residents) live. Five churches vainly try to meet the spiritual needs of fifty thousand people, and there is one saloon for every hundred inhabitants. These facts sufficiently indicate the character of the neighborhood in which these young collegiates, representing the highest type of American womanhood, elect to spend a portion of their time." The steady growing and remarkable results following the efforts of these young college women would furnish material for a volume. From this beginning other college settlements have followed upon the same basis—that one must take to the people what one has for them.

The Alumnæ House Settlement of the New York Normal College opened at 446 East Seventy-second Street, New York city, in 1894; the Philadelphia College Settlement opened at 617 Carver Street in April, 1892; the Boston College Settlement opened at 93 Tyler Street, January, 1893; while many others have followed, fathered by coeducational institutions, such as the University of Chicago Settlement, started in January, 1894, at 4655 Gross Avenue; the Northwestern University Settlement, opened in 1891, at 26 Rice Street, Chicago; and a Log Cabin Settlement, opened in a very small place in the mountains of North Carolina in March, 1895.

In every one of these, the home element is the main idea. Thus the Northwestern University Settlement reports, "The character of the work has been to exalt the home and increase the pleasures of the home makers." The New York Settlement reports in connection with its kindergarten work, "The second year of the kindergarten work has made us realize more deeply than ever how natural and vital is this way of reaching the homes and the confidences of our neighbors." The Mothers' Club of the Boston Settlement has had instruction concerning the sanitary conditions of the neighboring homes, while Dr. Mary Hobart talked to it of proper food for babies, and Mrs. Alice P. Norton has directed the mothers in cutting and making various garments.

The work of college women for the settlements, and through them for better home making, is not confined to settlement residents, as large financial aid has been given all the college settlements by the undergraduates and alumnæ of the twelve or more important colleges for women in the East.

The undergraduates of Smith, Swarthmore, the Woman's College of Baltimore, and Bryn Mawr have assisted the residents of the Philadelphia Settlement in many ways; while Barnard, Elmira, and Packer students consider the New York Settlement as their care, and Wellesley and Radcliffe girls are very helpful at the Boston Settlement.

That the value of a knowledge and practical application of the principles of domestic science as a great factor in the leavening of the community about them is never lost sight of is shown in the establishment by the Philadelphia Settlement of a kitchen and coffee house in the fall of 1895 at the southwest corner of Seventh and Lombard Streets. This was started upon much the same lines as the New England Kitchen, and with the same primary objects—"to furnish to our neighborhood, through the kitchen, nutritious food, properly cooked, at the lowest price consistent with a narrow margin of profit, and to offer, through the coffee house, a clean, cheerful place, free from all objectionable features, where a comfortable lunch or meal might be had at reasonable rates." The expectations in regard to the success of this project have been fully realized, it having been found, as in the case of the New England kitchens in Boston and New York, that "where food can be as easily obtained as drink, many a man will take the food in preference." The number of penny lunches sold during the first year was 21,332, and the number of meals served during June alone was 2,928.

In the Boston Settlement domestic science is used as a means to its ends in the support of mothers' clubs, a kitchen garden for girls of fourteen and another for girls of eight to ten, a mothers' cooking class in the homes, besides classes in sewing. In fact, in all the settlements this work with the mothers and children, and through them for the homes, is one of the most important.

One young college woman, Miss Alberta Thomas, of the domestic science department of Pratt Institute, Brooklyn, has had the needs of students who wish to board themselves particularly in mind, and has invented an oven upon the principle of the Aladdin oven, which she declares that a housekeeper could improvise with boxes from the grocers. The long cooking necessary makes the food easy to digest and cheap pieces of meat palatable, and also makes possible the leaving of puddings, meats, and vegetables many hours without attention, which is so valuable to the student who is often away many hours at a time. She has lately been experimenting with various *menus* for breakfast, luncheon, and dinner which will be appetizing, contain the necessary amount of nutriment, and give the student but little trouble to prepare, and which can be supplied for one dollar and a half per week.

Not long ago Mrs. Eliza R. Sunderland, a Ph. D. from Michigan University and a Unitarian minister of great ability, reminded her large audience of women that their chief interests must, in the majority of cases, ever center about the home; that women are the natural home makers, and that any system of education which lost sight of this fact was incomplete.

Thus, by addressing popular audiences, by writing magazine articles and books, by demonstration lectures upon the science and art of cookery, by teaching the subject in high schools, grammar schools, and colleges, by the establishment of depots for the sale of scientifically prepared as well as savory food, by practically demonstrating her knowledge in different ways in the homes of her poor neighbors in connection with college settlements, by working upon practical problems connected with domestic science in strong committees connected with education associations and branches of the Association of Collegiate Alumnæ, and in many other ways do we find the college woman working in the field of domestic science, reaching thousands of homes and home makers. All her intellectual training, which it has been feared might divert her energies from home duties which by nature and opportunity she is especially fitted to discharge, has but made her the more eager to discharge them, but with a new and different interest, along better lines thought out as a natural consequence of her new opportunities.

We are getting beyond the day when instinct and Providence were expected to do duty for definite knowledge and special training in the business of home making. The college woman is giving us methods as a permanent basis for results, and with that largeness of vision and special understanding born of her special opportunities, yet true to her woman's instinct, which nothing can eradicate, has seen what might be bettered, and is bettering it in that place which is most potent for all that is good or evil in life—the home.

SKETCH OF CHARLES GOODYEAR.*

By CLARKE DOOLEY.

IN the rush and whirl toward the end of a century so fertile in discoveries and inventions; when, day by day, we are coming to accept the most marvelous announcements of science and new creations for comfort, for safety, or pleasure with lessening enthusiasm, as if they were only an anticipated right—at such time, when, enjoying so much, the world is already looking forward in reveling wonder to the "Century of Electricity," it were well to single out and assign to their merited place those who have most contributed to make this progress possible. Among them should be ranked Charles Goodyear, the discoverer of vulcanization.

Charles Goodyear was born in New Haven, Connecticut, December 29, 1800. He was the son of Amasa and Cynthia (Bateman) Goodyear, and a descendant of Stephen Goodyear, who was the associate of Governor Eaton, and after him head of the company of London merchants who founded the colony of New Haven in 1638. Amasa Goodyear was an inventor of important agricultural implements. The boy observed the good accomplished by some of his father's innovations, and this contributed to his inventive bias. His early years were passed in New Haven. He is described as a studious boy; at ten, serious and manly, with no taste for boyish plays, and, if missed, was generally discovered reading. He had no fondness for machinery, but was always trying to improve articles used in the service of the house and farm; when not at school, was usually occupied with his father's business; was a dutiful son, and at sixteen his father showed his confidence by consulting his judgment. He was early under the influence of strong religious impressions, which were to characterize his life, and desired to enter the ministry, but his father's business constrained him to give up the idea. So from seventeen to twenty-one we find him apprenticed at hardware in Philadelphia.

He then returned to Connecticut to become a partner in the

* See also India Rubber and Gutta Percha, by the writer. Popular Science Monthly, March, 1897.

business of his father, and in 1824 married Clarissa Beecher. She was devoted to her husband, and endured without complaint the hard vicissitudes of life which befell them in his long pursuit of his discovery. In 1826 he opened a store in Philadelphia for the sale of hardware, principally the products of their own factory. It was the first for the sale of domestic hardware in the country. Under his management the house acquired an ample fortune, but failed in 1830. It was a great trial to Goodyear, yet he submitted without regrets or loss of courage to what he considered providential.

The next ten years he was repeatedly arrested for debt, not wishing to take the benefit of the bankrupt law. He strove to complete his inventions in hardware, and from the sale of one of them, completed in prison, obtained temporary subsistence. He does not seem to have been depressed, but rather to have grown stronger by reliance on a clear conscience and a lofty purpose. Soon after his reduction from affluence to poverty he decided to devote himself to invention; partly because he felt it would be difficult for him to get rid of the epithets "inventor" and "visionary," so often considered synonymous. Moreover, he is said to have felt himself divinely called by his aptitude, his past course, his circumstances, and a strong inward impulse.

As a schoolboy his attention was drawn to the mysterious property of India rubber. A thin pellicle peeled from a bottle attracted his notice, and suggested that it would be very useful as a fabric if it could be made uniformly so thin and so prepared as to prevent its adhering together and becoming a solid mass, as it soon did from the warmth and pressure of the hand. So his mind was dwelling upon the problem before Thomas Hancock in England made his first unsatisfactory solutions of rubber in oil of turpentine about 1819. The substance began to be known in the United States in 1820; its manufacture to attract attention about 1831.

Modern Europe was unacquainted with rubber until the discovery of America. Uncertainty reigned, some supposing it of animal origin, until 1736. From that time *savants* busied themselves with it. Hancock introduced the first mechanical processes (from 1818), molding, ink-erasers, etc.; Mackintosh his benzene solution and garments in 1823. The shoes made by the South American Indians had been favorably received in Europe; but, at the critical period in the United States, and likewise from deterioration of the gum, the public was abandoning them and many other articles of rubber fabrication.

In the United States rubber became a subject of investigation, and Dr. Comstock obtained a patent in 1828 for its solution in oil of turpentine and its application to stuffs. The first practical success was attained by E. M. Chaffee (1830), who invented a machine for spreading his oil-of-turpentine solution on cloth. Not to invest in rubber companies about 1833 was thought to indicate a lack of financial insight.

Goodyear read of the success of these companies and, in casting about to help himself, naturally turned to the substance which had earlier attracted his attention. Having made an improvement in the valve of a life-preserver, he returned to the Roxbury Company and tried to sell them his invention. The agent recognized its merit, and, hoping to enlist a clever intelligence in their interests, unfolded to him the startling condition of rubber manufacture in the United States: that the seeming prosperity was not real; that the company had made and sold large quantities of goods in the cool months of 1833–'34, but the following summer the greater part had melted; and that new ingredients and machinery had been vainly tried. He urged him to try to solve the secret, intimating that almost any price would be gladly given. By the end of 1836 the "India-rubber fever" had spent itself, not a solvent company was left, and the very name was detested.

Charles Goodyear at once began his experiments, melting his first gum in the debtors' prison, Philadelphia. He continued them the winter of 1834–'35, making his mixtures with his own hands and rolling them with a rolling pin. He considers it fortunate that rubber is five cents per pound, for as long as he can command that sum he will be able to continue experiments. And he soon discovers that chemists, physicians, and researchers have been baffled in all attempts to make the substance take on the qualities desired. He is thirty-five, bankrupt, and in poor health, yet does not shrink from what to the strongest might well have seemed a superhuman task; and is sustained by "the reflection that what is hidden and unknown, and can not be discovered by scientific research, will most likely be discovered by accident if at all, and by the man who applies himself most perseveringly to the subject." With a friendly loan he makes shoes of fine appearance, but summer finds them reduced to an offensive mass. He thinks there must be some substance to mix with the gum, and tries almost everything he can obtain. None of the learned men indicate the course to be taken; he is on an unknown sea.

He has the best success with magnesia, producing the first white goods; but his beautiful book and piano covers began to ferment, and soon turned brittle and hard. At New Haven he recommenced the work which was to occupy his attention to the end of his life, shoes being the first goods offered, as they were of easy manufacture. This was the beginning of the long-continued family employment with caoutchouc, his eldest daughter making the first pair of vulcanized shoes that were produced. The gum, dissolved in oil of turpentine, colored with lampblack, and hardened with magnesia, was spread upon flannel, and out of this material finely embossed shoes were made. But they proved to be a failure in the winter of 1835–'36 (Trials of an Inventor, by B. K. Peirce). "It was at this time," says his daughter, "that I remember beginning to see and hear about India rubber. It began to appear in little patches upon the window panes and on the dinner plates. Father took possession of our kitchen for a workshop. He would sit hour after hour, working the gum with his hands."

Goodyear thought the difficulty was in the turpentine, was glad to get some barrels of unthickened sap (alcohol had been added), and hoped to dry the gum so that it would not decompose. His Irish workman announced that he had made the important discovery—having given his trousers a thorough coating of the liquid—and was regarded, as may be imagined, with some dismay, until the trousers soon had to be cut off to enable him to rise from his seat by the fire. The inventor was now satisfied that the stickiness belonged to the gum itself, that it was not a result of the process employed. His early failures were made disheartening by the refusal of friends, to whom he had held out high hopes, to extend further aid. He buried a little son, and was obliged to sell his furniture and resort to the pawnbroker, losing the household linen spun by his wife. Yet he did not lose hope, and still felt confident that God was leading him to the accomplishment of his task. This faith sustained him in what is perhaps *the most remarkable pursuit of a discovery in the realm of invention.*

Alone he reached New York, worn and rusty, his hands covered with "gum elastic," and was supplied with facilities for experiment. He produced good results by boiling the articles, made with magnesia, in quicklime and water, and made thin sheets of gum for the first time (Hancock had done the same). Somebody being asked how Mr. Goodyear might be known, said, "If you meet a man who has on an India-rubber cap, stock, coat, vest, and shoes, with an India-rubber money purse *without a cent of money in it*, that is he." He obtained a patent for his new process and medals at the fairs of the Mechanics' and American Institutes in 1835. He manufactured articles, but, alas! soon found that weak acid neutralized the lime and rendered them sticky. Discouragement only made him more self-sacrificing and determined. His next improvement was somewhat accidental, led to a better sale of his products, and advanced him to the threshold of his great discovery. Being of æsthetic tastes, he was always striving to improve the appearance of his goods. He tried aqua fortis (commercial HNO_3) to remove an excess of bronze from a sheet, and found it dissolved it. Later he examined the piece and found it "cured," as he called it. He does not appear to have known that his acid contained sulphuric acid (North American Review, vol. ci; *Le Caoutchouc et la Gutta Percha*, E. Chapel, p. 47). The cloth was of superior quality and stood heat sufficiently well for many purposes; so he was happy again. A patent was secured (1836) for his "acid-gas" process, and a partner (William Ballard) with large capital readily found. The fabrication of beautiful articles was begun in Bank Street and on Staten Island, whither he removed his family, and recognition was received from many quarters. Before taking out this patent he was so overcome by noxious vapors in his laboratory that he nearly lost his life. Fortune, however, turned again, and the firm was carried under by his partner's affairs in the panic of 1836–'37. This injured him greatly, being ascribed to want of merit in his goods. Reduced to poverty again, he pawned his umbrella to Mr. Vanderbilt to reach the city. Though in direst need, still he did not give up India rubber. The family was helped back to Staten Island, where he was allowed to print piano covers and ladies' aprons in colors and bronze, the sale of which was of some assistance. Their few teacups served both for table and experiments. Attempts to rally the courage of stockholders failed, owing partly to the general gloom prevailing. His persistent faith in gum elastic and his habit of wearing it, to test and advertise it, led to his becoming an object of ridicule, and he was regarded as a monomaniac. But he had the good fortune to find favor with J. Haskins, of the Roxbury Company, who invited him to Boston and proffered him aid.

Despairing of New York, Goodyear secures a loan, and with choice specimens arrives (toward the end of 1837, says E. Chapel) in Roxbury, Massachusetts, where so much had been made and lost in rubber. Former friends in hardware forward his designs as far as they are able. E. M. Chaffee, whose inventive genius had given the industry its initial movement, becomes specially interested, and advises perseverance. Chaffee, supposing, as had Goodyear, that the adhesiveness arose from the oil of turpentine employed, had invented heavy machinery for dissolving the gum without its use; but, as we have seen, the stickiness was inherent in the substance itself. So, old difficulties reappearing, the revival of trade had proved to be but temporary. Chaffee and Haskins secure assistance for Goodyear, and allow him to use the valuable idle machinery in their factory. Prosperity seems to smile again on the indefatigable experimenter. He invents a new process for making shoes and secures a patent, but sells it to meet immediate wants—a course he was often obliged to pursue, thus removing himself from lasting benefits. He also makes piano covers, table and carriage cloths superior to any that had been produced up to this time in the United States. A demand arises; he is enabled to sell licenses for manufacture, realizing five thousand dollars in a single year; and the family is glad to be united and comfortable in Roxbury. The hopes of the friends of India rubber were rising high.

In the summer of 1838 Goodyear met Nathaniel Hayward, of Woburn, Massachusetts. He had been the foreman of a rubber company, and manufactured on his own account. Hayward had tried powdered charcoal and lime to dry the gum, but now sprinkled sulphur upon it and hardened it by the rays of the sun, claiming to have received the process in a dream. The same discovery was made simultaneously in Germany by Dr. Lüdersdorf. (This chemist was yet to discover that the process only "cured" the surface.) Hayward's discovery had attracted no attention, and had the serious objection of causing a very disagreeable smell whenever employed. Goodyear is surprised to find much the same effect *upon the surface* of the gum as that produced by his "acid-gas" process. He purchases Hayward's patent of February 24, 1839, gives him employment, and manufactures at Woburn and Roxbury. He and others supposed that the process also "cured" the body of the gum. The increased attention excited by rubber at the time led to an order from the Government for mail bags, and he gave it the widest possible publicity. At last the world shall see what he can do! He hastened to gather his family around him to share in the beckoning prosperity, and his aged parents and two younger brothers, sufferers from his failure, joined him. What was his mortification to find his beautiful mail bags decomposing and dropping from their hooks! In late experiments he had been using coloring matters, white lead, vermilion, etc. Introduced freely into the bag composition, they had proved deleterious, as the gum was then "cured." After his final invention he was enabled to make use of them. He says, "Had it not been for this misfortune from the use of these articles, in all human probability the vulcanizing process would never have been discovered."

Our inventor was now at the stage where he could fabricate thin sheets, somewhat durable. How to produce the effect in a mass of the substance? He feels himself near the solution of the question. Outwardly the worst discouragement besets him. Instead of the large fortune his friends had anticipated, his whole invention seems now to be worthless. The public, so often misled by experimenters, becomes utterly disgusted with the business and the material. From comparative ease and comfort Goodyear is once again reduced to absolute want. Everything salable is sold for the payment of debts;

he sees his parents and family deprived of their means of support; he has passed four years in trying to improve a material that has resisted all the ingenuity of investigation, that had ruined so many men, and in which large capital had been lost; and he has given his exclusive attention to the subject. "It was generally agreed," he says, "that the man who could proceed further in a course of this sort is fairly deserving of all the distress brought upon himself." His friends urged him to take up some other business, declaring that he was only bringing discomfort upon himself and others. But he kept on and made a few articles by the old process, by which means and the pawn shops the family was able to live. Had machinery or important capital been necessary, he needs must have relinquished his experiments and abandoned the pursuit of what so many regarded as an *ignis fatuus*. As it was, with a small sum he made experiment upon experiment, trying to retrieve the lost reputation of his invention. The influence of sulphur upon the surface especially interested him. At Woburn his triumphant discovery was to be accomplished. Parlor became workshop. Here with his family and two assistants he manufactured shoes. The family is described as happy in all their extremities; the mother uncomplaining; the father, amid his cares and the struggle to solve the important problem, always genial.

So, in the spring of 1839, he is trying the effect of heat upon the mail-bag compound. While talking in the kitchen with persons familiar with India rubber, he makes a rapid gesture, and a piece of the gum he holds in his hand accidentally comes in contact with the hot stove. As the substance, in its natural state, melts at a low degree of heat, great was his surprise to find that it had charred without dissolving, and that no part of it was sticky. His daughter says: "As I was passing in and out of the room, I casually observed the little piece of gum which he was holding near the fire, and I noticed also that he was unusually animated by some discovery which he had made. He nailed the piece outside in the intense cold. In the morning he brought it in, holding it up exultingly. He had found it perfectly flexible, as it was when he put it out." When further experiments show that his process "cures" the rubber through, and that the new substance resists heat, cold, and the action of acids, and before he has convinced any one of the value of his invention, "I felt myself," he says, "amply repaid for the past, and quite indifferent as to the trials of the future." Two years passed before he was able to convince any one outside of his family of the importance of his discovery. The world had to be shown, by time and varying temperatures, that "metallization" (as the process was first called) was effective. This was a bitter period for the Goodyears. Their condition became distressing: potatoes gathered before they were grown, school books sold to keep the wolf from the door. Goodyear feared to die before finishing his task. So he struggled on to determine the conditions for best results, boiling his mixtures in saucepans, suspending them from the teakettle, often working far into the night. His yellowed, haggard look and worn rubber coat gave him a wild look. It seemed as if his important secret was to perish with him. A thousand failures were to discover defects. The operation required exactness and promptitude; one condition a failure, all was spoiled; and often he could not apply the heat soon enough. So he saw the necessity of reliable apparatus. Rattier and Guibal, of Paris, made him an offer for his "acid-gas" process, which would have immediately relieved his pressing wants; yet he refused, saying he was perfecting another which would render it worthless. The incident accords with the character of the man. When gloom hung low above the Goodyear cottage, a ray of sunlight came in means for the inventor to reach New York, where William Rider advanced a certain amount for experiments. His family was freed from want, and better conditions for success were obtained.

Before the new firm was well under way Rider failed, and it lost its capital. Goodyear was also manufacturing, at Springfield, Massachusetts, sheets of vulcanized rubber and shirred goods for suspenders and elastics. These were having a large sale. Now that success was attained, his brother-in-law advanced capital to continue the business.

About to continue his enterprise in 1841, he has his last experience with the debtors' prison in the United States. Yielding to remonstrances, he took the bankrupt law; but, when fortune favored him, one of the first things he did was to pay off thirty-five thousand dollars' worth of old claims. He was in no hurry to seek a patent, considering his invention safe, and was more intent on its perfection for the good of humanity than regardful of his personal interests. So Hancock, in England, scraping Goodyear's samples and smelling the sulphur, persevered until he rediscovered the process, and first obtained a patent, November 21, 1843. He and Brockedon (who secured the samples) named the operation "vulcanization." It was ten years after beginning his experiments before Goodyear felt able to produce perfectly vulcanized rubber with economy and certainty. Then, apprised by his agent (Newton, who hastily took patents in his own name in France, January 8, and in England, January 30, 1844) of what Hancock had done, he took out an American patent, June 15, 1844. The same summer he introduced his "steam process" for dissolving without solvents. It cost several years of trials to get rid of the liability of fabrics to peel off, but he succeeded at last by mixing fiber with the gum. He considered this invention only second to vulcanization. When he had brought the fabrication of shoes to sufficient perfection, he disposed of his rights for one half cent a pair. Thus, when he should have been in condition to enjoy the fruits of his discoveries, he was harassed by financial cares to the end of his days. An idea of the business he opened up to others may be formed from the fact that the companies holding the shoe rights paid Daniel Webster a fee of twenty-five thousand dollars for his triumphant defense in 1852. It was the last legal argument Webster made, and has been considered a fitting close to his brilliant professional career (The Green Bag, vol. vii). Webster's story will serve to keep in mind the effects of cold on unvulcanized rubber: receiving a present of a cloak and hat, he one day stood the stiffened cloak on the veranda, the hat on top. Several worthy citizens, passing afterward, respectfully saluted the strange figure, thinking it was the sage himself.

After vulcanization was an established fact and patented in Europe and the United States, Goodyear worked on for sixteen years in the effort to apply rubber to new and especially humanitarian uses —life-saving appliances on water, sails, water beds, etc. In personal expenditures reasonable, he was very prodigal in his experiments—often from the desire to save time or to test his ideas upon a sufficiently large scale. It was his habit to have light and writing material at hand at night, and thus many things were recorded by his own hand, or by dictation, that would otherwise have been lost. A prey to dyspepsia, liable to attacks of gout, and delicate as he was, his achievement is the more remarkable. He received over sixty patents, yet his chief benefit, relatively, may be said to have been the consciousness of working for mankind. His rights were infringed; litigation and experiments consumed large sums. "No inventor, probably," says the commissioner, granting an extension of patent in 1858, "has ever been so harassed, so trampled upon, so plundered by that sordid and licentious class of infringers known in the parlance of the world as 'pirates.' The spoliation of their incessant guerrilla warfare upon his defenseless rights has unquestionably amounted to millions." He spent much time and money upon rubber sails, which, from greater impermeability, were to be smaller, from nonliability to mildew, more durable; and, being nonfreezing, to prove a great relief to sailors on northern coasts; and he died in the conviction that they would supersede all others. Captain Popham, on whose ship they were tried, accorded them high praise. Goodyear's experiments also laid the basis for hard-rubber manufacture. Gail Borden, famous for his condensed-milk process, once said to one of Mr. Goodyear's sons: "After experimenting unsuccessfully so many years, I should have given up in despair if I had not read a sketch of your father's life."

In 1853 he published, for friends and private circulation, and made entirely of rubber, Gum Elastic and its Varieties, with a Detailed Account of its Application and Uses, and of the Discovery of Vulcanization, copies of which, we are informed, are still in existence. With better instincts for business and willingness to stop and gather the fruits of his labors, as friends often urged, Goodyear might have realized an immense fortune. But almost everywhere he was unfortunate in protecting his rights. Hancock had to admit that he saw the first sample of vulcanized rubber in the hands of Goodyear's agent; yet, both in England and France (where Hancock's process had been introduced), rights were lost through technical difficulties. He spent thirty thousand dollars on his beautiful exhibit at the London Exposition in 1851, and obtained a medal. In 1852 he went with his family to Europe to establish his patents and improve and introduce articles manufactured under them. His wife died in a foreign land, and in 1854 he married Fanny Wardell, of London. Foreseeing the importance of hard rubber, he was the more easily induced to make a lavish display at the Paris Exposition in 1855, where, at an expense of fifty thousand dollars, he exhibited inlaid rubber furniture, jewelry, ornaments, carved caskets, painted panels, etc., obtaining a grand medal, and later a ribbon of the Legion of Honor.

The exposition and his agents' mismanagement abroad and dishonesty at home drew him into greater financial difficulties, and he was imprisoned in Paris for debt. Lack of experienced workmen and necessary heavy machinery in Vienna, the reversal of a favorable decision by a French court, failures in the United States affecting European houses, and a decline in rubber manufacture, all contributing to embarrass his condition, he was obliged to renew his loans on ruinous terms. From April, 1856, to May, 1858, he resided at Bath, worried by debts, a prey, even then, of the pawnbroker, tormented by the gout, yet still experimenting with life-saving appliances. He would have been extremely poor had not his patent been extended for seven years soon after. By the winter of 1859, besides his home in New Haven, he had a residence in Washington fitted with a large bath for trying the life-saving boats and apparatus upon whose perfection he was so intent. Thus, when he might at last have rested, he could not, as his mind was constantly dwelling on the needs and perils of mankind. It is curious that he should have been last employed with a life-preserver, the subject which had engaged his attention at the outset. With a friend he started for Connecticut to see his dying daughter, going by steamer, on account of his delicate health, as far as New York. On reaching that city they received intelligence of her death. As Mr. Goodyear was unable to continue the journey, they repaired to the Fifth Avenue Hotel, where he afterward died, as the church bells were ringing, Sunday morning, July 1, 1860. Of nine children, five survived him.

Some of the published biographical sketches of the discoverer convey the idea that he left an insolvent estate. From his surviving son, Prof. William H. Goodyear, we learn that the greater part of the last fifteen years of his father's life was passed in comfortable circumstances; and that his estate, though his affairs were somewhat complicated at the time of his death, was worth several hundred thousand dollars, the greater part of which was ultimately invested profitably in the well-known Goodyear shoe-sewing machine (an invention improved by Charles Goodyear, *fils*). An effort was made to extend his patent a second time for the benefit of his family. But it was not very difficult for those grown rich out of his discovery to point out improvidence—particularly in his later years—and so, with the cry of "Monopoly," raised in the press, the project was frustrated. The whole tenor of his life shows him to have been a man of most honorable intentions. He gave cheerfully and unsparingly for benevolence when he had the means. Further, it goes almost without saying that he never neglected those who had assisted him, and that he promoted their welfare, and that of his relatives, to the extent of his ability. Palissy, the celebrated rediscoverer of white enameling, knew that the process had been accomplished before. But Charles Goodyear was not in the same position in regard to vulcanization, and his chief merit may, therefore, be said to have been his *remarkable faith* in its final accomplishment, which inspired his untiring pursuit of his idea under the most adverse conditions. From France, in *Le Caoutchouc et la Gutta Percha*, by E. Chapel, comes a note of worthy appreciation and *a suggestion* which should find echo on this side of the ocean: "Sufficient account has not been taken, in the United States, of the character of this researcher; it is owing to him that we have been able to take so great advantage of caoutchouc, that its employment has become indispensable in medicine, in chemistry, in physics, in electricity—in a word, in all the arts and sciences, in which, in many cases, it permits the realization of progress of the highest importance. We should consider Goodyear one of the benefactors of his race, and must regret that no statue to that end has been raised to this Bernard de Palissy of the New World."

Correspondence.

COMPETITION AND SOCIALISM.

Editor Popular Science Monthly:

DEAR SIR: In reading over your June magazine this morning I came upon your very able essay on Competition and the Golden Rule. I am very much impressed with its general fairness as well as its penetration, but particularly with the opening paragraph on those advocates of socialism who teach that competition is a negation of the golden rule.

I feel that I ought to admit you are justified in treating all socialists as if they were enemies of competition; and I grow quite disgruntled myself with those of my fellow-advocates who are continually denouncing competition in the way you have described. I am quite willing to confess that if any further arguments were needed in defense of competition, your article supplies them; and that true competition—i. e., between the individual faculties and energies of individuals—is an element of life itself, which no institution, even were it desired, could for any extended period wipe away.

But what I should like to call your attention to, if kindly permitted, is that modern socialism (the replacing of privately owned capital by socially owned, or functional, capital in the production and distribution of wealth) does not involve a negation of competition. You are, of course, familiar with the general expression of the object of socialism, "To every man according to his deed." If every man is to be rewarded "according to his deed," it is possible only by observing the competitive attainments of each and all.

But it may be said that that is a mere banner declaration, and that we must look to the necessary workings of the socialistic system in order to determine its regard for competition. Admitted.

Now, as I have been able to understand the necessary effect of the "replacement of private by social capital," its only consequence as to competition would be in eliminating such competition as between the units of capital, or dollar and dollar; for example, to such competition as we now see going on between the different bodies of capital—as in parallel railroads, the multitude of stores, etc. In the interest of a sound political economy it is, indeed, desired that this prodigious waste of both capital and individual energy, arising from the anarchy of private capital, should be stopped. That is, the two railroads should not be laid where one might meet the needs of society, etc.; but that the utmost economy of capital should be insisted on in modern society, where the absolute interdependence of our lives makes the present waste (about fifty per cent of our capital and labor) a terrible tax upon all.

While, therefore, competition between bodies of capital when engaged in organized production or distribution *is* in fact sought to be eliminated because of its terrible expense, this consequence in no way follows as to the vastly more important human constituents of the system. "To every man according to his deed" will mean, with important modifications, the same wage system we now have and the same relative ratio of service with reward. We believe—we think we know—that wages will double or treble under the elimination of rent, interest, and profit, and that other monster with no defenders—*waste;* that an Edison and many others will make immensely more money, according to their deed, than their poorly equipped moral, mental, or physical competitors. But at the same time that every man's possessions will be limited to his actual wages, it is fairly expected that his influence and power in the government of the world will be similarly limited to the measure of his character, his moral and mental means.

It must be admitted that communism does imply a total negation of competition, according to its maxim, "To every man according to his need, from every man according to his power." But it is too late in the nineteenth century for intelligent men to confound two systems not alike even in their moral aspirations, much less in their economic proposals. Socialism is to-day as much a science as definition and precision of statement can make any character of institutions. It teaches that a system of industry, which is in fact collective in its dependence and interdependence of parts, should be collective in its responsibilities, collective in its powers, and collective in the distribution of its benefits. These ends can be secured only by the same social ownership of the system of industry which the people of this country have long ago inaugurated as to their government itself. They own that government in theory, at least, body, root, and branch. In fact, their reasoning in behalf of republican institutions is identical with ours in favor of a democratic system of industry. The only difference in the transition from privately owned governments (aristocracies and monarchies) to democratic governments, and that of private capital to social capital, is that the former must antedate. The principle is identical. The object is the same, namely, the amelioration of men from the abuses of irresponsible power. And what prodigies of power the captains of industry have now become! Not a king among the Stuarts or the Hanovers has held such powers. And yet, in the industrial government of the enlightened world to-day, these powers are above every government, imperial or republican, far above the puny power of the masses, and in the hands of stock gamblers who, under the glamour of a rising or falling market, can not govern their own miserable passions.

I do not hope to change any views you may have deliberately reached, even on a subject which calls for frequent modification of the smaller details of its statement. But I hope I may ask you to correct in any way you may find convenient my conclusions if they seem wrong in respect to the relation of socialism with competition. The advance of socialism in the last five years throughout the *enlightened world* has been so great as to call for careful examination by all thinkers, so that if its teachings are wise and just they may be hastened to power, otherwise that they may be insured their merited fall.

Very sincerely yours,

DAVID J. LEWIS.

CUMBERLAND, MD., *July 15, 1898.*

Editor's Table.

SOCIALISM AND COMPETITION.

WE print in our correspondence column a courteous letter from Mr. David J. Lewis, of Cumberland, Md., who writes to say that, though a socialist, he approves of the position taken in our recent article on Competition and the Golden Rule, and that modern socialism, by which he understands the replacing of privately owned by publicly owned capital in the production of wealth, does not involve the cessation of competition. This, of course, is a question which we did not raise in the article referred to: we merely sought to meet the *a priori* objection to competition contained in the declaration often made that, if the Golden Rule is right, competition must be wrong. We are quite prepared to believe that competition will prove to be an indestructible element of human life, and that, though temporarily driven out by the pitchfork of socialistic legislation, it will, like Nature, fly back at the first chance.

Our correspondent's position, we confess, is one which we find it a little difficult to understand. He speaks of the social ownership of capital and the elimination of rent, interest, and profit, but says that these things would not do away with the wage system, or with the gaining of immensely more money by the more capable members of the community than by the less capable. There will be Edisons under the new system who, just as at present, will have vast advantages over their "poorly equipped competitors." Only—this we infer—they will have to work strictly for wages, and can never exploit their own inventions or become employers of labor. When the people take possession of the private capital now employed in industry and commerce, they will simply complete that emancipation, the first step in which was to displace monarchical and aristocratic by democratic institutions. Henceforth capital will never compete with capital, because all capital will be under one ownership; but individuals will go on competing with individuals for the largest shares obtainable from the common fund.

All this may make a harmonious system in the mind of our correspondent, but to us it presents great incongruities. We find it difficult to realize the Edisons in harness; and we fear it might not be easy to persuade the "poorly equipped moral, mental, or physical competitors" to whom he refers to be satisfied with relatively inferior wages. When all are fed from the same trough, it will require much grace to be content with less than an average share. But perhaps grace will much more abound under the socialistic *régime* than it does amid the bustle and strife of our present system. There are, however, some special points to be noticed in connection with our correspondent's theory. We can not see that the parallel between the establishment of democracy and the suppression of private capital holds good. A government of any kind is either carried on in the interest of the people or it is not. If it is, and if it has not yet assumed a democratic form, the people are entitled, when the proper moment has come, to say: "We are quite capable of managing this business of government ourselves, through representatives whom we shall freely elect; and we release you—kings, potentates, nobles—from all further responsibility on our behalf." If it is not carried on in the interest of the people, then it is a mere tyranny, against which the people have a right to rebel the moment they feel strong enough to do so. In seizing the government they are seizing that which can not belong by right to any private individual. The case is altogether different when it comes to seizing capital. Without aiming at a too scientific definition, we may say that capital is the unexpended portion of each person's earnings. He who takes that takes what the individual has a natural right to hold and to employ. It is not customary to argue that, because the time comes when a young man assumes the direction of his own actions, and no longer trusts implicitly to paternal advice, he should, to complete his emancipation, proceed to possess himself of the old gentleman's worldly means. Yet socialists tell us that political emancipation should logically be followed by the appropriation of private capital.

To take another point. There is waste of capital involved, no doubt, in many forms of competition; but the *régime* of competition, or, as we would say, of freedom, is on the whole favorable in the highest degree both to the production and to the conservation of capital; seeing that the interests and the energies of all are constantly engaged for both objects. To be sure, there is clashing of interests here and there; but every one is on the alert to do his best for that portion of capital which he individually holds; and, as a result, capital is continually on the increase. The proof, if proof were needed, is found in the fact that the rate of interest tends continually to fall while the rate of wages tends to rise. Is it at all certain that under a socialistic management of capital the same phenomena would be witnessed? Is it certain that the energy, activity, and resource of the workers of the community would stand at the same level at which they do to-day? He who says that they would, affirms that of which he has no knowledge, and which the experience of the world so far can not be said to render probable.

What governments do under present conditions is to take from the citizens a portion of their earnings to expend upon works in which the interest of all is concerned, and which require to be carried out with absolute uniformity of principle and method. Foremost in importance among the necessary works of government is the administration of justice, including the protection of life and property. Law must be the voice of the community; individuals can not be left to make it or apply it for themselves. Closely following upon the necessity for common laws is the necessity for common action in various matters pertaining to the good order and health of the community. A true test of that which belongs to the sphere of government and that which belongs to the sphere of individual action lies in the essentially restrictive character of governmental action. Government says, "Thou shalt not ——"; but when we come to the proper sphere of individual liberty, we find numberless openings for positive constructive action. Government does not say, "Thou shalt go to church"; but individual enterprise gives us churches to go to if we feel so disposed. Even in the matter of education the mandate of Government is not so much "Thou shalt be educated" as "Thou shalt *not* through ignorance be a menace to society." If the Government says, "Thou shalt be vaccinated," the real meaning is, "Thou shalt *not* become a means of spreading infectious disease."

It is quite true that the state in our time manifests a disposition to betake itself to many lines of constructive work; but how far, in doing so, it makes a profitable use of the capital it disposes of—capital taken in taxes from the free industry of the country—we are not prepared to say; though we doubt much whether in any case the balance sheet is a favorable one. With large means at their command it is easy for public functionaries to show material results of a more or less imposing kind; but what we do not see is the amount of individual initiative and resourcefulness which the rival activity of the state obscures and suppresses. The post office is often pointed to as a very beneficent form of state activity; but it is certain that it is not an illustration of the profitable employment of capital. Were all the functions of modern life carried on upon similar financial principles, there would be much more poverty in the land than there is. The free industry of the country amasses capital upon which the Government draws, and, so long as industry is in the main free, the Government can afford to commit many follies without inflicting fatal evil on the community; but tie up industry in socialistic bonds, and many singular and undesirable results might follow.

We do not feel much encouraged, therefore, by the assurance our correspondent gives that, under socialism, individual competition would still flourish, and that exceptional talents would still reap exceptional rewards. We are not specially interested in competition as such, nor do we sympathize any more with the man of exceptional than with the man of ordinary ability. What we are interested in is the freedom of the individual citizen to use, and develop, and profit by, and render profitable to others, such natural faculties as he may possess to the utmost extent. What we are also interested in is the free development of the moral life of the community, under the action of a growing sense of responsibility of man to man. We do not want stereotyped characters or enforced virtues; we want men to grow into a recognition of their duties to one another, and we believe they will do so if the political power will only keep its hands off matters that do not belong to it. There is no agency more effectual in repressing the better instincts of the human heart than compulsion or the threat of compulsion; and the air to-day is full of threats of compulsion. We are not doing good or getting good fast enough, and a lot of extra-good people—as they think themselves—are going to help forward our moral education by various legislative measures. Now the man who is going to be made good by an act of the legislature does not in general like the prospect, and he is very apt to harden his heart against the operation. That is why the more truly moral the law is, the more it is apt to fail of its object. As to capital, the possession of it by an individual is a great responsibility, and one that for the most part is not as fully recognized as it ought to be; but we should much prefer to trust to a growing moralization of public opinion in the matter than rashly to transfer all capital to the state, and rely for its fructification and wise distribution on the disinterested statesmanship of our representative bodies.

LIVING AND DYING NATIONS.

Close inspection of Lord Salisbury's deliverance before the Primrose League on living and dying nations discloses a want of scientific precision. Describing the living nations, he said: "You have great countries of enormous power, growing in power every year, growing in wealth, growing in dominion, growing in the perfection of their organization. Railways have given them the power to concentrate upon any one point the whole military force of their population, and to assemble armies of a magnitude and power never dreamed of in the generations that have gone by. Science has placed in the hands of those armies weapons ever growing in the efficiency of their destruction, and therefore adding to the power, fearfully to the power, of those who have the opportunity of using them." Referring to the dying nations, he said: "In these states disorganization and decay are advancing almost as fast as concentration and increasing power are advancing in the living nations that stand beside them. Decade after decade they are weaker, poorer, and less provided with leading men or institutions in which they can trust. The society—and official society, the administration—is a mass of corruption, so that there is no firm ground on which any hope of reform or restoration could be based, and in their various degrees they are presenting a terrible picture to the more enlightened portion of the world." The British premier himself did not cite any examples in illustration of this classification. His commentators, however, exercised no such restraint. They were sure that among the dying nations we should place Turkey, China, and Spain, and among the living, that is, the growing—Russia, Germany, France, England, and the United States. But, like the classification of Lord Salisbury, such a list confounds the growth of military power with the growth of industrial and moral power. It attributes to dying nations traits characteristic of living nations, and, *vice versa*, traits attributed to living nations belong to dying nations.

But before more trustworthy tests can be applied it is needful to ascertain what constitutes growth and what constitutes death. Happily, the law of evolution offers an easy solution of this question. Without being too precise, growth, according to that law, signifies, first, an increase of mass; and, second, such a rearrangement of matter and motion as to effect a more perfect adjustment of means to ends. But the attainment of this object involves a change of the mass from a homogeneous condition to a heterogeneous one and from an indefiniteness and incoherency of parts to definiteness and coherency. Decay, on the other hand, means a loss of mass, and such a rearrangement of matter and motion as to produce a diminished adaptation of means to ends. With the change from heterogeneity to homogeneity, the parts become less and less definite and coherent. If these abstract terms of general evolution be converted into the concrete terms of social evolution, we get a scientific conception of Lord Salisbury's taking phrase. A growing society is one where the population is increasing in numbers, and each individual finds the conditions of existence constantly bettered. The simple relations of primitive life are changed into the complex relations of civilized life. All the social organs required to meet every want and taste spring into existence. Instead of being limited to plunder, or the chase, or pastoral pursuits, human activity assumes the countless forms of modern industry. But while society is thus becoming more heterogeneous, its parts are becoming more definite and coherent. To increase the efficiency of their labor, people devote themselves to some particular pursuit. At the same time they become to an increasing degree dependent upon one another; for, in order to get what they want, they must exchange with one another the products of their toil. Where evolution is thus permitted to operate freely, the most perfect adaptation of society to the conditions of existence takes place, and the greatest possible degree of happiness is attained. In a decadent society this process is reversed. Because of the tyranny of custom, which forbids social change and adaptation, or in consequence of the Government's usurpation of functions that do not belong to it, which has the same fatal effect, people cease to be free to do as they please, and to live the life that seems to them best. Robbed by the crushing taxation necessary to sustain the bureaucratic parasites that enforce the rules and regulations throttling industry, they become discouraged, and, abandoning the honest pursuits of peace, they become beggars or brigands. Under these conditions, society becomes disorganized, and eventually disappears. As in Mesopotamia and other parts of Asia, once rich and populous, the country reverts to solitude.

We are now in a position to see that modern societies are not in a condition that permits of Lord Salisbury's easy classification. Decadent as some of them are in many respects, it is by no means certain that they have reached the limits of evolution and entered upon a career of dissolution. Evolving with great rapidity as others are, it is by no means certain that they are not pursuing a course that will bring them to ruin. Turkey is probably the most decadent of all. But it is not because of her loss of territory; it is because of her rigid social structure, her incapacity to adopt the ideas and institutions of progressive societies, and her failure to protect her people from the rapacity of officials and brigands. Although less militant, China suffers in a like manner. Besides the tyranny of custom, which represses the activity of the individual and thwarts social evolution, there is the tyranny of a powerful and corrupt bureaucracy. In consequence of both, ideas and institutions are antiquated, industry is in a primitive state, and the rewards of toil are very small. Nevertheless there are signs of growth. Railroads and telegraphs are being introduced, quickening the circulation of products and ideas. A movement is afoot to improve industrial methods and the administration of the government. Compared with Turkey and China, Spain is a progressive state. Within the last century a considerable increase in population has occurred. During the same period, freedom, the essential condition of growth, has made many conquests. The Inquisition has been abolished. Religious toleration, with a free press and free speech, has been established. The right of association has been recognized. The most onerous and odious of the industrial regulations of centuries of despotism have been repealed. Indeed, the conditions of social evolution are more favorable in Spain than in any of the great continental countries. To be sure, she has, like Russia, Germany, France, and Italy, a powerful and corrupt bureaucratic system; but she does not have to bear the burdens of an immense standing army, nor is she subjected to its centralizing and demoralizing influences. Unlike Russia and Germany, she does not have a ruler that seeks to impose his will upon her people, and to force them to live in disregard of their wishes. The bitter class hatreds born of militancy do not exist in Spain that exist in France. Although the Spanish population is poor, it has not, as in Italy, been driven by misgovernment and destitution to brigandage and insurrection.

While it can not be denied that England and the United States are nations in a state of rapid evolution, their evolution is not taking place in the way usually supposed. It is not by acquisitions of foreign territory that nations grow great and powerful. Such acquisitions may be signs of decay, and, like certain tumors, hasten death. If they are due to the militant impulse—the progenitor of the new colonies of France and Germany—and require standing armies to keep them in subjection, causing a heavy drain upon the resources of the mother country, they are a source of weakness. What constitutes the greatness of England and the United States is the increase of their populations, the capacity of these populations for private initiative, the development of their resources, the discovery of new methods of production, the improvement of old methods of distribution, the generous rewards bestowed upon toil, the deference shown for the rights of others—in a word, the more perfect adjustment of life to the conditions of existence. Were it not for a change of policy that has occurred in both countries, this adjustment would continue until the soil had been forced to yield the largest product and the population had reached its maximum in numbers, industrial skill, and social amelioration. But this change is destroying freedom; it is checking social mobility; it is increasing the functions and regulations of government; it is adding to the army of militant and bureaucratic parasites; it is preventing labor from receiving its highest reward and the individual from attaining his greatest happiness; to sum up, it is bringing about just such a state as is deplored in Turkey and China and working the ruin of Italy and France. The money taken from the individual and spent in ways not his own has reached an enormous sum, and is constantly increasing. The discontent and animosity growing out of this aggression are increasing in a like degree, taking the form of labor insurrections, agitations for the depreciation of the currency, and the robbery of the rich under the cover of inquisitorial and confiscatory taxes in support of schemes for the benefit of the poor. In the United States more particularly, there has been a rapid development of the militant spirit, which demands the adoption of an imperial policy of aggression and colonial expansion, the construction of a great navy, the organization of a large standing army, and the erection of extensive coast fortifications. But unproductive activity of this kind will make life harder, provoke more discontent, and possibly lead to the same outbursts that have taken place in Italy. Here, as elsewhere, such occurrences will be the opportunity for the military despot, and with him will come the repression that makes further social evolution difficult or impossible.

Scientific Literature.

SPECIAL BOOKS.

M. Louis Proal's *Political Crime*,* the best volume of the Criminology Series, is a needful contribution to the study of sociology. Few people have any adequate conception of the amount of crime connected with politics. Still fewer appreciate the far-reaching and deplorable consequences of that crime. The reason is plain. An idea altogether too prevalent is that in politics a course of conduct may be pursued that would be regarded as highly immoral and reprehensible in other forms of human activity. In the interest of the public welfare it is permissible to practice a code of ethics that differs in no wise from that practiced in war—a code that found its most perfect and odious exposition in Machiavelli's Prince. M. Proal's book is an energetic and scholarly protest against this view. "Craft and violence," he says, "may score ephemeral successes, but they do not assure the greatness and prosperity of a country. The successes achieved by an immoral policy are not lasting; sooner or later nations, like individuals, politicians just as private persons, are punished for the evil or rewarded for the good they do." Again he says: "If a lengthy period be examined, one is struck in a general way by the fact that failure attends an immoral policy. A politician, face to face with a serious difficulty, thinks recourse to an unjust expedient of immediate utility the simplest mode of escape from it, but the future is not slow to teach him the drawbacks of injustice." Never was there a time in our own history when it was more important that such a lesson be learned, not only by politicians but by philanthropists of the socialistic order, and scrupulously observed.

At the outset M. Proal exposes the falsity of the current notion that the philosophy invented to justify this form of crime originated with Machiavelli. "Politics," he says, "did not await the advent of Machiavelli to become shifty, violent, and sanguinary. Statesmen did not need the lessons of the Italian writer to teach them to lie, to proscribe their adversaries, and confiscate their belongings. The desire to rule, the exercise of authority," he adds, explaining the cause of political crime and exposing its kinship with war, "teach fraud and violence." Even so great a philosopher as Plato and so enlightened a statesman as Canning approved Machiavellian principles. "It seems to me," wrote the Greek in his Politics, "that our magistrates will often be obliged to have recourse to lying and deceit in the interest of their fellow-citizens, and we have declared elsewhere that a lie

* Political Crime. By Louis Proal. New York: D. Appleton and Company. Pp. 335. Price, $1.50.

is useful when it is employed as a remedy—and rightly so." Referring to the unjust laws promulgated against the Catholics under James I, the Englishman says, "Unjust as these stipulations were, the safety of the state rendered them necessary." It is only when such principles are found in the mouth of a terrorist like Marat that their infamous character is fully realized. "Before this supreme law," he wrote, alluding to "the safety of the people," and in justification of the crimes that he and his partisans committed, "all other laws should be as naught. To save the country all means are good, all means are just, all means are meritorious."

M. Proal's exposition of the direful fruits of such a political philosophy is scholarly and complete. Of the eleven chapters in his book, nine of them are devoted to a citation of some of the more striking crimes of ancient and modern history, particularly that of France, committed to insure "the safety of the people." They are of great interest and value, including as they do Political Assassination and Tyrannicide, Anarchism, Political Hatreds, Political Hypocrisy, Political Spoliation, Corruption among Politicians, Electoral Corruption, The Corruption of Law and Justice by Politics, and The Corruption of Morals by Politics. The cumulative effect of this mass of facts is irresistible. They make clear, as nothing else can, how politics may poison the whole social fabric—how, indeed, it may produce effects wholly unexpected. "Bad political morals," says M. Proal, "spread to the people; they accustom it to deceit, cruelty, and injustice, and they diminish its loathing for evil. The immorality of those who govern infects sooner or later those who are governed." He tells us that "the Terror rendered cruel even those who fought against it, and it left its mark upon the youth of the higher classes." He tells us further that "the triumph of might makes people lose confidence in right, and destroys their faith in justice." Not only do immoral politics lead to cruelty and greed, but, as M. Proal shows by a number of examples, to intemperance, gluttony, and even sexual laxity. He shows, finally, that by "the creation of privileges" they produce changes in the structure of society. "Undoing the work of God, who gave the same rights to all men," he says, "they have created inequality in the matter of civil and political rights, they have altered the true mutual relations of men, and they have established inequality even in respect to justice."

The only important lesson taught by this demoralization is not the necessity of a scrupulous observance of a rigid code of ethics in political action. Hardly less important is the lesson that all writers and public speakers should possess sound judgment. "I believe," says M. Proal, "that disordered ideas produce moral disorder, that a false thesis may call forth an infinite number of bad actions, that a sophism is often more dangerous to society than a crime." As judge of the Court of Appeal at Aix, before which political criminals had been tried, he had ample opportunity to confirm this view. Reprobation too severe can not, therefore, be visited upon such a writer as M. Renan, who says, "It is better that a people should be immoral than that it should be fanatical." Nor should approval ever be bestowed upon works in glorification of revolution or other forms of violence. They are text-books of political crime. "The historian," said Lamartine, who, with Thiers and Louis Blanc, had been guilty of the offense, "who furnishes crime with an excuse and cruelty with a fallacious pretext, paves the way unawares for future indulgence toward the imitators of these crimes." As to certain newspapers and speakers, with which the United States as well as France is cursed, M. Proal says that "like corrosive acids," they "destroy all they touch," and "like alcohol," they "inflame the blood, agitate the nerves, sear the brain, and dry up the heart." Until the truth with regard to the facts of history and the questions of the day is set forth scrupulously, it is needless to expect an end of political crime.

Professor *Packard's* elaborate *Text-Book of Entomology* * was prepared with the wants of both the student and teacher in mind, and the book has grown in part out of the writer's experience in class work. In instructing small classes in the anatomy and metamorphoses of insects, it was felt that the mere dissection and drawing of a few types comprising some of our common insects were not sufficient for broad, thorough work. Without depreciating the importance of laboratory study, it needed to be supplemented by frequent explanations or formal lectures, with collateral reading by the student in some general treatise in structural and developmental entomology. The present text has been prepared to serve this purpose, giving, of course, with much greater fullness and detail what was roughly outlined in the class work. The aim has been to afford a broad foundation for future more special research by any one who may want to carry on the study of some groups of insects, or to extend in any special direction our present knowledge of insect morphology and growth. The number of insects in orders, families, genera, and species (they forming about four fifths of the animal kingdom), their habits and transformations, and the variety of ways in which they affect human interests, are given as reasons why they have attracted more attention from students than any other classes of animals. They are represented as perhaps more complicated in structure than any other animals. Having defined their general position, Professor Packard describes the chief differences between them and their neighbors—the crustaceans, trilobites, spiders, and others. Their morphology and physiology are considered in respect to their external and internal anatomy, under which head all their parts are described with their several relations and functions. The second part of the book is devoted to the embryology of insects, and the third to their metamorphoses. Copious bibliographical lists are appended to each of the departments, arranged by dates so as to give an idea of the historical development of the subject. A full index completes the volume.

GENERAL NOTICES.

In Dr. *Oppenheim's* book on *The Development of the Child*,† the subject is treated in a philosophical spirit. The author makes a serious study of the factors that contribute to the child's development and the formation of his character, and seeks to find how they may be most advantageously treated and cultivated so as to secure the best results. He makes much less account of heredity than do most authors—reducing it, in fact, to its lowest terms—and gives special predominance to the environment and nutrition. "There is not enough of conviction in the minds of parents and guardians," he says, "that the responsibility of their children's acts, good and bad, rests upon their older shoulders; that the final outcome of their chil-

* A Text-Book of Entomology, including the Anatomy, Physiology, Embryology, and Metamorphoses of Insects. For Use in Agricultural and Technical Schools and Colleges, as well as by the Working Entomologist. By Alpheus S. Packard. New York: The Macmillan Company. Pp. 727. Price, $4.50.

† The Development of the Child. By Nathan Oppenheim. New York: The Macmillan Company. Pp. 296. Price, $1.25.

dren's lives depends almost entirely upon the influences, the nutrition, the environment which the authority of the parents and guardians provides." He begins by pointing out and presenting the differences in the constitution of the child and the adult, so as to show "that an infant's development is not a rigidly immovable process, that it progresses slowly and irregularly, and that during its course the child is in so unstable a condition that no strain should be put upon his faculties." The comparative importance of heredity and environment is next considered, with the result that we have already indicated. The methods of the primary school are sharply criticised, and the rule is prescribed that "every subject should, in its claim for a place in the curriculum, be judged by its adaptability to the child's growth," and hints are offered toward a better method. Reasons are adduced and enforced with illustrations from children's words, why religious instruction, as usually applied, is not adapted to the child's mind and can hardly convey correct ideas. In a similar spirit the author discusses The Value of the Child as a Witness in Suits at Law; The Development of the Child Criminal; The Genius and the Defective; and Institutional Life in the Development of the Child. In the final chapter, The Profession of Maternity, the importance is emphasized of making training for the duties of motherhood a predominant feature in the education of women.

The twelve essays constituting Prof. *Josiah Royce's* volume of *Studies of Good and Evil*,* though seemingly varied in topic and as to the occasions on which they were first presented, represent together what the author calls a type of post-Kantian idealism. Their appeal is to those readers to whom studies of more familiar issues in the light of philosophical considerations are more enlightening than fundamental metaphysical arguments. Believing that the student should be relatively independent as to the manner in which he reaches his conclusions and as regards the kind of insight he seeks to impart to his readers, Professor Royce hopes that his papers may serve to indicate in what sense the philosophical theses he has to maintain possess a genuinely individual character. They are all, directly or indirectly, contributions to the comprehension of the ethical aspects of the universe, and are of various relations to technical philosophical issues. Four of them are essays in literary and philosophical criticism; one is directly concerned with the effect of the knowledge of good and evil upon the character of the individual man; one is a contribution to the metaphysical problem of evil in its most general sense; five, while dealing with metaphysical and psychological problems connected with the nature and relationships of our human type of consciousness, are somewhat more indirect contributions to the ethical interpretation of our place in the universe. One is a historical study of a concrete conflict between good and evil tendencies in early California life. The first paper, The Problem of Job, presents the author's theory of evil. The second is a psychological study of a personal experience of John Bunyan. The third paper, on Tennyson and Pessimism, bears on a theory of the relation between good and evil; and another general aspect of that relation is discussed in the fourth paper. These studies prepare the way for the metaphysical issue of the ethical interpretation of reality; and the problem of the general relation between natural law and the demands of ethics is stated in the fifth essay; while the sixth states the general case for an idealistic interpretation of the universe in its relations to self-consciousness. The question of what finite consciousness with all its burdens of good and evil may be and mean is treated in the seventh and eighth essays; and the discussion of consciousness is continued in the ninth. The last three papers concern more special issues, and relate to Meister Eckhart, the German mystic of the thirteenth century; the squatter riot of 1850 in Sacramento; and the late French philosophical critic, Jean Marie Guyau.

Mr. *MacEwan's Essentials of Argumentation** is the outgrowth of a dozen years' experience with classes in an agricultural col-

* Studies of Good and Evil. A Series of Essays upon Problems of Philosophy and of Life. By Josiah Royce. N.w York: D. Appleton and Company. Pp. 384. Price, $1.50.

* The Essentials of Argumentation. By Elias J. MacEwan. Boston: D. C. Heath & Co. Pp. 412. Price, $1.12.

lege. The time for literary training being limited in such an institution, a course had to be provided that would be most helpful to students who had not time to study all the niceties of literary expression, and could, at best, master only the elementary principles of rhetoric and make themselves familiar, in a general way, with the ordinary forms of prose composition. Their work would require proficiency in description, clear and sound reasoning, and the cogent presentation of what they would want others to accept as true. Adapting his course to this condition, the author made it largely one in argumentation, with the result of a more rapid development of the student's power of reflection and greater facility and accuracy of expression. The present book follows the plan of the course thus described. While adapting his work largely to the practical questions of the day, the author has inserted model examples of argument from every source, whether new or old, affording illustrations that would illustrate. Famous passages from Webster and Burke, from Shakespeare's oratory, and from Huxley's addresses are accompanied by minute analyses of their parts, qualities, and points; and a list of more than two hundred propositions for argument or debate, and a glossary of terms, are given.

La Industria Agricola is a new agricultural paper started at Caracas, Venezuela, with Señor Guillermo Delgado Palacios as editor. Of the thirty-two pages of the first number six are devoted to the exposition of the purposes of the magazine and the bearing of science on agriculture; five to the agricultural bureaus and societies of Venezuela; ten to the agricultural staples of the country, wheat, sugar cane, and corn; two to agricultural items from the United States; and the rest to industrial novelties and miscellaneous articles.

L'Intermédiaire des Biologistes (The Biologists' Intermediary) is a useful semimonthly international organ of zoölogy, botany, physiology, and psychology, published in Paris under the editorial direction of MM. Alfred Binet and Victor Henri, with numerous colaborers of equal scientific standing, which has just completed its first year. The number before us has as its leading original articles papers on the sexuality of aphides, by E. G. Balbini, and on the Colorability of Living Protoplasm, by F. Henneguy; and these are followed by two pages seeking answers from correspondents, seven pages of answers to previous questions—the notes and query feature being one of the most prominent of the publication—and classified summaries of the biological contents of periodicals. Price, 12 francs ($2.50) a year.

The Philosophy of the Humanities includes three addresses delivered on separate occasions and to different bodies by Thomas Fitzhugh, professor of Latin in the University of Texas. They discuss the evolution of classic culture and its pedagogic treatment, and inquire into the philosophic basis of the humanities. The subjects are The Evolution of Culture, The Pedagogic Aspect of Culture Evolution; Organization of the Latin Humanities in College, and Organization of the Latin Humanities in Secondary Education. The author is a sturdy advocate of the study of Latin. (University of Chicago press.)

A *Bibliography and Index* of North American Geology, Palæontology, and Mineralogy for 1892 and 1893, compiled by *Fred Boughton Weeks*, and constituting Bulletin No. 130 of the United States Geological Survey, contains 1,121 titles. The index is complete and elaborate, classified by States and main subjects, and arranged alphabetically throughout. A list of publications examined is appended.

In the comparative study of *L'Évolution régressive en Biologie et en Sociologie* (Regressive Evolution in Biology and Sociology), the ground is taken by the authors (MM. *Jean Demoor*, *Jean Massart*, and *Émile Vandervelde*) that the word evolution does not in itself imply either progression or regression, but designates all transformations, whether favorable or unfavorable, and they have applied themselves to the study of the latter kind. They have conducted the results of their several special researches in the biological and social fields so as to show how the regressive feature is manifested in both, and that every transformation involves a loss as well as a gain; that "regression is not an accident of evolution, but is the inverse of progressive evolution, the necessary complement of all transformation, organic or social." When we study any transformation whatever we may hit upon, taking variations as they come, we find that as a consequence of it some parts of the structure become useless, and their gradual elimination ensues, as in the interest of the organization itself, considered as a whole. The working of this principle is considered in its various aspects in the worlds of organic life and society. (Paris: Félix Alcan, Bibliothèque Scientifique Internationale.)

The *Bibliography of the Anthropology of Peru*, published by *George A. Dorsey* in the Anthropological Series of the Papers of the Field Columbian Museum, Chicago, shows that the list of books and papers relating to the subject is a very considerable one and would of itself furnish a respectable library; yet the compiler does not pretend that it is exhaustive. He has only done his best with the material accessible to him. His aim has been, so far as possible, to cover the whole ground, and to include such works from the earliest times down to the present day as treat of the modern Indians and of the Peruvians of ancient times, and to include all known editions of the early Spanish authorities. Interest and value are added to his work by the short biographical sketches he furnishes of about fifty of the more important authors of the early Spanish times. Mr. Dorsey hopes to follow this work with an index by subjects and topics.

The eleventh volume of the Annals of the Argentine Meteorological Office (*Anales de la Officina Meteorológica Argentina*), Walter G. Davis, director, covers the observations of the year 1893. It includes elaborate tables similar to those which have characterized previous volumes of the *Anales*, with climatic details, at the stations of San Jorge (Cordoba), Isla de los Estados, Chos-Malal, Paramillo de Uspallata, on Potro Muerto; with, in addition, summaries of monthly observations from October, 1895, till December, 1896, at Isla de los Estados, and from May till August, 1896, at Chos-Malal. Twelve new stations were established during the year covered by the report. Voluntary observations of the principal meteorological elements were received from thirty-six points, and of rain from seventy-three. Reports of observations made six times a day were received from Concepcion, Paraguay. Stations have been established outside of the republic, near its frontiers, in cases where suitable points could not be found in the same latitudes within the national territory, whereby important data have been secured that would otherwise have been missed.

PUBLICATIONS RECEIVED.

Adams, C. J. The Matterhorn Head and other Poems. Rossville, Staten Island, New York: The Bureau of Biophilism. Pp. 20.

Agricultural Experiment Stations. Bulletins and Reports. Michigan State Agricultural College: Elementary Science Series. No. 1. Beans and Peas before and after Sprouting; No. 2. Wheat and Buckwheat, ditto; Seeds of Clover and Timothy, ditto; Observations on the Leaves of Clovers at Different Times of the Day. All by W. J. Beal. Pp. 8 each; Report of the Botanical Department of Michigan State Agricultural College. By W. J. Beal. Pp. 24; Michigan Monthly Bureau of Vital Statistics, May, 1898. Pp. 20.—New Jersey: No. 129. Asparagus Rust. Pp. 20.—New York: Popular Editions of No. 139. Plant Lice; No. 140. Wood Ashes not an Apple-Scab Preventive; No. 141. Some Results in Stock Feeding. Pp. 6 each; Bulletin No. 142. Director's Report for 1897. Pp. 24.—United States Department of Agriculture: Farmer's Bulletin No. 74. Milk as Food. Pp. 40; Miscellaneous No. 15. Changes in the Rates of Charge of Railway and other Transportation Services. By H. C. Newcomb. Pp. 80.—West Virginia: No. 52. Strawberries. By L. C. Corbett. Pp. 24.

American Catholic Historical Society of Philadelphia. Record. Quarterly. Vol. IX. No. 2. June, 1898. Pp. 180. 50 cents; $2 a year.

Aveling, Eleanor Marx. History of the Commune of 1871. Translated from the French of Lissagaray. New York: International Publishing Company, 23 Duane Street. Pp. 500.

Baldwin, J. M. The Story of the Mind. (Library of Useful Stories.) New York: D. Appleton and Company. Pp. 236. 40 cents.

Barnes, C. R. Plant Life, considered with Special Reference to Form and Function. New York: Henry Holt & Co. Pp. 478. $1.12.

Bulletins, Reports, and Proceedings. American Museum of Natural History: Memoirs. Anthropological. The Jesup North Pacific Expedition. Facial Paintings of the Indians of North British Columbia. By Franz Boas. Pp. 24, with 5 plates.—Baltimore Medical College: Annual Announcement and Catalogue, 1898-'99. Pp. 32.—Indiana: Report on Geology and Mineral Resources, 1897. Pp. 1197.—Johns Hopkins University: General Statements as to the Courses of Instruction. Pp. 20.—Minnesota: Botanical Studies. Conway MacMillan, State Botanist. Second Series. Part I. Pp. 68.—Museum of Comparative Zoölogy at Harvard College: The Geological History of the Isthmus of Panama and Portions of Costa Rica. By Robert T. Hill. Pp. 140, with 13 plates.—Torrey Botanical Club: Bulletin. July, 1898. L. M. Underwood, Editor. Pp. 60. $2 a year.—Yale University Observatory: Report of the Managers for 1897-'98. Pp. 22.—United States Department of Labor: Bulletin. July, 1898. Economic Aspects of the Liquor Problem and other Subjects. Pp. 156.—United States Commissioner of Education: Report for 1896-'97. Pp. 1136.—University Geological Survey of Kansas: Vol. IV. Paleontology. Pp. 594, with plates.

Carus-Wilson, C. A. Electro-Dynamics. The Direct-Current Motor. New York: Longmans, Green & Co. Pp. 298. $1.75.

Congdon, E. A. A Brief Course in Qualitative Analysis. New York: Henry Holt & Co. Pp. 62. 60 cents.

Detmer, Dr. W., and Moor, S. A. Practical Plant Physiology. London: Swan, Sonnenschein & Co. New York: The Macmillan Company. Pp. 535. $3.

Groos, Karl. The Play of Animals. Translated, with the author's co-operation, by Elizabeth L. Baldwin. With a Preface and Appendix by J. Mark Baldwin. New York: D. Appleton and Company. Pp. 341. $1.75.

Harris, Edith T. The Story of Rob Roy, by Sir Walter Scott, condensed for Home and School Reading. (Appletons' Home-Reading Books.) New York: D. Appleton and Company. Pp. 306. 60 cents.

Keyser, L. S. News from the Birds. (Appletons' Home-Reading Books.) New York: D. Appleton and Company. Pp. 229.

Mills, Wesley. The Nature and Development of Animal Intelligence. New York: The Macmillan Company. Pp. 307. $2.

Mutual Boiler Insurance Company, Boston. Cost of Boiler-Room Labor. Bad Shoveling. Pp. 201.—Comparative Steam-making Values of Coals used in the Northeastern States. By R. S. Hale. Pp. 9.—Tests of Steam-pipe and Boiler Coverings. By C. L. Norton.

Overton, Frank. Applied Physiology, including the Effects of Alcohol and Narcotics. Primary Grade. Pp. 128.—Intermediate. Pp. 188.—Advanced. Pp. 432. American Book Company.

Pyle, Howard. The Divinity of Labor. (Commencement Address.) Wilmington, Del. Pp. 12.

Redway, Jacques W., and Hinman, Russell. Natural Advanced Geography. American Book Company. Pp. 160.

Reprints. Lyons, Florence M.: A Contribution to the Life History of Euphorbia Corollata. Pp. 8, with plates.—Hester, C. A., M. D.: The Pathology of Uræmic Intoxications. Pp. 20—Mercer, H. C.: A New Investigation of Man's Antiquity at Trenton. Pp. 20.—Merck's Digest: No. 16. Tannalbin (astringent). Pp. 8; No. 18. Aqua Levico (alterant tonic). Pp. 4; No. 21. Ichthalbin (alterant, antiphlogistic, and assimilative). Pp. 8. Merck & Co., New York.—Rotch, A. L.: The International Aëronautic Conferences. Pp. 8.—Silenker, M. A., M. D.: Clinical Observations of a New Antipyretic. Pp. 4.—Smith, W. R.: A Contribution to the Life History of the Pontederiaceæ. Pp. 16, with plates.—Wadsworth, M. E.: Zirkelite. P. 1; The Elective System in Engineering Colleges. Pp. 39; Mineral Plates in Converging Polarized Light with the Petrological Microscope. Pp. 8; The Elective System in Technological Schools. Pp. 14; Some Statistics of Engineering Education. Pp. 24; The Michigan College of Mines. Pp. 16; The Origin and Mode of Occurrence of the Lake Superior Copper Deposits. Pp. 28.

Ripley, F. H., and Tapper, Thomas. A Short Course in Natural Music. Book 1. Elementary. American Book Company. Pp. 144. 35 cents.

Troeger, J. N. Harold's Rambles. (Appletons' Home-Reading Books. Nature Study Readers.) New York: D. Appleton and Company. Pp. 155. 40 cents.

Fragments of Science.

International Language Study.—An interesting and comparatively new scheme for the study of foreign languages is described by E. H. Magill, ex-president of Swarthmore College, in a recent issue of The Kindergarten Magazine. "How these foreign languages can best be taught in our schools and colleges is a question which has received much attention at the hands of experienced educators of this generation." Some have contended that no attempt should be made to teach the student to converse or write in the foreign language, but that he should simply learn enough of grammatical form to enable him, when he has obtained a vocabulary, to read the written language easily. In fact, this opinion has been very generally held by educators. The method of instruction about to be described, however, seems in a fair way to change this feeling into one favoring a more perfect mastery of the language. "It is now about two years since M. Mieille, a professor in the Lycée of Tarbes, Hautes-Pyrénées, while in England, devised a method of international correspondence between students and teachers in France and England, which has been warmly received by educators and students in those two countries, and several thousands on either side of the channel are now entered upon the lists and mutually rendering each other great aid in becoming familiar with their respective languages. . . . The method of procedure may be simply described thus: Let those schools, colleges, or individuals who wish to begin this system send the names, ages, and addresses of those who wish to correspond to the following well-known firms in Paris: For young students, send to MM. Armand Colin et Cie., No. 5 rue de Mezières, Paris, and for older students, teachers, or other mature persons, address Libraire Hachette, 79 Boulevard Saint-Germain, Paris. These firms will give prompt attention to such requests, assigning to each person whose name, etc., is sent, a suitable correspondent; and these French correspondents write the first letter, in French, to their American friends, who on receiving the letters promptly reply in English. After these first letters the next letter from France is written in English, and the second letter from America is written in French. The correspondence thus commenced is continued as begun, alternating the two languages; also all letters received which are written in the language of the receiver are returned carefully corrected to the writer. Thus, if letters are filed, at the end of the year each student has model letters in the foreign tongue, and his own corrected letters for careful study. In Swarthmore College, Pennsylvania, about thirty students are enrolled as correspondents. The letters as received are read aloud in class, sometimes translated, sometimes in French, and are made most interesting topics for the lesson of the day. No one who has not tried the system can fully realize the new life and spirit that are thus infused into the class. Instead of being a dry and dull grammatical lesson, with little direct practical bearing upon daily life, the language is seen at once to have a life and meaning before little expected by the student."

The Liquefaction of Hydrogen.—At a recent meeting of the Royal Society, Professor Dewar read a paper describing the method by which on Tuesday, May 10th, he had succeeded in liquefying hydrogen, the last of the so-called "permanent gases." The apparatus used was a year in building, many slight but important details going to make up the final successful machine. The hydrogen was cooled to $-205°$ C. and then allowed to escape continuously under a pressure of one hundred and eighty atmospheres from the nozzle of a coil of pipe at the rate of ten to fifteen cubic feet a minute, into a vacuum vessel doubly silvered, which was itself surrounded with a space kept below $-200°$ C. With these arrangements liquid hydrogen began to drop from this vessel into a second vacuum space, doubly isolated by being inclosed in a third, and in five minutes twenty cubic centimetres of liquid hydrogen were collected. The yield of liquid was about one per cent of the gas. The liquid was clear and colorless and showed no absorption spectrum. When a long piece of glass tubing sealed at one end and open to the air at the other was immersed in the liquid hydrogen, solid air immediately appeared in it; and when a specimen of purified helium in a sealed tube was immersed, a distinct fluid was seen to collect in it. It would seem from this that there is little difference between the boiling points of helium and hydrogen. Professor Dewar pointed out that all known gases had now been condensed into liquids which could be manipulated at their boiling points under atmospheric pressure in suitably arranged vacuum vessels, though even so great a man as Clerk Maxwell had doubts as to the possibility of ever liquefying hydrogen. With liquid hydrogen as the cooling agent a temperature could be reached within 20° or 30° of the zero of absolute temperature, and its use would open up an entirely new field of scientific inquiry. M. Moissan read a similar paper before the Academy of Science in Paris early in May. It is also claimed that Professor Olszewski had previously determined the boiling point and critical temperature of hydrogen.

Grasses in Iowa, Nebraska, and Colorado.—Prof. L. H. Pammel, in his Notes on the Grasses and Forage Plants of Iowa, Nebraska, and Colorado, remarks on the different aspects the forage question in central Iowa presents now from what it did fifteen years ago. At that time considerable areas of unbroken sod still remained. Now the wild prairies have ceased to be a factor in the production of hay. They have given way to cultivated fields and pastures, and the few small unbroken areas occurring here and there are chiefly confined to the small drainage basins between the hills where moisture interferes with proper cultivation. The standard and other cultivated grasses that have been introduced have been tried with varying success; the native species vary in quantity and quality in different parts of the State. Several native leguminous plants have more or less value for fodder. The pastures suffer deterioration from overstocking and the growth of weeds. The grasses can not endure the close grazing and extensive trampling to which they are subjected, and die out, and weedy annuals plant themselves in their places, or the native ragweeds and verbenas spread and occupy the soil. All of these have become so plentiful that farmers note their more frequent occurrence than in former years. In Nebraska the grasses do not grow so luxuriantly season after season as in Iowa, but the climate is more favorable for winter grazing, and there are many valuable species of native forage plants. In the semiarid regions of northeastern Colorado, the areas that were at one time cultivated have been allowed to revert to grasses, and the region has become famous as a stock country and is seemingly prosperous. In the country north of this, though the rainfall is limited, there are thousands of acres of fine meadow and grazing lands covered with a dense growth of grama grass. A large number of native grasses occur along irrigating ditches and streams, and many of them are highly nutritious. In the mountain regions, the foothills and higher mountain slopes produce a large number of valuable grasses, increasing in variety and richness with the ascent. Cattle are raised for beef, and dairying is carried on at the lower altitudes.

Our Native Gems.—From Mr. G. F. Kunz's report on the production of precious stones in the United States during 1896 we learn that true rubies have been found in the Corvee Valley, Macon County, N. C., in a manner of occurrence new to science, along with some very beautiful almandine garnets, corundum, gold, and other minerals of value. The best ruby crystal so far obtained weighs about six and a half carats. The sapphires in Montana have already been mentioned in The Monthly. Many fine crystals of beryl of gem value were found in Topsham, Maine, one twelve inches long and two inches in diameter. Other beryls were found at Hampden, Md., and Bakersville, N. C. A topaz was found in Idaho, about one hundred miles north of Boisé, and other topazes at Thomas Mountain and Simpson Springs, Utah. Tourmalines continue to be found at Paris, Maine, Haddam, Conn., and Waynesville, N. C. Olivine chrysolite and peridot are reported from Webster, N. C.; several varieties of garnet in Tulare County, Cal.; quartz crystals with fluid inclusions in Herkimer County, N. Y.; thousands of pounds of crystals of quartz in three counties of Arkansas, and other quartz near Cheyenne Pass, Wyoming, Whitehaven, Pa., at Autauga, Ala., and in Tulare County, Cal.; and quartz of different varieties at localities in North Carolina, Idaho, the Black Hills, New Mexico, and Washington; rutilated amethyst crystals in the Black Hills, and Goochland County and Livingston, Va.; chrysoprase at Visalia, Cal.; agate in Wyoming and at Soldier's Delight, Md.; opal at Bare Hills, Md., and Clover Creek, Idaho; wardite, a new "semi-precious" stone, in Utah; Smithsonite, a golden-yellow carbonate of zinc, locally known as "yellow fat," in beautiful mammilar masses in the Morning Star Mine, Yellville, Ark. Besides these are the fossilized woods, which have become generally known. Mr. Kunz's report for 1895 mentions also moss agate at two localities in Wyoming and two in California; labradorite at Toronto, Ont., and Mont Shavano, Cal.; rhoderosite in Colorado and Utah; realgar at the Golden Gate Mine, Utah; and the largest black tourmaline known, monazite, and xenotine on Manhattan Island.

The Growth and Decay of Nations.—The following paragraphs are taken from an article in a recent Contemporary Review, by Thomas Hodgkin, D. C. L.: "It is a question which has been often discussed, and to which men's minds have often turned of late, whether states and nations have, like individual men, their necessary periods of infancy, childhood, adolescence, and old age, to be followed, in the one case as in the other, by death, which is the end of all. The analogy between the state and the man at once suggests itself; but analogy is not in itself proof: on the contrary, it is sometimes one of our most misleading guides. That many great and strong empires have faded and vanished away is obvious.

"'Assyria, Greece, Rome, Carthage, what are they?'

"But are we therefore forced to conclude that all states must die? Is it incumbent on the wise statesman to look forward to his country's death and to make provision for that event, as it is incumbent on each one of us individually to 'consider our latter end,' and so to order our affairs that those who come after us shall not have occasion to curse either our improvidence or our over caution? I suggest the question without presuming fully to answer it. Only I may hint that it does seem as if, for some reason or other, there were a greater tenacity of life among the nations of modern Europe than there was in most of the nations of antiquity; and that I do not see why, for practical purposes and for its influence upon conduct, we need look forward to an inevitable death of our country any more than to that death of the physical universe which, as philosophers tell us, is probable, perhaps inevitable, in some incalculably distant future age. But if death is not the inevitable doom of a state, it is quite certain that states are liable to something which we may without any strained analogy call disease. Looking back over the pages of history we can easily recall instances of states which have had their energies wasted by fierce attacks of fever; states which have suffered from raving madness; states which have overtasked their powers by undertaking labors beyond their strength and have died of overwork; states which have dropped noiselessly out of the ranks, the victims of senile decay. Since, then, there is such a thing as national disease, and since it threatens primarily the happiness and eventually the life of the state, a serious student of history will be ever on the alert to discover the symptoms of disease in the past life of nations, and to trace the manner of its working, in order that he may combat its first manifestations in his own country. In fact, I think we may say that this work, the study of political health and disease, is emphatically *the* business and the *raison d'être* of all history."

Adam Smith and Astronomy.—Mr. W. T. Lynn calls attention in a recent issue of The Observatory to the fact, not generally known, that Adam Smith, famous through his Wealth of Nations, was something of an amateur astronomer. He wrote a history in his younger days of astronomy up to the time of Newton. It was published in 1795, five years after the author's death. In view of the care which this author took to destroy all his manuscripts which he did not deem worthy of publication, his opinion of this *brochure* is of interest. The following paragraph occurs in a letter of his to Hume, dated at Edinburgh, April 16, 1773: "As I have left the care of all my literary papers to you, I must tell you that, except those which I carry along with me, there are none worth the publication but a fragment of a great work which contains a history of the astronomical systems that were successively in fashion down to the time of Descartes. Whether that might be published as a fragment of an intended juvenile work, I leave entirely to your judgment, though I begin to suspect myself that there is more refinement than solidity in some parts of it." The full title is The Principles which lead and direct Philosophical Enquiries, illustrated by the History of Astronomy."

The New York State Library.—The New York State Library, according to its last annual report, grew in 1897 from 198,700 volumes to 207,934 volumes in the State Library proper, with 33,739 volumes in the traveling and extension libraries, making with the 108,111 duplicates a total of 349,784 volumes. The policy is fairly started of building up one of the strongest education libraries; and the State has the best general law library in the country. Any registered physician in the State may borrow from the medical library without expense except for transportation. The use of the library in the evening has increased fivefold during the past five years. Scholars from a distance are more and more coming to Albany to make investigation; and lawyers and public men after other business is transacted often find the evening use of the library advantageous. Books are more and more sent from the shelf to institutions and scholars in all parts of the State, a thirtyfold gain having been realized in this function since 1889. Besides distribution to clubs and individuals, 19,750 volumes of State publications were sent out through the library last year to permanent depositaries. The preparation of syllabuses as guides to study for university-extension lectures, clubs, and individual students is growing in importance and promises to become one of the recognized departments of the library work. The library school, which is claimed to be the first of its kind in the world, continues to grow in strength and reputation; and it has been necessary to increase its facilities. Its usefulness has been generally recognized by librarians—in other countries as well as this.

Advantages of Large Telescopic Glasses.—The principal advantages of a large telescopic object glass—forty inches aperture in the special case as compared with a smaller one, ten inches—are summarized by Prof. George E. Hale as consisting of, first, its power of giving much brighter star images and thus of rendering visible faint stars that can not be seen with the smaller telescope; second, in the fact that it gives at its focus an image of the object enlarged in proportion to its greater diameter; and third, in its capacity of rendering visible as separate objects the components of very close double stars or minute markings upon the surface of a planet or satellite. The large glass has its disadvantages too, among the chief of which is that it requires better atmospheric conditions to bring out its best qualities. The discoveries of the fifth satellite of Jupiter and the two satellites of Mars were made with large telescopes, and could hardly have been made with smaller ones. Much fine detail on the moon which the author has never been able to see with the twelve-inch telescope is "clearly and beautifully visible" with the forty-inch. Micrometrical measures are effected with much more ease and certainty with the large telescope. "It is particularly in astrophysical research that a great telescope is advantageous. It is necessary in spectroscopic observation to have as much light as can be gathered into a single point, and for this a large glass is essential. It follows from these facts that great telescopes really have a mission to perform. While, on the one hand, they are not endowed with the almost miraculous gifts which imaginative persons would place to their credit, they do possess properties which render them much superior to smaller instruments and well worth all the expenditure which their construction has involved. In answering the question, 'Do large telescopes pay?' it is simply a matter of determining whether the work which can not be done without the aid of large telescopes is really worth doing."

New Features in School.—The report of the Superintendent of Schools of Springfield, Mass., tells of a new departure in the reading classes by substituting literary reading for the school readers of the old sort. "Ten years ago all the fourth and fifth readers were taken out of the schools, and literature and reading matter bearing directly on geography and history were introduced in their place. Since then all the third readers and nearly all the second and first readers have been displaced by reading matter which is intrinsically interesting to children. In point of quality, pupils in going through the grammar schools now read more good literature than pupils in any of the courses in the high school read a few years ago. Much of this literature is read in connection with the study of history." The superintendent expresses his belief that the time has come when no new schoolhouses shall be erected in the city without some provision for personal cleanliness in the way of facilities for bathing. This he regards as necessary for the health of the school, on account of the number of pupils who come from tenement houses and unsanitary quarters with skins in such a condition as to contaminate the air of the schoolroom. A school bath was first established in Göttingen, Germany, in 1883; and the example of that place has now been followed in about forty German, Swiss, and Scandinavian cities, where warm shower baths have been introduced into the common schools. At Charlottenburg, Prussia, the entire equipment of a bath accommodating fifty or sixty children an hour cost only three hundred and fifty-seven dollars. The study of music has been made elective in the Springfield school; and a department has been established in the high school, with the aim not of teaching the children to play or sing, but to appreciate the best classical music. The system of savings, auxiliary to the savings banks, established in the schools, works well, and the savings have materially increased. The teachers are supplied with stamps, which are sold to the children, and entries to their credit are made for the amounts. When the sum reaches a dollar, the child is urged to deposit it in one of the city savings banks, or he can draw it out for the purchase of necessaries.

Working of the Elective System in Colleges.—The results of the discussions concerning the elective system of study courses, as presented by Prof. A. P. Bingham in the Educational Review, have been its adoption into the common thought and the quiet extension of its range into our higher schools. "That can hardly be called a reputable college which has not admitted it in some measure. . . . In some cases the system has been adopted sparingly and timidly, as if under stress of competition. More often it has been received heartily up to a certain limit." The method of its application has, however, been very diversified, resulting in a great variety of schemes, a considerable number of which are reviewed and analyzed by the author. "No two colleges agree as to what studies are 'essential for all who are candidates for a liberal degree.' As to the working of the elective plan, the author believes that its risks are overestimated." No candid observer of college life can deny that free choice has promoted vital scholarship and hastened the growth of manly judgment in college students. It has revolutionized college teaching by sealing the doom of the lazy instructor. It has steadily extended its conquests, and is pushing its way into more colleges and over wider areas of the college course. That it should stand without important checks few would contend, but that the college student does not often abuse the elective privilege is, in the belief of the author, capable of proof. And a contribution to this proof is made from the records of the author's own college, Colgate University. Professor Bingham regards his study, as a whole, as indicating the sobriety, earnestness, and intelligence of the college man, and has no question that, "for the average man, sound habits of steady endeavor grow best in fields of choice."

MINOR PARAGRAPHS.

By availing himself of the properties of surface tension, M. Charles Henry has discovered a method of producing permanent coloration by the use of light-colors, without the aid of any pigment. Liquids having a superficial tension less than that of water are deposited on water in thin layers, where they reflect the colors of the spectrum. By whistling over this layer we obtain for each tone a vibration which is responded to by a special coloration, and a kind of molecular landscape is produced. The liquid, however, soon evaporates, and the play of colors vanishes. In order to preserve the colors, a fixed excipient is introduced into the liquid, which will retain the thickness of the pellicular layer, and the colors as well, after the essence has evaporated. Some resin or coal-tar substance is used for this, giving permanence to the pellicle and the picture. M. Henry has further devised a process for producing this pellicle and picture upon a solid foundation, as of wood, glass, or paper, and even for accomplishing it by mechanical processes. The nature of the ground in which the picture-pellicle is laid has much to do with its character. Dark grounds give intense colors, white grounds lighter ones, and grounds of intermediate colors various shades. The process is called *iri chromatime.*

The images left by uranium upon a sensitive plate locked up with it in the dark may be regarded as an effect of the fluorescent property that metal is known to possess. Dr. Russell has, however, described to the Royal Society experiments from which it appears that mercury, zinc, magnesium, cadmium, aluminum, nickel, pewter, bismuth, lead, tin, antimony, and cobalt give out radiations capable of affecting the sensitive plate, and will leave images of themselves after standing upon one in the dark for about a week, although they possess no evident luminosity. Gold, platinum, and iron exhibit little or no power of the kind. A figure scratched upon the polished face of a sheet of zinc repeated itself. The interposition of a coat of varnish between the metal and the plate served to increase the effect, while glass, which makes no difference when uranium is applied, stopped the action with the other metals. Some non-metallic substances, such as straw, wood, charcoal, and printer's ink, presented the same property of leaving images. A section of young larch wood printed its formation clearly on a plate, so that the rings and bark could be made out. In many cases the activity was increased by heating the body, and diminished by cooling it.

A silicified tree is described by Lewis Woolman in the Report of the Geological Survey of New Jersey which lies in the orange-colored sand near Lindenwold in that State. The farmer of the land having regularly plowed up pieces of silicified wood, Mr. Woolman and his friends dug for the stump. It measured seven feet six inches across at the base, which had been much broken by the plow, tapering to five feet two inches twelve feet higher up. Beyond this the central part of the trunk was missing, but the outer parts continued as two parallel arms, in line with the lower part of the trunk, to a total length of twenty-six feet. The silicification was perfect, and the rings of annual growth were plainly shown. An average of seventeen annual rings to the inch was determined, and the age of the tree when it fell was approximately estimated at six hundred years. Fragments split lengthwise and those broken directly across showed beautifully the structure of wood, and this is more minutely defined under the microscope. The orange-colored sand bed in which the trunk was buried, and the grounds of lighter yellow that overlie it near by, are known to have at least a local wide distribution.

NOTES

The general character of London weather is rather strikingly brought out by the records of the Greenwich meteorological department for 1897. The total record of sunshine for 1897 was 1,543 hours, divided as follows:

January	19.8	July	252.7
February	34.1	August	219.8
March	123.4	September	114.5
April	144.7	October	111.7
May	251.6	November	41.7
June	178.3	December	50.3

The mean temperature for the year was 50.3°; highest, 90.2° on June 24th; lowest, 23.3° on December 24th. The rainfall was about seventeen inches, being seven inches less than the preceding fifty years' average.

It is shown in a paper by Mr. Henry C. Mercer that the mediæval art of *Fractur* or illuminative writing was systematically prosecuted in Pennsylvania as late as 1854, and that survivals of stated instruction in it can be traced to the winter of 1896–'97. Illuminated song books, title-pages to small song books, rewards of merit on loose leaflets, baptismal certificates, and marriage and burial registers constitute the chief specimens of this sort of work.

The working of certain factors of evolution upon a human race is illustrated in Mr. G. A. Dorsey's paper on the Geography of the Tsimshian Indians. Although the members of this tribe to-day are only a remnant of the stock as it existed in 1850, they seem to be holding their own in point of population, while some of the other coast stocks are diminishing very rapidly. They are nearly all Christianized, wear European clothing, and work in the salmon canneries during the summer months. Yet their ultimate absorption and extinction are only matters of time. The new villages, and especially the canneries, are bringing the different stocks of the coast into more and more intimate relations, and this results in the disappearance of pure types. The introduction of the Chinese element may further complicate matters.

M. Deniker, of the Museum of Natural History in Paris, has received from Corea three hundred and seventy-five specimens of roots, seeds, fruits, etc., represented in the pharmacopœia of the country as sovereign remedies against various diseases. There are also among them powders of soapstone, sand, and other mineral substances. All are enveloped in complicated wrappers inscribed with Corean and Manchu formulas. A manuscript containing a list of a hundred and ten medicines which can be manufactured with the drugs has also been sent to the museum. It gives, in connection with each formula, the name of the disease for which the remedy is to be administered. There are remedies for cold in the head, indigestion, headache, ill humor on getting up in the morning, and indisposition after "making a night of it."

A species of ant in Victoria, Australia, is described by Mr. J. C. Goudie, which keeps in close confinement a mealy aphis that feeds on the stems of eucalyptus, around and over which it constructs a dome of pieces of grass, etc., that holds the aphis imprisoned and keeps other ants away. In front of the door of this covering, if it has one, two sentinel ants are posted, which vigilantly guard the opening. Each inclosure generally contains from three to a dozen aphides, and about as many ants. When the author broke into some of these structures to inspect them more closely, the ants at once seized their aphides and carried them off.

Sir Gardner Wilkinson observed more than fifty years ago that the ancient Egyptians had a keen appreciation of the comic, and published a considerable number of drawings from the monuments that fully established the correctness of his view. Further illustrations of the fact, given by Herr Emil Brugsch Bey, are published in French and German papers as new discoveries. A newly exhumed papyrus of the twenty second dynasty contains humorous sketches of cats and rats, in which the cats act like rats and rats like cats. In one design, a rat dressed as a grand lady is served by a servant cat, who offers her a mirror. In the next scene a rat poses as a young Egyptian dandy, while his valet cat dresses his beard and adjusts an immense wig upon his head. In a third scene a cat is officiating as nurse to a young rat. All the pictures are colored.

RICHARD QUAIN.

APPLETONS'
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OCTOBER, 1898.

THE RACIAL GEOGRAPHY OF EUROPE.*

A SOCIOLOGICAL STUDY.

(Lowell Institute Lectures, 1896.)

By WILLIAM Z. RIPLEY, Ph. D.,
ASSISTANT PROFESSOR OF SOCIOLOGY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; LECTURER IN ANTHROPO-GEOGRAPHY AT COLUMBIA UNIVERSITY.

SUPPLEMENT.—RUSSIA AND THE SLAVS.

ON the east, the west, and the north, the boundaries of the Russian Empire are drawn with finality. Its territory ends where the land ends. The quarter of this empire which is comprised in Europe is defined with equal clearness on three sides and a half. Only along the line of contact with western Europe, shown on our map facing page 724, is debatable territory to be found. Even here a natural frontier

* To a number of eminent anthropologists I am especially indebted for assistance in the collection of original Slavic materials used as the basis of this paper. Among these should be especially mentioned with grateful recognition of their invaluable aid: Prof. D. N. Anutschin, president of the Society of Friends of Natural Science, Ethnology, and Anthropology in the Imperial University at Moscow; Prof. A. Tarenetzky, president of the Imperial Military Medical Academy at St. Petersburg; Prof. Lubor Niederle, of Prague; Dr. Adam Zakrewski, chief of the Statistical Bureau at Warsaw; Dr. Talko-Hryncewicz, now in Transbaikal, Siberia; Dr. Olechnowicz, of Lublin; Dr. Matiegka, of Prague, and others. In the translation of the Slavic monographs, I have been aided by Charles S. Hall, Esq., of the Suffolk bar, and Dr. Leo Wiener, of Harvard University.

All references run to an exhaustive Bibliography of the Anthropology and Ethnology of Europe, which, after more than a year of unceasing application, is about to be issued as a special bulletin by the Boston Public Library. It will contain the complete title in the original language of every monograph to which reference is made. Through the courtesy and liberality of the librarian and trustees, together with the generosity of many Slavic authors, it is due that nearly all these papers, many of them rare, are now in the collections of the library.

runs for a long way on the crest of the Carpathian Mountains. To be sure, Galicia, for the moment, owes political allegiance to Austria-Hungary; but the Ruthenians, who constitute the major part of her population, are nowise distinguishable from the Russians, as we shall soon see. This leaves merely the two extremes of the Baltic-Black Sea frontier in question. The indefiniteness of the southern end of this line, from the Carpathians down, is one cause of that Russian itch for the control of the Bosporus which no number of international conventions can assuage. The Danube could never form a real boundary; a great river like that is rather a unifying factor in the life of nations than otherwise. Hence the great problems of the Balkan Peninsula. From the Carpathians north to the Baltic Sea, likewise, no geographical line of demarcation can be traced with surety. No water shed, worthy of the name, between the Dnieper and Vistula exists, although the one runs east and the other west not far from the present boundary of Poland and Russia. The former country is possessed of no sharply defined area of characterization. The State of Texas has as clear a topographical title to independent political life. The partition of Poland was in a measure a direct result of geographical circumstances. These have condemned this unhappy country, despite the devoted patriotism of her people, to a nondescript political existence in the future. By language the Poles are affiliated with Russia, not Germany; but in religion they are Occidental rather than Byzantine. Thus Poland stands to-day, padded with millions of politically inert Jews, as a buffer between Russia and Teutonism. It is a case not unlike that of Alsace-Lorraine. In both instances the absolute inflexibility of physical environment as a factor in political life is exemplified.

From the Carpathian Mountains, where, as we have said, Russia naturally begins, a vast plain stretches away north and east to the Arctic Ocean and to the confines of Asia; an expanse of territory, in Europe, eleven times as large as France.* Nor is it limited to Europe alone. Precisely the same formation, save for a slight interruption at the Ural Mountains, extends on across Asia, clear to the Pacific Ocean. European Russia, only one quarter the size of Siberia, is, however, the only part of immediate interest to us here. Nowhere in all its vast expanse is there an elevation worthy the name mountain. Even the most rugged portion, the Valdäi Hills in southern Novgorod, are barely one thousand feet high; they are more like a table-land than a geological uplift.

Whatever its local character, be it great peat swamps or barren steppe, the impression of the country is ever the same. Monotony

* Leroy-Beaulieu, 1881–'89, gives a superb description of the country. Its simple geology is shown by map in Petermann, xli, 1895, No. 6.

in immensity; an endless uniformity of geographical environment, hardly to be equaled in any country inhabited by European peoples. Thus is the geographical environment of the Russian people determined in its first important respect. Their territory offers no obstacle whatever to expansion in any direction; the great rivers, navigable for hundreds of miles, are, in fact, a distinct invitation to such migrations. On the other hand, this plain surface and the great rivers offer the same advantages to the foreigner as to the native; there is a complete absence of those natural barriers behind which a people may seek shelter from the incursions of others. The only natural protection which the region offers is in its dense forests and swamps. These, however, unlike mountains, offer no variety of conditions or natural products; they afford no stimulation to advance in culture; they retard civilization in the act of protecting it; they are better fitted to afford refuge to an exiled people than to encourage progress in a nascent one.

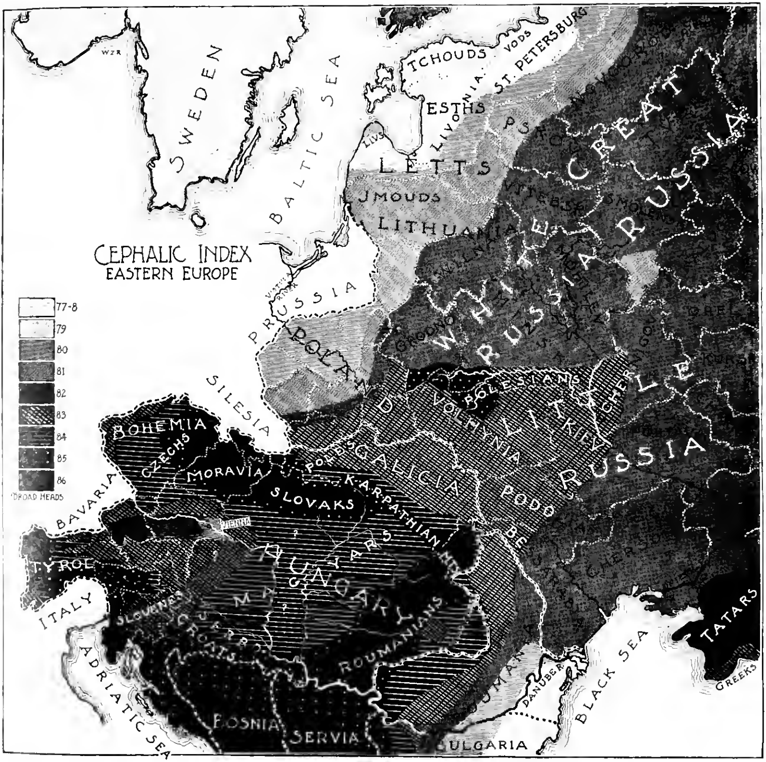
The second factor in determining a geographical area of characterization is its relative fertility. As we have observed before, this invites or discourages the movement of populations, in armies or in peaceful migration, just as much as the configuration of the surface makes this an easy or difficult matter. Judged by this second criterion, the territory of European Russia varies considerably. Leroy-Beaulieu divides it into three strips from north to south. The half lying north of a line from Kiev to Kazan (see map on page 731), constituting the forest zone, is light soiled; it varies from heavy forest on the southern edge to the stunted growth of the arctic plains. South of the forest belt, south of a line, that is, from Kiev to Kazan, lies the prairie country. This is the flattest of all; over a territory several times the size of France, a hill of three hundred and fifty feet elevation is unknown. This prairie or woodless strip is of surpassing fertility—the so-called Black Mold belt, just south of the forests, rivaling the basin of the Mississippi in its natural richness of soil. From this the country gradually becomes less and less fertile, with the decreasing rainfall, as we go south. This brings us at last to the third region, that of the barren steppes, or saline deserts, which center about the Caspian Sea. These are found also less extensively north of the Crimean Peninsula, as far west as the lower Dnieper. Their major part lies south and east of the Don River. As Leroy-Beaulieu observes, the real boundary between Europe and Asia, viewed not cartographically, but in respect of culture and anthropology, lies not at the Ural River and Mountains at all, where most of our geographies place it. Sedentary, civilized, racial Europe, roughly speaking, ends at a line, shown on our map, up the Don from its mouth to the knee of the Volga, thence up the latter and away to the northeast. This brings us to Asia, with its terrific extremes of continental climate, with its barren steppes, its slit-eyed Mongols, and its nomadic and imperfect culture.

A word must be said, before we proceed to the physical anthropology of Russia, as to the languages which are spoken there. The true Russians form about one half the population of the European portion of the country; the rest are Letto-Lithuanians, of whom we shall speak in a moment, Poles, Jews, Finns, and Mongols, with a sprinkling of Germans. The true Russians are divided into three groups of very unequal size.* These are said to differ not only in language, but in temperament as well. About fifty of the seventy-odd millions of them, known as Great Russians, occupy the entire center, north, and east of the country. These are the "Muscovites," their historic center being in the ancient capital city of Moscow. Next in numbers come the people of Little Russia, or Ukraine, which, as our maps show, inhabits the governments of the southwest, up against Galicia. They in turn center politically in Kiev, covering a wedge-shaped territory, with its point lying to the east in Kharkov and Voronesh. The Cossacks, who extend down around the Sea of Azof into the Kuban, are linguistically Little Russians also. The third group, known as the White Russians, only four million souls in number, is found in the four governments shown on our maps, extending from Poland up and around Lithuania. This White Russian territory is flat, swampy, and heavily forested, in strong contrast to the fertile, open Black Mold belt of Little Russia. In topography and in the meagerness of its soil White Russia is akin to the sandy Baltic provinces from Lithuania north. Linguistically, the White and Great Russians are closely allied; the dialect of the Little Russians is considerably differentiated from them both. This is probably due to the Tatar invasions from the east across middle Russia. In face of these the Great Russians withdrew toward Moscow; the White Russians took refuge in their inhospitable swamps and forests, while the population of the Ukraine was left to itself at the south.

Entirely distinct from the Slavs in language is the Letto-Lithuanian people, which, to the number of three million or more, occupies the territory between the White Russians and the Baltic Sea extending down into northern Prussia.† Their speech, in the comparative isolation of this inhospitable region—an isolation which made them the last people in Europe to accept Christianity—is the most archaic member of the great Aryan or inflectional family. Standing between Slavic and Teutonic, it is more primitive than

* Rittich, 1878 b, has mapped their distribution in minute detail.

† Müschner and Virchow, 1891, have studied these Prussians.


CEPHALIC INDEX
EASTERN EUROPE
77-8
79
80
81
82
83
84
85
86
BROAD HEADS
SWEDEN
BALTIC SEA
TCHOUDS
VODS
ST. PETERSBURG
ESTHS
LIVONIA
LIVS
LETTS
JMOUDS
LITHUANIA
GREAT RUSSIA
WHITE RUSSIA
PRUSSIA
POLAND
GRODNO
SILESIA
POLESTANS
VOLHYNIA
KIEV
LITTLE RUSSIA
BOHEMIA
CZECHS
MORAVIA
SLOVAKS
KARPATHIAN
GALICIA
PODO
VIENNA
BAVARIA
TYROL
HUNGARY
MAGYARS
ITALY
SLOVENES
CROATS
ROUMANIANS
ADRIATIC SEA
BOSNIA
SERVIA
BULGARIA
DANUBE
BLACK SEA
TATARS
GREEKS

either. Three tribes or peoples of them coexist here: Letts, Jmouds or Samogitians, and Lithuanians proper, as shown on our map. Contact with the Finnic-speaking peoples north of them—Esths, Livs, Tchouds, and Vods—has modified the purity of the Lettic speech considerably. These Finns, in turn, speak a language like that of the Magyars in Hungary, and the Basques, which is not European at all. It is similar in structure to the primitive languages of Asia and of the aborigines of America. It represents a transitional stage of linguistic evolution, through which the Aryan family has probably passed in earlier times. But the language of the Letto-Lithuanians, while primitive in many respects, bears no relation structurally to the Finnic; it is as properly Aryan as the speech of the Slavs.

The perfect monotony and uniformity of environment of the Russian people is most clearly expressed anthropologically in their head form. Our results are shown graphically, it is believed for the first time, by the accompanying map of cephalic index. The proportions of the head, as we have sought to prove in our previous papers, are to-day regarded as perhaps the most indubitable test of racial derivation for Europe, at least. The cephalic index is merely the breadth of the head in percentage of its maximum length from front to back. Thus a cephalic index of 82 means that the head is $\frac{82}{100}$ as broad as it is long. A rise of index implies an increasingly broad or short head. Low indexes mean long heads; high ones denote a round or bullet-shaped cranium. Of course, as we must reiterate, our indexes are merely the averages for great numbers of individuals. They express more or less roughly the central type toward which the populations as a whole tends.

Bearing in mind that the Poles and Letto-Lithuanians along the Baltic Sea are not Russians properly, and excluding, of course, the Tatars of the Crimea, a moment's consideration of our map * shows at once a great similarity of head form prevailing all over Europe from the Carpathian Mountains east and north. The cephalic index oscillates but two or three points about a center of 82. This is about the head form of the northwestern French; appreciably

* Our data for this map may be found mainly in the original and excellent compilation of Niederle, 1896 a, pp. 54–57. Additional material of great value, especially from unpublished sources, is given in Deniker, 1897 and 1898 a; while his work, announced *in extenso* (1898 b), promises to give the most notable results. An especial feature will be his map of the cephalic index of Europe, prepared through the munificence of Prince Roland Bonaparte. It will be a contribution unsurpassed for comprehensiveness. We had, prior to the knowledge of these, independently collected data from the original sources, published in L'Anthropologie, vol. vii, 1896, p. 513, in part; but these later authorities agree so perfectly with our own observations, that reference to them is sufficient. We can only add certain unpublished data on the Magyars from Dr. Janko, of Buda-Pesth; Talko-Hryncewicz's (1897) recent observations in Podolia; Varobdev on the population of Great Russia; etc.

broader, that is to say, than the standard for the Anglo-Saxon peoples. In places the breadth of head in Russia increases, especially among the Polesians isolated in the marshes of Pinsk and along the swamps of the Pripet River. These people are supposed to be infused with Polish blood, which may account for it,* as the southeastern Poles are quite brachycephalic (broad-headed). At other times, as in southern Smolensk, the index falls to 80.† Our widest range of variation in Russia is about five units. Compare this with our former results for western Europe. In France, less than half the size of this portion of the Russian people covered by our map, the cephalic index runs from 78 to 88. In Germany the limits are about the same; while in Italy, only one eighteenth the size of European Russia, the head form changes from an index of 75 in Sardinia to one of 89 in the Alps of Piedmont. These are about the extremes of long- and broad-headedness presented by the human species; the Russian type is about midway btween the two.

One cause of this unparalleled extension of a uniform type, measured by the proportions of the head—a variability, notwithstanding the size of the country, only about one third of that in the restricted countries of western Europe—is not far to seek. It lies in the monotony of the Russian territory, which we have emphasized above. Once more are we confronted with an example of the close relation which exists between man and the soil on which he lives. A variety of human types is the natural accompaniment of diversity in physical environment. Intermixture and comparative purity of race may coexist side by side. Switzerland and the Tyrol offer us violent contrasts of this sort. Russia, devoid of all obstacles in the way of fusion, presents a great mean or average type, about halfway between the two limits of variation of which the European races elsewhere can boast. But pass beyond the foothills of the Caucasus, and behold the change! A Babel of languages—no less than sixty-eight dialects, in fact—and half as many physical types, of all complexions, all head forms, and all sizes. Truly it seems to be a law that mountains are generators of physical individuality, while the plains are fatal to it.

The population of Russia is not alone made up of Russians. We have in our preceding paragraph expressly excluded the population of the Baltic provinces. For the Letto-Lithuanians are not Slavs, as we have already observed, and of course the Finnic peoples, Esths,

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* Talko-Hryncewicz, 1894, p. 159, on the anomalous position of the Polesians. Rittich, 1878 b, divides them dialectically between White and Little Russians. Talko-Hryncewicz, 1893, p. 133, and 1894, p. 172, gives his observations on head form. The seriation points to a strong brachycephaly.

† Deniker asserts an index of 80.8 in southern Vollhynia and of 86 in southern Kiev; but I am unable to confirm it by adequate data.

Tchouds, and Vods, are still more distinct. Our map at once brings the peculiar head-form of these groups into strong relief. All along the frontier of Germany, and away up to Finland, a strong tendency to long-headedness is manifested. This contrast, as it appears to the ordinary traveler, is exemplified in our portraits. A narrow head generally is accompanied by a rather long and narrow face; our Mongol types, with their very round bullet heads, are characteristically broad and squarish-faced. This is partially due to the prominence of the cheek bones. It is this latter characteristic of our American aborigines which gives them their peculiar Mongol aspect. I have observed the very broad face to be one of the most persistent traits in the cross-breeds. Dr. Boas has proved it statistically. Even a trace of Indian blood will often cause this peculiarity. Now, the Russians express their relative broad-headedness, as compared with the Letto-Lithuanians and Baltic Finns, in the relatively squarish form of their faces.* The Volga Finns, on the other hand, with more admixture of Mongol blood, are perceptibly broader faced. Our portraits make this difference apparent at once.

South and west of the Carpathian Mountains a second great division of the Slavs exists. This includes the Poles, Czechs, Slovaks, Moravians; and—divided from them by the intrusive Magyars, who speak a Finnic language—the Slovenes, Serbo-Croatians, and Bosnians in the south. This *congeries* of scattered Slavic nationalities seems to be, for some reason, politically adrift in Europe. The Bulgars and Roumanians belong to a still different class. For the former, while Slavic in speech, is quite distinct in physical derivation; and the Roumanians, in origin probably allied to the Slavs, speak a corrupted Romance language. Matters are indeed becoming mixed as we approach the Balkan Peninsula. This entire group of southwestern Slavs is characterized by a very prevalent broad-headedness, much more marked than among the Russians, as Weisbach has been proving for twenty-five years. Their brachycephaly is directly conjoined to that of the Alpine highlands in the Tyrol, where we pass beyond the limits of Slavdom, and enter the territory once occupied by the Celts. Our map points to a once universal broad-headedness over all the present Austro-Hungarian Empire, from which a spur seems to extend over into Little Russia, becoming lost in an expanse of longer-headedness in the plains beyond. All the mountainous regions are still characterized by brachycephaly; it is a repetition of the law which holds good throughout western Europe. This brachy-

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* Talko-Hryncewicz, 1893, p. 169, and Majer and Kopernicky, 1885, p. 59, show the round broad face of the Poles in Galicia, as compared with the Ruthenians. The Carpathian mountaineers seem to be anomalously long-faced. (Kopernicky, 1889, p. 49.)

Great Russian. Vladimir Government. Cephalic Index, 84.2.

Great Russian. Vladimir Government. Cephalic Index, 82.

Tatars. Goursuf, southern Crimea.

Slavic Types (with Tatars).

cephaly is tempered only in those districts like Austria, where we know both from language and history that the Teutonic influence has been strong. Other physical traits will corroborate this deduction shortly. Yet these Austrian Germans are to-day only distantly related to the blond Scandinavian Germans along the Baltic. They resemble the Bavarians and Swabians, who are, as we know, a cross between the blond Teutonic race and a thick-set, broad-headed Alpine one. Leaving aside for the moment the long-headed strip on the Black Sea, shown by our map, we can not resist the final inference that all this part of Europe, now inhabited by the southern Slavs, is fundamentally Alpine in racial type, although eroded in places by Teutonic influences from the north, and disturbed by the volcanic irruption of the Finnic Magyars and the Turkish Bulgarians.

The word Russian is undoubtedly derived from a root meaning red. Our adjective *rufous*, and the name Ruthenian, applied to the inhabitants of Galicia, bear the same signification. The name is aptly applied, for the Russians, wherever found, are characterized by a distinct tendency toward what we would term a reddish blondness. Janczuk, in the government of Minsk, in White Russia, found almost half his peasants to have hair of this shade.* It is not a real red, however. It might be called either a light chestnut, a dark flaxen, or an auburn tint. This shade of hair, combined with what Talko-Hryncewicz terms a "beer-colored" eye, is the center from which variation up or down occurs. This range of variation is quite considerable, and seems to conform to the general law for all Europe, to which we have already called attention.† Brunetteness increases regularly from north to south. In Russia the population also manifests a distinct tendency toward darker hair and eyes from west to east. The Baltic Sea is the center of distribution for blondness, here as in Germany. The relations are well illustrated by the following table; statistics offer merely a scientific confirmation of the facts of common observation:

Percentage of Types (Hair, Eyes, and Skin combined).	176. Letto-Lithuanians.	961. White Russians.	252. Podolians.	2,619. Little Russians.	188. Ruthenian mountaineers.	22,682. Great Russians.
Blond	67	57	55	33	28	40
Mixed	28	31	29	16	32	40
Brunette	5	11	18	20	40	20

These figures show that the Letto-Lithuanians are the lightest people in the group. They are characterized most frequently by a blue eye, and light hair which rivals the Swedes and Norwegians in

* 1890 b, col. 69.

† Popular Science Monthly, vol. l, April, 1897, p. 765.

its purity.* Two thirds of these Baltic peoples appear as pure blondes. The Poles are nearly as light, apparently. Majer and Kopernicky,† in fact, found more blond types among adults even than Virchow did among his German school children, and this, too, despite the fact that the blondness of the latter would surely decrease with growth. Next to the Poles and Letto-Lithuanians come the White Russians and the people of Podolia (see map facing page 724), with still a majority of blond types. The Great Russians are somewhat darker, but even they are appreciably lighter in complexion than the little Russians in the southern governments. These Ukainians are still blue or lightish in eye, but betray a strong disposition to dark-brown hair. This latter is here as common as the light brown.‡ The "beer-colored" eye, in most frequent combination with really dark hair, brings us to the culmination of brunetteness among the Galicians in the Carpathian Mountains. These Gorali, as our table indicates, in contrast with the Letto-Lithuanians, show the clear brunette at last outweighing the blond. The name "black Russians," applied to these mountaineers to distinguish them from the Ruthenians, or "red Russians," of the plains of Galicia, appears to be deserved. They seem to contain twice as many clear brunette types as the Ukrainians, who are in Russia accounted dark. Beneath all these variations, however, underlies the rufous tendency of which we have spoken. It distinguishes the Russian blondness from that of all other Europeans.

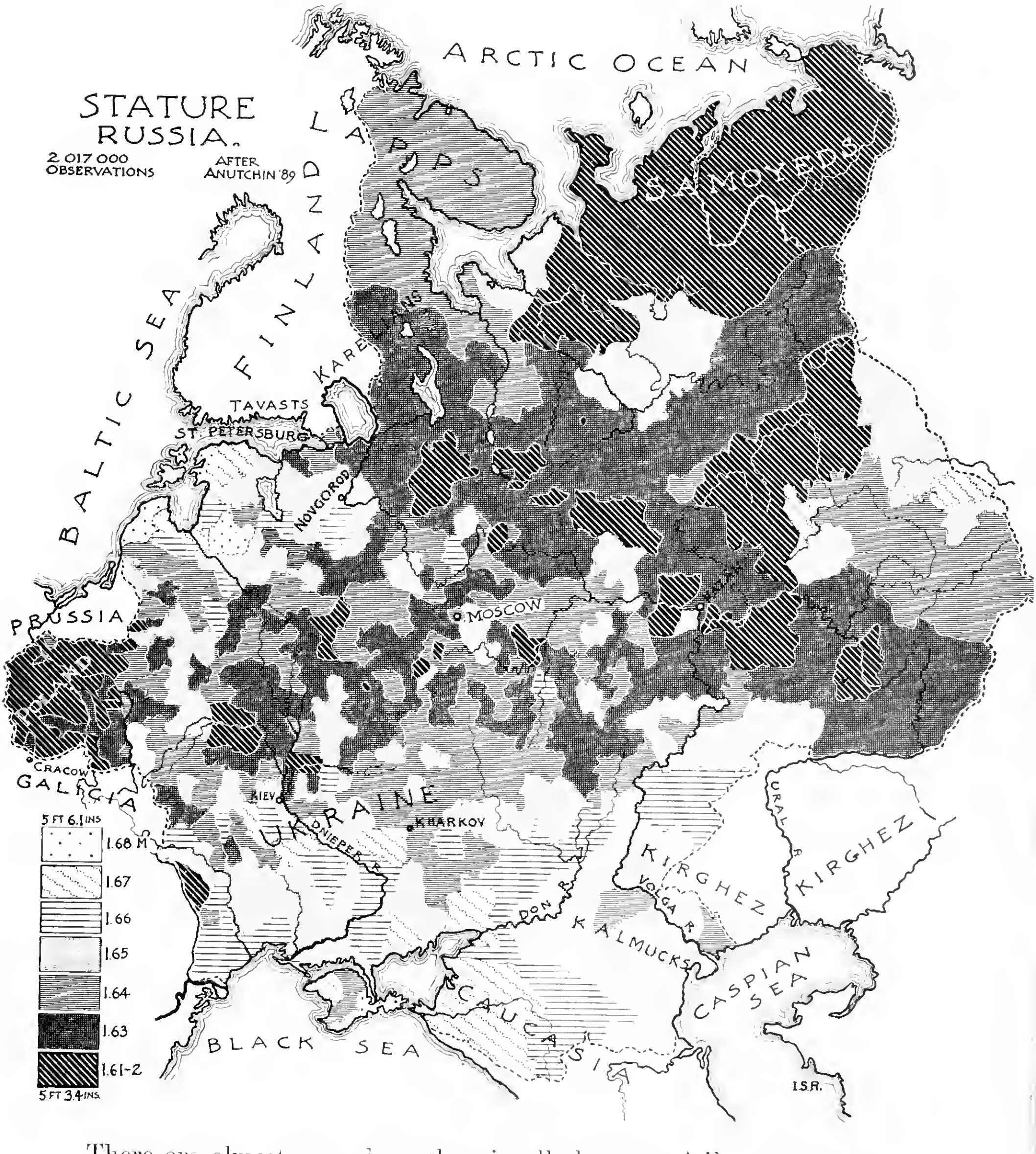
In stature the Russians are of medium height, but they betray the same susceptibility to the influences of environment as other Europeans Our map, herewith, illustrates this clearly. This investigation of upward of two million recruits, by the eminent anthropologist Anutchin, shows a considerable variation according to the fertility of the country. Thus in the northern half, above Moscow and Kazan, the adult males are two inches shorter than in the Ukraine about Kiev, which lies in the heart of the Black Mold belt. The difference between White and Little Russians is due to the same

* Talko-Hryncewicz is the only observer who has consistently applied a uniform system of observation to various localities. This table, arranged from his works of 1893, p. 112, 1894, p. 168, and 1897, p. 279, presents the best summary of his conclusions. He has covered Lithuania, White and Little Russia. We have added results from Majer and Kopernicky, 1877, p. 112, and 1885, p. 43, and Kopernicky, 1889, as to the Ruthenians and Poles in Galicia. We add, although not strictly comparable, Zograf's (1892 a, p. 165) results on the Great Russians. More definite comparisons, yielding, however, entirely parallel results, may be drawn from the color of the hair alone. Thus we may include the Poles and even the southern Slavs as far as Bulgaria. To the tables in Talko-Hryncewicz's papers may then be directly added Weisbach's observations over a large field. Niederle, 1896, pp. 60 *et seq.*, has done this most satisfactorily.

† 1877, pp. 90 and 112, and 1885, p. 34. Elkind's results (1896) also show a marked blondness.

‡ Tschubinsky, 1878, p. 364, confirms these results.

cause. Other influences besides physical environment are, however, at work, beyond question. This is especially the case in Poland. This unhappy country is the adopted fatherland of millions of Jews.



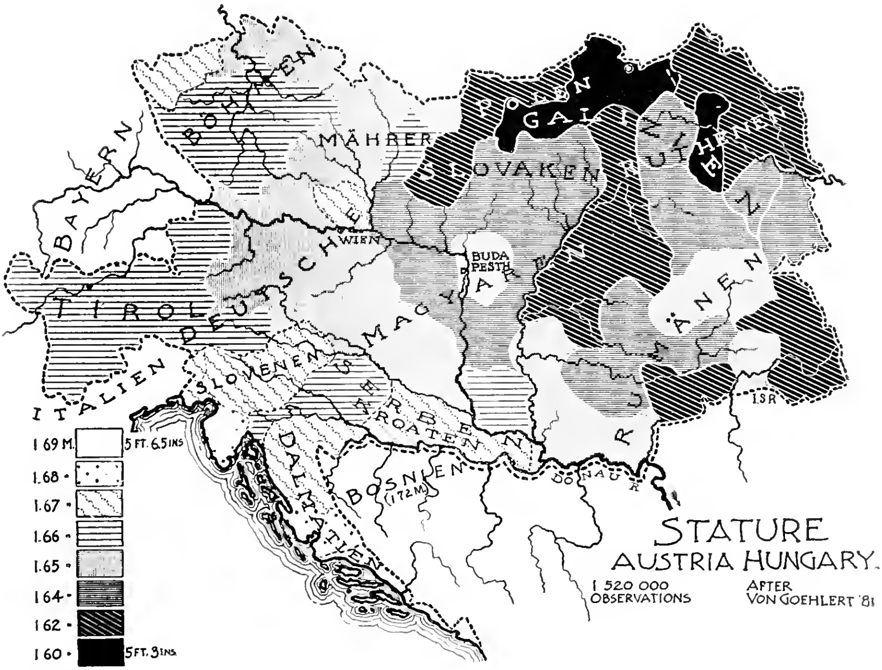
There are almost more here than in all the rest of Europe put together. These Jews are one of the most stunted peoples in Europe. In how far this is the result of centuries of oppression, and in what degree it is an inherent ethnic trait, we need not stop to consider. It is an indisputably proved fact. The presence of this horde of Jews, in Poland often outnumbering the natives, especially in the towns, is largely accountable for the short stature shown by our map. This does not exonerate the Poles by any means from the charge of relative diminutiveness. The degree in which they are surpassed by their Slavic neighbors is shown by our map on the next page. Comparisons with Russia are facilitated by the uniformity of tints. Yet even here in Austria-Hungary the shortness of the Poles and Ruthenians, which together form the population of Galicia, may be partly attributable to the large contingent of Jews.

The clearest example of stature as an unmitigated ethnic trait, hereditary and persistent, is shown in the eastern half of Austria-Hungary, on our second map. Notice the lightness of shading among all the Germans (Deutsche) in Austria, in the Tyrol, and in the northwestern corner of Bohemia (Böhmen). These are just the districts where Teutonic infiltration from the north has been historically proved since early times. We have already mentioned it in our study of the head form. The German-speaking Austrians, then, are by nature, and not by acquisition, an inch or two taller than many of the Slavic peoples subject to their political domination. It is the same phenomenon already so familiar to us in the case of the relatively gigantic Burgundian peasantry in France to-day; in the tallness of the people of Lombardy; and, above all, in the Teutonized eastern half of the British Isles. This latter example comes directly home to us, because we in America owe a large measure of our surpassing stature to the same ethnic cause. Never has a physical trait shown so surprising a persistency as in the height of these Teutonic peoples.

Just here a difficulty confronts us—one which no anthropologist has satisfactorily explained. Our second map shows a very tall population among the southern Slavs, the Slovenes, Serbo-Croatians, and Bosnians, contrasted with the short Poles, Ruthenians, and Slovaks in the northeast. This can not historically be traced to a Teutonic ancestry. Anthropologically it is even less probable, because these southern Slavs are all very dark in hair and eye, being in this respect as in head form the polar extreme from the Teutons of the north. A distinct subcenter of giantism, inexplicable but established beyond all doubt, exists just east of the Adriatic Sea. Its influence radiates through the Slovenes over into northeastern Italy. We find indication of it in the Rhætian parts of Switzerland. Deniker, in his recent classification of the anthropological types of Europe, carries it even further, under the definite name of the Adriatic or Dinaric race.* Can it be denied that the tallness of

* 1898 a, with map. We emphasized the same fact in our general stature map of Europe in the Popular Science Monthly, li, May, 1897, p. 30.

the Tyrolese, who in their mountainous habitat, despite the depressing influence of their environment, surpass the Swiss, the Bavarians, the Austrians, and the Italians, may not possibly be due to a double ethnic source? At just this point in the Tyrol the Teutonic wave of tall stature from the north and the Adriatic one from the south come



together. Thus an exception to the law that, other things equal, the populations of mountains are unfavorably affected in stature by their environment may possibly be explained.

Turning back to our map of stature in Russia, on page 731, we observe a distinctly lighter shading—that is to say, a taller stature along the coast of the Baltic Sea. This is merged in the mediocre stature of the Great Russians, a little east of Novgorod. Although unfortunately our map does not give the data for Finland, we know that a similar superiority of stature extends all across this province. All the Finns in this part of Russia are very tall. G. Retzius, Bonsdorff, Hjelt, Eliséev, and all observers agree in this. An average

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NOTE.—This map seems to give average statures slightly lower than those of other observers, like Weisbach, Korösi, and Janko; but, on the other hand, they are corroborated by Scheiber, Majer and Kopernicky, and Zuckerhandl. In all cases the relativity of the various districts is precisely the same; it is confirmed by the maps for the empire by Le Monnier and Myrdacz. It seems to fit perfectly the results for neighboring countries, given by Livi, Zakrezewski, and Anutchin.

height not a whit less than that of the pure Scandinavians in Norway and Sweden is proved. It lessens toward the north in contact with the Lapps, most stunted of men at an average of only five feet for adult males. It decreases on the east among the Karelian Finns, falling rapidly to the Russian average. Bear in mind that in no other part of northern Europe, save in Scandinavia, just across the Baltic Sea, is an average stature anywhere near that of the Finns to be found; that a cross with the Swedes in consequence is inadequate as an explanation for this tallness; that wherever there is contact with the Slav, precisely as in Austria-Hungary, where, as we have seen, an ethnic trait ran up against Slavdom, the bodily height falls to mediocrity; and draw the only inference possible both from geography and physical anthropology. We shall deal with the philologists later. The Finn and the Scandinavian are at bottom of the same race.

Summarizing our results thus far, we find two physical types more or less clearly coexisting in the Russian people, and throughout all the Slavs, too, for that matter. One is tall, blondish, and long-headed; the other is brachycephalic, darker-complexioned, and of medium height. The relative proportions of each vary greatly from one region to another. Among Lithuanians and Poles, the former is more noticeable; in the Ukraine the other type becomes more frequent; the Great Russians stand between the two; while among the southern Slavs the blond, long-headed variety entirely disappears. Not only do the relative proportions of these component types vary from one region to another. Distinct differences in the several social strata of the same locality appear. The tall dolichocephalic blondes are more characteristic of the upper classes as a rule, so far as the matter has been examined.* Our results for western Europe are entirely harmonious with this tendency. And, thirdly, it is curious to note that the relative proportions of these two ethnic types have changed entirely since prehistoric times. This point is of so great significance that we must examine it a bit more in detail.

Nowhere else in Europe is the complete submergence of an old race by an intrusive one more clear than in the Slavic portion of Europe. Bogdanof, founder of Russian archæology, devoted his entire life to proof of this fact in his own country.† The first indications of this submerged aboriginal population were given by crania

* Olechnowicz, 1893, 1894, and 1897, has obtained some highly interesting results among the "petite noblesse" in Poland. Talko-Hryncewicz, 1897, confirms it, in Bull. Acad. Science, Cracow.

† The facts yielded by his first investigation in 1867 have been confirmed by every observation since. We are fortunate in that a complete summary of his life work was given by himself at the International Congress of Anthropology at Moscow in 1892. Titles of all his monographs will be found in our bibliography above mentioned.

Blond Lithuanian.

Finn. West coast, Finland. Cephalic Index, 78.

Cheremiss. Volga Finns. Mordvin.

Finno-Teutonic Types.

from the tumuli which are scattered all over Russia from the Carpathians almost to the Ural chain, and even beyond in Siberia. These Kurgans, so called, are merely large mounds of earth from twenty to fifty feet high, sometimes single, sometimes arranged in series for miles. They are not unlike the simpler relics of our own mound builders. The dead level of the country makes them in the open prairies often of great service to herdsmen in tending their flocks. These tumuli were found for the most part to date from the stone age; no implements or ornaments of metal were unearthed in them. The absence of weapons or utensils of war in the Kurgans also denoted a peaceable folk. The population must have been considerable, for these tumuli are simply innumerable. The men of this prehistoric period betrayed a notable homogeneity of type, even more uniform than that of the modern living population. The crania were almost invariably of a pure, long-headed variety; the cephalic indexes ranging as low or lower than that of the purest living Teutonic peoples to-day. Remembering that the modern Russians are well up among the moderately broad-headed Europeans, it will be seen what this discovery implied. Nothing else was known save that this extinct people were very tall, considerably above the standard of the Russian mujik to-day. The most obvious explanation, in view of the fact that Finnic place names occurred all over Russia, was that these tumuli were the remains of an extinct substratum of Finns, driven out or absorbed by the incoming Slavs. Their civilization, made known to us by Uvarof, and more recently by Inostranzef, was definitely connected with that of the Merian people, so called by the historians.

Soon a new and significant point began to be noted. While the range of this primitive long-headed people, so different from the living Russians, was distinctly set on the north and east, no definite limits could be set to it toward the southwest. In the meanwhile Kopernicky and others, from 1875 on, began to find evidence of the same dolichocephalic stratum of population, underlying all the Slavs in Podolia and Galicia.* Their track has been followed, entirely antedating the modern Slavs, down into Bohemia and Moravia, by Niederle † and Matiegka,‡ and as far as Bosnia, where, in the great discoveries at Glasinac,# the existence of this same aboriginal population was abundantly proved. On the west, Lissauer followed it across Prussia beyond the Vistula. || Thus on every side it was traced to the

* Kohn and Mehlis, 1879, give a complete *résumé* of Kopernicky's results in an excellent work which seems to be little known. See especially vol. ii, pp. 108–110, 152, 153.

† 1891 a, 1894 a, p. 277, and best of all in his masterly work of 1896 a, pp. 67–75, where he gives data for all Slavic countries in detail. His paper in French, at the Moscow Congress of 1892, gives a mere outline of the results obtained. Palliardi, 1894, deals with Moravia also. ‡ 1892 b, and 1894 a. # Glück, 1897 c, p. 575. || 1874–'78.

limits of Slavdom, and found to underlie it throughout. Two explanations were suggested for this widespread phenomenon. Bogdanof and a few others asserted that civilization implied an increased broad-headedness, that a morphological change had taken place in the same people, while the majority of anthropologists found in it proof of an entire change of race since the earliest times. The first explanation, even granting that the brachycephalic races as a rule are endowed with a greater cranial capacity than the long-headed ones, could hardly be accorded a warm reception in any of the Anglo-Saxon countries like our own. To relegate long-headedness to an inferior cultural position would result not only in damning the entire Teutonic race, but that one also which produced the early Semitic, Greek, and Roman civilizations. No explanation for the recency of broad-headedness in the Slavic countries is, then, tenable for a moment, save that the brachycephalic contingent is a newcomer in the land.

Which of these two ethnic elements which have contended so long for mastery among the people of this part of Europe represents the primitive Slavic type? It is a delicate matter, by no means free from national prejudice. The Germans have always looked down upon their eastern neighbors, by reason of their backwardness in culture. Our ignoble word "slave" is a product of this disdain in Europe of the Slav.* To find the primitive Slavic type, therefore, in that variety, which accords so completely with our pattern of the Teutonic race, is disheartening to the Germans as for the Slavs themselves; it runs counter to their distrust of modern aggressive Teutonism. Even science is not free to violate the provisions of the Triple Alliance with impunity.

The most generally accepted theory among anthropologists as to the physcal relationship of the Slavs is that they were always, as the majority of them are to-day, of the same stock as the broad-headed Alpine (Celtic) race. This latter occupies, as we have seen, all the central part of western Europe. It predominates among the north Italians, the French in Auvergne and Savoy, and the Swiss. It prevails in the Tyrol and all across southern Germany, in Alsace-Lorraine, Würtemberg, and Bavaria. The French anthropologists, especially Topinard, have emphasized the direct similarity in head form which exists between all these people and the Slavs. The name Celto-Slavic has been applied to this broad-headed race by virtue of this fact. It was a logical deduction from the first discovery of broad-headedness among the Slavs by A. Retzius, von Baer, and Weisbach. The main objection to it came from the philologists, who found the Slavic

* Consult Canon Taylor, Words and Places, p. 303, and Leroy-Beaulieu, 1893–'96, i, p. 97, on this.

languages much nearer the Teutonic than the Celtic branch. This Celto-Slavic theory, affirmed by the French anthropologists, mainly on the ground of similarity of head form, is generally sustained by the Germans on the basis of their investigations of relative brunetteness among school children.[*] These have all tended to show that the Slavonized portions of Germany and Austria were darker than the purely Teutonic ones.

The native anthropologists are divided in theory as to the type of their Slavic ancestors. No one pretends to question the facts in the case; the divergence of opinion is merely as to which stratum of population, which region, or which social class of the two we have described, is entitled to claim the honored title. Thus Anutchin,[†] Tarenetsky,[‡] Talko-Hryncewicz,[#] Olechnowicz,[‖] Kopernicky,[△] Pic,[◊] Ikof,[‡] and Janczuk[‡] identify the modern broad-headed population as a Slavic invader of originally Finnic territory; while Bogdanof,[‡] Zograf,[**] and especially Niederle,[††] represent the claims of the extinct Kurgan people to the honored name of Slav. Leroy-Beaulieu seems to represent a popular tendency in favor of this latter view.[‡‡] For our own part, we rather incline to agree with Matiegka that it is a question which the craniologists are not competent to settle.[##] That the Alpine (Celtic) racial type of western Europe is the best claimant for the honor seems to us to be the most logical inference, especially in the light of studies of the living aborigines of Russia, to which we must now turn.

Three ethnic elements are generally recognized as component parts of the Russian people—the Slav, the Finn, and the Mongol-Tatar. The last two lie linguistically outside the family of related peoples which we call Aryans, the only other non-Aryan language in Europe being the Basque.[‖‖] In any classification of them, according to their physical characteristics, we must, however, set aside all the evidences of language as untrustworthy. To admit them as a basis of classification would involve us at once in inextricable confusion.[△△] These tribes have all been more or less nomadic for ages

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* *Vide* our article on Germany in Popular Science Monthly, vol. lii, November, 1897, p. 67. Kollmann, 1882 b, and Ranke, 1886–'87, vol. ii, p. 267, dissent from it. *Cf.* Rhamm in Globus, vol. lxxi, No. 20.

† 1892, pp. 279–281. ‡ 1884, pp. 63–65. # 1893, p. 171.

‖ 1893, p. 37; 1895, p. 70. △ Kohn and Mehlis, vol. ii, pp. 114, 153, and 164.

◊ Athenæum, Prague, vol. viii, p. 193. ‡ 1890, col. 103.

‡ 1890 a, col. 202. ‡ 1892, pp. 10 and 13. ** 1896, p. 63.

†† 1891 a, 1892 a, and especially in his positively brilliant 1896 a, pp. 59 *et seq.* Consult his answer to criticisms, 1891 b, and in Globus, vol. lxxi, No. 24 also. His bibliography of the subject is superb. ‡‡ 1893–'96, vol. i, pp. 96 and 108. ## 1891, p. 152.

‖‖ *Vide* Popular Science Monthly, vol. li, September, 1897, p. 613.

△△ The errors of such a classification are well exemplified in Leroy-Beaulieu's otherwise excellent work, in which his aborigines are utterly confused in relationship. Rittich in all in this great plain country; they have taken on and put off customs, language, and religion time and again, according to circumstances. The latter characteristic, religion, in fact, affords us a far better standard for ethnic classification than language, for the Finns have persisted in Christianity, the Turks and Tatars have held to Mohammedanism, and the Mongols proper to Buddhism, with a remarkable constancy. The varying proportions of barbarism in each group are well illustrated by this fact; for in race, as in religion, the Finns are truly indigenous to western Europe, the Tatar-Turks are Oriental, while the Mongols proper are Asiatic.

The evils incident to any linguistic classification of the aborigines in Russia are best illustrated by a comparison of the Lapps with the Livs, Eths, and Tchouds of the Baltic provinces; both groups alike speak Finnic languages; the philologists, therefore, from Castren to Mikkola, class them as alike members of a Finnic "race," along with the Magyars or Hungarians, who are also Finnic in speech. Nothing could be more absurd than to assert a community of physical origin for the three. The Magyars, among the finest representatives of a west European type, are no more like the Lapps than the Australian Bushmen; and the Baltic Finns are equally distinct. The Lapps, as our portraits illustrate, are among the broadest-headed people in the world.* Their squat faces show it. In stature they are among the shortest of the human species. Virchow's celebrated hypothesis that they are a "pathological race" seems excusable on this ground. Their hair and eyes are very dark brown, often black. Could any type of human beings be further removed from this than the Finns described to us by G. Retzius, Bonsdorff, Eliséef, or Mainof? These latter are among the tallest of men, with fair skin, flaxen or tow-colored hair, and blue eyes. Turn to our map on the next page. It shows us among the Esths, on the Baltic coast, through the Cheremisse on the Volga, and clear beyond the Ural Mountains among Ostiaks and Voguls in Siberia, a long-headedness not a whit less pronounced than throughout Teutonic Germany. The contrast of tints on our map corresponds to a radical contrast of physical type.

Turning to the Russian aborigines, then, with an eye single to their purely physical characteristics, we may relegate them to two groups, sharply distinguished in isolation, but intermixed along their lines of contact. Our map of cephalic index herewith will roughly

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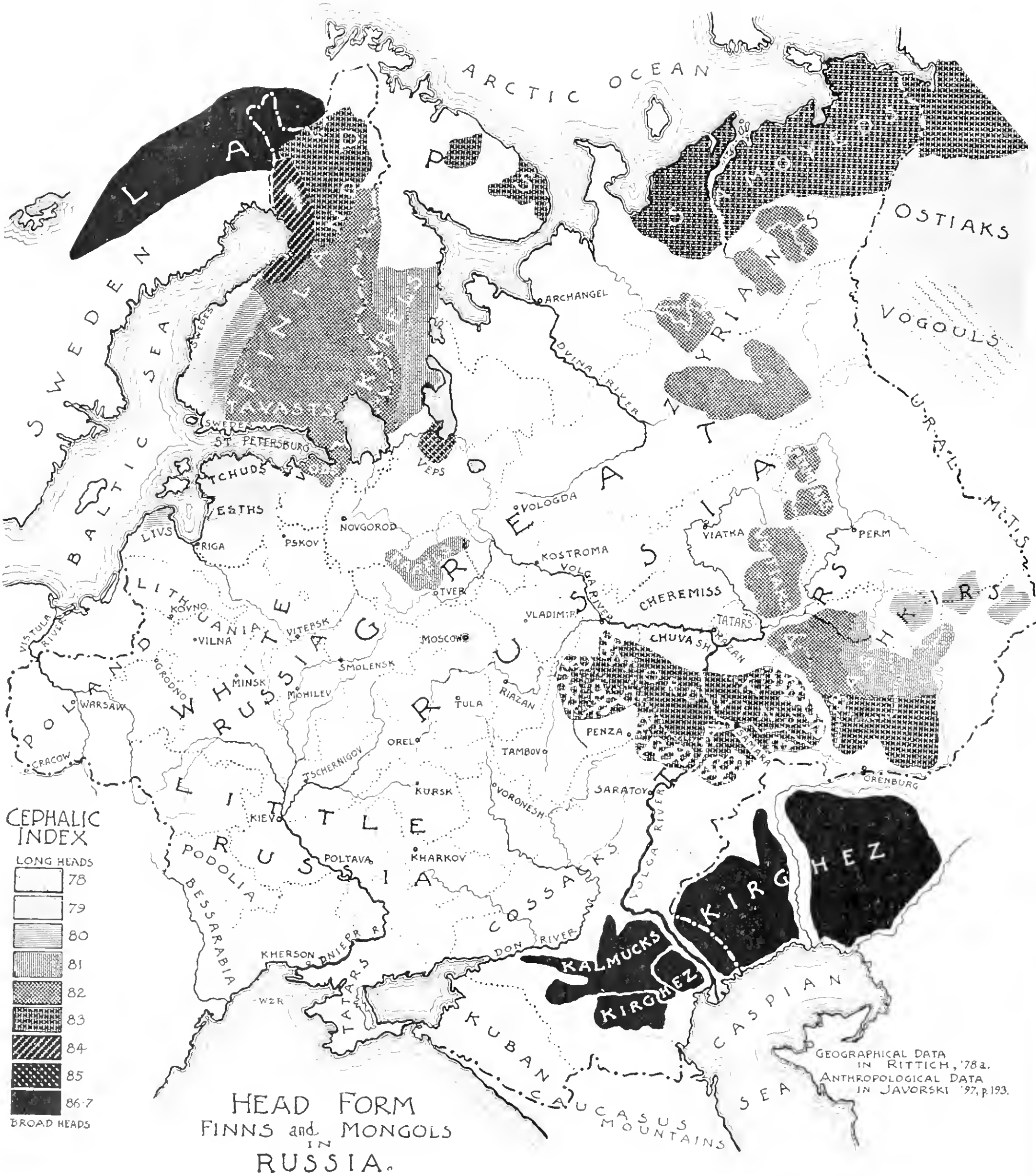
his work, and Keane, 1886, and in his Ethnology, 1896, pp. 303 *et seq.*, are equally at sea. Since the days of Nilsson and Prichard, the philologists have befogged the questions of physical descent. Niederle, 1896, in his appendix upon the subject, seems to be very confused. Topinard, Anthropology, p. 465, has alone avoided the prime difficulty.

* Sommier, Kelsief, Kharuzin, Garson, and others have studied them in detail.

make the division clear. Our two pages of portraits, chosen as representatives of each, will strengthen the contrast. The first group is distinctly long-headed, with an index as low as 79 or 80,



HEAD FORM
FINNS and MONGOLS
IN
RUSSIA.

among the Livs, Esths, Cheremisse, Chouvaches, and Vogul-Ostiaks in Siberia. These are all more or less clearly blond, with a distinctly rufous tendency, even among the extreme eastern tribes of

Voguls and Ostiaks.* Sometimes, as among the Votiaks, whom Dr. Beddoe † inclines to identify with the Budini of the Greeks, because of their red hair, we find this trait very marked, especially in the beard. It seems to be somewhat less pronounced along the Baltic, where the Livs, Esths, and Tschouds shade off imperceptibly into the pure blond Letto-Lithuanians. Here we discover the source of that peculiar reddish blondness of the modern Russians of which we have spoken, for a widespread admixture of blood in the Slav from this stock is recognized by all. In this first type we recognize the Finn, using the linguistic term guardedly, with the express reservation that not every tribe of Finnic speech is of this racial ancestry.

Our second physical type of the Russian aborigines is the polar extreme from this long-headed, red-blond one. We may follow it on our map by the black tints, indicating a prevalent broad-headedness. This is best exemplified at the two extremes of Russia, in the Lapp at the northwest and the Kalmuck and Kirghez hordes of the Caspian steppes. The Samoyeds are merely a continuation of the Lapp type toward Asia along the Arctic coast. These people correspond closely to what we popularly regard as Mongolian. They are all dark or black haired, with swarthy skins; they are peculiarly beardless. With the round face corresponding to the bullet head, high cheek bones, squint eyes, and lank hair, they constitute an unmistakable type.‡ We may provisionally call it Mongol for want of a better word, but it must not be confused with the Turk or Tatar, which is quite distinct. Across middle Russia, and above all among the Bashkirs, we discover a variety of mongrels, compounded of Finn and Mongol, with a strong infusion of Tatars through the whole. Kazan, at the elbow of the Volga, is truly a meeting place of the tribes. The intermingling of strains of blood, of religions, customs, and of linguistic stocks may be observed here at a maximum. Especially where, like the Mordvins, widely disseminated in little groups, not aggregated in solid communities, as among Cheremisse or Tchouvaches, has the infusion of Tatar traits taken place. An interesting fact in this ethnic intermixture is the extreme insidiousness of the Mongolian features. This is a fertile source of confusion of the Finnic and the Asiatic tribes. Many long-headed red-blondes, as among the Ostiaks and Zyrians, who are surely Finnic at bottom, superficially resemble the Mongols in cast of countenance. We have explained, however, in the case of the Basques, how unreliable these facial features are a test of physical descent, for, being distinctive and noticeable, they are immediately subject to the disturbing influences of artificial selection.

* Sommier, 1888, p. 246; 1887, p. 104. † 1893, p. 42.

‡ Ivanovsky is the best authority on these people.

They may thus wander far from their original type, becoming part of the local ideal of physical beauty prevalent among a primitive people. Only in this way can we explain the almond eyes, flat noses, and high cheek bones of tribes which by their blondness and head form betray unmistakably a Finnic descent.

One objection to our ascription of the name Finn to a long-headed type is bound to arise. We must meet it squarely. If the Finns are of this stock, why is all Finland relatively so broad-headed as our map makes it appear? Here is the largest single aggregation of Finnic-speaking people; ought we not to judge of the original type from their characteristics in this region? By no means, for Finland is the refuge of a great body of aborigines driven forth from Great Russia by the advent of the Slavs, just as also all along the isolated peninsulas of the Baltic and in the Valdai Hills north of Tver. But in Finland, in contradistinction to these other places of refuge, the Finns were crowded in together against the Lapps. Especially in the north we see clear evidence of intermixture. The Russian Lapps are very much less broad-headed than their pure Scandinavian fellows, by reason of such a cross.* Can we deny, contrariwise, that a similar rise of index in the case of the Finns must have ensued for the same reason? The Karels, further removed from the Lapps, are somewhat longer-headed; the Baltic Finns, being quite free from their influence, are much more so. Moreover, all along the southwest coast of Finland the heads are much longer. Observations upon twenty-eight Finns in the lumber camps of Michigan by my friend Mr. David L. Wing, yielded an average index of only 78.9, while thirty-nine Swedes were two units lower. A portrait of one of these Finns will be found on our page of Finnic types. Granting that the infusion of Swedish blood all along this coast must be reckoned as a factor, a distinct tendency to this long-headedness among the Finns appears. Coupled with the long-headedness of the Cheremisse, Vogul-Ostiaks, and others, and especially the tendency of the mongrel Bashkirs to dolichocephaly as we leave the Caspian Mongol influence and approach the Ural Mountains, our affirmation of an original long-headedness of this type seems to be justified.

If our original Finns are proved to be long-headed blondes, oftentimes very tall; if the Letto-Lithuanians, contrasted with the Russian Slavs, betray the same physical tendencies; if, just across the Baltic Sea, the main center of this peculiar racial combination is surely located in Scandinavia; and, finally, if in every direction from the Baltic Sea, whether east across Russia or south into Germany, these traits vanish into the broader-headed, darker-complexioned, medium-statured, and stocky Alpine (Slavo-Celtic?) type: how can we longer

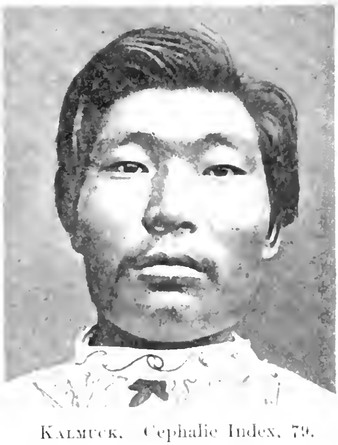
* Kelsief, 1886, and Kharuzin, 1890 b.

Lapp, Scandinavia.
Cephalic Index, 94.

Samoyed, Arctic Coast.
Cephalic Index, 87

Kirghez, Horde of Bukee.

Kalmuck. Cephalic Index, 86.



Kalmuck. Cephalic Index, 79.

Mongol Types.

deny that Finns, Letto-Lithuanians, and Teutons are all offshoots of the same trunk? A direct physical relationship between the three, referring them all to a so-called nordic race, is confirmed by the very latest and most competent authority;* and this in absolute independence of our own conclusions.

If it be established by further investigation, our theory goes far to simplify the entire problem of the physical anthropology of Europe. It is not a new idea. Europeaus advanced it twenty years ago on the basis of the then recent archæological discoveries of a long-headed, tall race in the tumuli of the stone age, but it never gained any acceptance at the time. A curious corollary of this theory is that De Quatrefages and Virchow, in their celebrated international controversy over the origin of the Prussians, were both partly in the right. Virchow resented the view of a Finnic origin of his people as an insult, because Lapps and Finns were then confused with one another, and he certainly was right in denying any affinity of Prussians with Lapps. De Quatrefages, in asserting that the Prussians were of Finnic ancestry, was equally in the right, if our theory be true; but he erred in supposing that this damned them as non-Teutonic. For us the Prussians, along with the Hanoverians and Scandinavians, are all at bottom Finnic. We would not stop here. We would agree absolutely with Europeaus in his further hypothesis—that these Finns of northern Europe are directly related with that primitive Mediterranean long-headed stock, sprung from the same root as the negro, which we have shown to underlie all the other races of Europe.† Its blondness is an acquired characteristic, due to the combined influences of climate and artificial or natural selection. From this center in the north, invigorated by the conditions of its habitat, and speedily pressing upon the meager subsistence afforded by Nature, this race has once again during the historic period retraced its steps far to the south, appearing among the other peoples of Europe as the politically dominant Teutonic race.

The anthropological history of northeastern Europe is now clear. The Slavs penetrated Russia from the southwest, where they were physically an offshoot from the great Alpine race of central Europe. In so doing they forced a way in over a people primitive in culture,

* Consult Deniker's map of the Races of Europe, 1898 a, in L'Anthropologie, vol. ix, p. 129. Talko-Hryncewicz, 1893, p. 170, emphasizes the similarity of Letto-Lithuanians and Finns. Kohn and Mehlis, vol. ii, pp. 108 a: d 153, acknowledge the similarity of Kopernicky's Kurgan people and the Teutonic Reihengräber, as does Bogdanof, 1892, pp. 19–21, also.

† The Aryan Question, Popular Science Monthly, vol. lii, January, 1898, pp. 309 *et seq.* This is in perfect accord with Sergis's most recent work in Centralblatt für Anthropologie, 1898, p. 2; and with Niederle's conclusions (1896, p. 131; and especially in Globus, vol. lxxi, No. 24).

language, and physical type. This aboriginal substratum is represented to-day by the Finns, now scarcely to be found in purity, pushed aside into the nooks and corners by an intrusive people, possessed of a higher culture acquired in central Europe. Yet the Finn has not become extinct. His blood still flows in Russian veins, most notably in the Great and White Russian tribes. The former, in colonizing the great plain, has also been obliged to contend with the Asiatic barbarians pressing in from the east. Yet the impress of the Mongol-Tatar upon the physical type of the Great Russian, which constitutes the major part of the nation, has been relatively slight. For instead of amalgamation or absorption, as with the Finn, elimination, or what Leroy-Beaulieu calls "secretion," has taken place in the case of the Mongol hordes. They still remain intact in the steppes about the Caspian; the Tatars are banished to the eastern governments as well, save for those in the Crimea. The Asiatic influence has probably been more strong in determining the Great Russian character than the physical type. A struggle for mastery of eastern Europe with the barbarians has perhaps made the Great Russian more aggressive; vigor has developed at the expense of refinement. The result has been to generate a type well fitted to perform the arduous task of protecting the marches of Europe against barbarian onslaught, and also capable at the same time of forcefully extending European culture over the aborigines of the neighboring continent of Asia.

M. Adhemar Leclère relates of the King of Cambodia, as illustrating one of the superstitions dominant in the country, that a French trader had a fowling piece of remarkable accuracy, which he valued very highly. The king wanted to buy it, but the trader did not care to sell. The king then said he would have a bottle enchanted by his sorcerer, which the man should shoot at. If he missed it, the king would take the gun and pay for it. If he hit it, the king would pay for the gun and the man might keep it. The offer was accepted; the bottle was enchanted and hung up at a distance of a hundred and sixty feet. The king and his sorcerer were satisfied that the man could not hit it; but it flew to pieces at the first shot. The king was very angry at his sorcerer, who fled for home as ashamed of himself "as a fox captured by a hen."

The highest flight of kites made at Blue Hill Meteorological Observatory in 1897 was on October 15th, when the meteorograph was raised to a height of 3,571 metres, or about 11,600 feet above sea level, while the highest kite rose more than 120 feet above this. About 20,475 feet of line were used, and the pull, when the line was in the air, varied between 123 and 128 pounds. At the highest point reached the temperature was 41° F., while at the observatory it was 70° F. An interesting feature of this flight was the passage of the meteorograph through the cumulus and alto-cumulus levels of the clouds, as shown by the increase followed by a decrease of humidity at heights corresponding with those occupied by such clouds.

THE EVOLUTION OF HIGH WAGES FROM LOW COST OF LABOR.*

By EDWARD ATKINSON.

IN dealing with this subject I shall not submit many statistics. For data sustaining this thesis reference may be made to my own published works notably to the Distribution of Products: yet more to the Senate Report on Prices and Wages for Fifty-two Years, compiled by Commissioner Wright. The figures give conclusive proof that in every branch of industry, especially in all the arts which have been most fully developed by the application of science and invention, there has been a progressive advance in the rate of wages or in the earnings of all who are occupied on the farm, on the railway, in the factory, or in the workshop. This advance has been subject to temporary reductions during periods of commercial crises, usually very moderate. In such periods there is apt to be unemployment for a portion of the working force rather than any considerable reduction in established rates of wages. These periods are usually of short duration and from each small decline wages have taken a speedy upward trend. This advance in all rates of wages has been coupled with a general decline in the prices of nearly all products. In some branches of industry the advance in the rate of wages has been less than in others. When each of these cases is dealt with, usually one of two causes will be found. In many arts the progress of invention has lessened the demand for individual skill and aptitude in the workman. For instance in the making of a steel plow a few years since nearly all the workmen were of necessity skilled mechanics, earning relatively very high wages, yet such has been the application of machinery to the production of the plow that laborers may be called in from the adjacent fields who, if possessed of ordinary intelligence, may in three months or less become expert attendants upon the machines on which the separate parts that constitute the plow are made. Their wages are now as high as those of the skilled mechanics of a former generation, while the men of the present generation who correspond to the skilled plow makers of a former day have gone up into employments requiring even a higher type of individuality at higher relative rates of wages.

The same rule may be observed in the textile factory. It has often been remarked that there seemed to be a deterioration in the quality of the factory operatives at the present time as compared to

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* Read before Section I of the American Association for the Advancement of Science, Tuesday, August 23, 1898.

those who found good employment in textile factories in the ante-war period. In point of fact, the women of native birth who were then so numerous in the textile factories have advanced into employments which are better paid, less arduous and of a more individual quality. Their successors, largely French Canadians, who have taken their places in the factory, might not have been able to operate the machinery of a former day for lack of the individual qualities then called for. The mechanism is now more automatic than ever before. Consequently, those who do the work may be of less intelligence, yet their wages or earnings are now twice as much per day, more than double per hour, as compared to the American factory operatives of a generation since.

Again, the prices of the goods have been much reduced. In the grades of work which still require individual skill and aptitude in directing machinery of the highest type, the competition of employers to secure the services of the workmen of highest skill has advanced their rates of wages in some cases in excessive measure. Thus it happens that while during the last fifty years all wages have advanced, even the earnings of common laborers, there is a greater disparity in the rates at the present time than there ever was before. In this same period, while prices have been reduced, the margin of profits on each unit of product has been diminished yet more; the exceptions being only those products in which the supply of the crude material has been diminished in ratio to the increasing demand. This exception applies especially to the products of the forest.

We therefore find existing conditions to be, in fact, low relative prices, high relative wages, coupled with a lessened margin of profits in ratio to our total product as compared to each decade of the last fifty years. But, on the other hand, our aggregate product has been so vastly increased that even at the lessened margin on each unit the aggregate of profits is greater than ever before. The rich have become richer. The people of moderate fortunes have become much more numerous. The condition of the large proportion of those who do the manual and the mechanical work is better than ever before; and lastly, the submerged tenth are still poor in the ordinary sense in which the word is used, not from any fault in society, but because their own individual capacity has not been developed as rapidly as the opportunity which is offered them. There is probably a less relative demand for mere common and unintelligent labor than ever before. Such poor we shall always have with us and how to deal with that element in every population is not the purpose of this essay. I merely submit the fact that in the economic records of this country, which has enjoyed a continental system of absolute free trade among a greater number of persons spread over a wider area than ever enjoyed commerce free from restrictions before, there is a full and complete justification of the axiom of Frédéric Bastiat: "In proportion to the increase of capital, the absolute share (of a given product) falling to capital is augmented, but the relative share is diminished; on the other hand, the share falling to labor is increased both absolutely and relatively." We witness decade by decade increased production, lessened prices, higher wages, lessened cost of labor.

In addressing this association I may therefore venture to deal with deeper principles than those which govern the mere compilation of statistics.

It is but a year over a century since Malthus published his treatise upon population, in which he formulated what he believed to be a rule—namely, a tendency of population to increase in a geometrical ratio, while, as he believed, the means of subsistence could only increase in an arithmetical ratio. On this alleged tendency of population to outgrow the means of subsistence he based a rule which has since been called a survival of the fittest. He regarded the destructive influences of war, pestilence, and famine as necessary elements in limiting population to the possibility of subsistence. This theory of Malthus later became joined to a theory of a lessened production of food on given areas of land in ratio to the work done upon it, which I believe originated with Ricardo. These two pessimistic conceptions rightly brought upon political economy the name of the dismal science. Subsequently, and in recent years, both Darwin and Wallace have stated that they derived the theory of a natural selection or a survival of the fittest from the treatise of Malthus, which gave to each of them a direction in their study of natural forces which led in the end to their great work in establishing the principle of evolution. It would be presumptuous on the part of any member of one of the unlearned professions to pass judgment upon this theory in its application to animal life viewed wholly on the physical side. Yet, while we must admit that the experience of a century does not suffice either to prove or to disprove any such far-reaching proposition as that of Malthus, we may rightly ask if it is not true that if there were a tendency of population to outgrow the means of subsistence, that tendency could not fail to have disclosed itself even within the short period of a hundred years. The fact that there has been no such tendency has an important bearing on the right definition of survival of the fittest.

All hypotheses must in the end be tested by the logic of facts and by the common sense of the community regarded as a whole. No theory survives which is not true and complete in all its bearings. Whether or not the theory of evolution as it is now stated is complete may rightly be questioned even by the unscientific mind. Have its advocates taken cognizance of the human will and of the reason of mankind acting under its direction as the prime factors in the production and distribution of the material subjects—food, shelter, and clothing—on which material existence depends? If it may be rightly held that such a tendency as that which Malthus thought he had proved had any real foundation, it would have been disclosed during the nineteenth century. It has not been. There has not been a single decade in the nineteenth century in which the means of subsistence have not gained rapidly on the population of the globe. The tendency throughout the century has been to abate the dangers and evils of famine, to distribute an increasing abundance of food over wider and wider areas at a lessened cost, to mitigate the horrors of war, and to develop sanitary science. If the theory of Malthus is well grounded, then it follows that the whole of the so-called progress developed in the nineteenth century has been worse than useless. It has been merely increasing the numbers who must ultimately be subjected to the horrors of war, pestilence, and famine, in order that mankind may survive upon the face of the earth. This tendency to increase of relative product has been accompanied by an enormous increase in the capital of the world—that is to say, in the products of labor saved for future reproductive service—and this vast relative increase of capital has tended to a great reduction in the normal rate of interest earned in its safe use. The improvements in sanitary science have also led to a very considerable prolongation in the lives of the intelligent. It is probable that the great life-insurance companies have only been saved from the disaster which might have ensued from the rapid reduction of the safe rates of interest on their investments by this fact that life has been prolonged considerably beyond any of the life tables which are made use of in computing the annual premiums. These gains have not been made by means of the frequent wars of the century, but in spite of them. The effect of war has been to devastate sections of important countries, and to diminish production more than it lessened population. The effect of the conscription of the strongest and healthiest of the men has led to their destruction in great numbers, and to the survival only of the less capable and less fit to reproduce the species. There has even been a distinct deterioration in the size, weight, and physical energies of the population even of great countries like France; yet in spite of these evil influences the population of continental Europe has steadily increased. The application of science and invention has enabled the debt and army ridden countries of Europe—France, Germany, Austria, Italy, and Russia—to improve their general conditions, and, although these evil influences have kept the great mass of the people poor and in some countries on the edge of starvation, yet they have only retarded material progress without in any instance stopping it. Among the English-speaking people of Great Britain and her colonies, and the United States, and in the industrious and less warlike countries of Europe—Holland, Belgium, and Switzerland—there has been a steady gain in virility, in stature, in physical condition, and in mental skill and aptitude. In some of the eastern countries of Europe but lately redeemed from the devastating rule of Turkey, the present improved conditions are in more striking contrast with those which prevailed at the beginning of the century.

What, then, is wanting in the logic of the Malthusian conception of the survival of the fittest adopted by Darwin and Wallace? May it not be held that it is only incomplete, being limited to dealing with man as an animal, without giving regard to that prime quality of man by which he is separated distinctly from every other animal in being endowed with progressive desires and with the capacity to provide for his increasing wants?

In an address which I had the honor of making to the graduating class of the State University of South Carolina, June 26, 1889, under the title of Consumption Limited, Production Unlimited, I presented this case in the following terms:

"I have ventured, therefore, to say that on the basis of the statistics compiled in recent years it may soon be proved to be a rule or law of life that the power of man to consume the means of subsistence is limited, while, on the other hand, the power of mankind to produce and distribute the means of subsistence is practically unlimited.

"I have frequently ventured in conversation to try this hypothesis upon different people, and the very surprise with which it has been usually received goes to prove that the theory of Malthus has unconsciously governed the thought of a very large proportion of the thinking people even of this country.

"In support of this rather startling proposition, it may be suitable to point out again that material life is itself only a conversion of material forces into a new form. Man is the only animal that accumulates experience and thereby attains the power to give a new direction of a permanent kind to these forces of Nature; he therefore frees himself from subjection to the law of the survival, either of the strongest, the most subtle, or the most cunning; he attains the power to exist and multiply by dominating the forces of Nature, thereby increasing production and he makes progress by exchanging services with his kindred. Under these conditions the survival of the intelligent and the capable in increasing numbers becomes assured, because they are the fittest to survive."

I will now attempt to deal with the well-intentioned but very malignant dogma of Malthus, and also with the yet more important and admitted truths presented by Darwin and Wallace, from the point of view of an idealist. I know not how else to discriminate between one who holds the views which I shall attempt to present and one who regards man and his functions purely as a materialist giving regard to physical influences only.

So far as I comprehend the propositions submitted by either of these great leaders in scientific thought, their theories are all based upon the material conditions which govern man considered as one of the animals. If we deal with the existence of animal life as a stage in the conversion of forces by which the universe exists, we may fully admit that the animal is dominated by the forces of Nature. There may have been a development of species perhaps from a single germ. There has been a survival of one species of animal while others disappear. There has been an adaptation of animal life to the varying conditions of climate and soil in the long geologic ages. There has been a survival of the physically strongest of particular species. There has been a survival of the more intelligent species. Yet there is no evidence of the progressive development of intelligence or of experience in any existing species of animal except mankind. The dams built by the beavers in the far Northwest, of which Professor Agassiz computed the age at nearly two thousand years, as I remember, by the growth of the peat bogs that had gradually filled the lakes which the beavers created, were made in the same way that the beavers build their dams at the present time. There has been no variation, no progress. The beaver of the present generation to all intents and purposes corresponds to the beaver of two thousand years ago. True, the students of natural history have proved slight variations, slight adaptations and slight modifications in specific groups of animals, but as yet the one distinction remains which separates man from all other animals. None but men are endowed with progressive wants and with the mental capacity to secure their supply.

If it is held, as some naturalists may allege, that this statement is too strong, it may be admitted that there has also been a survival of species and of members of species whose brain measurement is to-day larger than in former periods which come within observation, and that there has been an increase of intelligence as distinguished from instinct. There are also members of particular species like beavers, who under certain conditions develop the power to build dams, and who under other conditions have not developed that power. Yet the fact remains that these slight variations, occurring in periods of almost geologic time, have no correspondence with the progress of mankind.

No other animal has yet developed the powers of reflection, forecast, and imagination, which not only create new wants among men, but which also develop the powers by means of which these wants can be supplied. All other animals are dominated by the physical forces of Nature. Man alone dominates these forces, giving them a new direction, tending constantly to the increase of the means of subsistence at a much more rapid rate than the increase of the population.

For untold ages the wind-swept prairies of the great Mississippi Valley had served to nourish a few millions of bisons which, ranging from north to south and grazing as they went, maintained a certain proportion of animal life to the means of subsistence, while a small number of Indians warring among themselves and showing no signs of progressive development sparsely occupied what is now the granary of the world. Presently came upon the scene men who had learned how to direct the forces of iron, steel, and steam. All the material conditions were changed under the power of the directing mind of man. From that valley are distributed the means of subsistence without which even in the present year disastrous famines would have devastated Europe. No man yet knows or can measure the potential or the productive energy of a single acre of land anywhere in ratio to the labor put upon it. We stand at the very beginning of progress in scientific agriculture, leading to lessened labor and increased product.

In the mind of Malthus and of Ricardo land appears to have been regarded as a mine subject like mines of metal to exhaustion. We are but beginning to learn that land is but an instrument or a laboratory responding in its products to the minimum of labor and the maximum of intelligence.

In order that we may fully comprehend the true nature and source of the increased production of the means of subsistence throughout the centuries, we must give regard to the relative insignificance of accumulated capital as compared to mental capital or experience. Material wealth counts but little as compared to mental capital. I have often had occasion to refer to the fact that the richest and most prosperous state in the world may possibly accumulate capital to the measure of three or possibly four years of production. Several years since I made a very accurate measure of the total valuation of all the mills, works, railroads, dwelling houses, goods and wares, tools and implements of the Commonwealth of Massachusetts, standing for the savings in a concrete or material form of more than two centuries of progress. They did not then equal the measure of three years' consumption. That which is the wealth of one generation is destroyed by the inventor who substitutes better mechanism for purposes of production and distribution. The entire profit of one generation, even of one decade, consists in what had been wasted in the previous decade. We are always within less than a year of starvation, yet never before did we possess such absolute assurance of abundant consumption.

I never happened to read Disraeli's strange novels until the present summer. While I was thinking of what I had to say in this matter I came across a paragraph which seems to me to cover much the same ground over which I have been led by my observations of the hard facts of a long business life. "Man is not the creature of circumstances. Circumstances are the creatures of men. We are free agents, and man is more powerful than matter." This is another way of saying that man dominates the forces of Nature, and is not dominated by them.

Does not this same conception pervade the Hebrew Scriptures? Under the name of Moses it is written of mankind "to be fruitful and multiply and replenish the earth and subdue it, and have dominion over the fish of the sea and over the fowl of the air and over every living thing that moveth upon the earth." Do we not find throughout the Scripture record of the Jewish history the same conception of the unity of the creative mind named by the Hebrew Jehovah, by the Christian named God? Do we not find in the Hebrew theory of the origin of species the sense of order and uniformity? Is not mankind a part of that universe, and have we not the right to believe that to man by the power of will and reason, of forecast and imagination, has been given such dominion over the forces of Nature as to enable him to direct these forces to conditions of progressive welfare the scope and end of which no one can even yet measure? Each of these great investigators whom I have named in his day and generation has served to promote the very progress with which his own conceptions seemed to be most at variance.

The prime object which Malthus had in view was to overcome the evils of the then existing poor laws of Great Britain, which he accomplished. The theory of evolution is held by the masters of science to have given the greatest incentive to movement and progress yet recorded in the history of scientific research. Yet it may not be complete. In almost the same year in which Malthus presented his malignant theory, justifying war, pestilence, and famine as necessary factors in the life of man, Immanuel Kant published his great essay on Eternal Peace, resting its certainty on the development of commerce and on the mutual services which men render each other in spite of the interruptions of war, and in spite also of the evil conception of the functions of commerce which has so long pervaded the legislation of this country, from which we have yet to emerge—namely, that the import of the goods of foreign origin which we procure in exchange for the domestic products is an industrial war upon domestic industry.

This leads me back to the thesis which gives the title to this paper. We are now exporting goods and wares of every type, from the crudest product of the field to the highest finished product of the metal works. Our supremacy over nearly every other nation, if not all, in the low cost of production of the crude materials which enter into these exports, our very low rate of national taxation, and our other advantages are conducive to this power of service which we render to other nations. Yet in this service the highest rates of wages are earned by our own workmen that are secured in any part of the world, ranging from twenty-five per cent to one hundred per cent above the rates of wages in the manufacturing countries with which we compete, and even tenfold the earnings in the nonmachine-using nations from which we procure the larger part of our imports. If the rate of wages governed our cost of production by the unit of product, not one dollar's worth of any of these goods would be sent out from our harbors. In this friendly contest to serve other nations for mutual benefit, the survival of the fittest will fall to that nation which maintains peace, order, and industry, and which removes all legal or artificial obstructions to commerce such as now exist in the fines that we impose on foreign goods under the name of protection, and in the obstructive provisions of our navigation laws whereby we are deprived of the paramount position upon the sea to which we are entitled.

It may have seemed as if I had been led wholly away from the subject which is the title of this paper in this somewhat presumptuous suggestion that the theory of evolution as represented by Darwin and his followers is totally inadequate in its application to the metaphysics of production and consumption or of trade and commerce. If the dogma of Malthus had been true in its application to the present century, and if the survival of the fittest based by Darwin upon the theory of a purely physical natural selection had been complete, the retrogression of the century would have been marked by deficiency of product, higher prices, lessening wages, larger relative profits, and increasing want. The trial balance of the more important countries and states of the world which are to be found in their statistical abstracts prove the reverse of all these necessary conclusions which must be derived from the erroneous or incomplete observations of the great investigators whom I have named. I trust, therefore, that the conclusions to which I have brought you may justify the title of my essay.

The real wage which is the incentive to work is the enjoyment of the necessaries, comforts, and luxuries of life—food, fuel, shelter, and clothing—that is to say, the necessaries and comforts of material existence. In the fact that the wages or earnings have risen while prices have fallen, and that those who do the physical work of production have secured decadė by decade an increasing share of a constantly increasing product by the expenditure of their earnings when converted into terms of money, is to be found the disproof of the Malthusian theory so far as it may be disproved in a single century. In these facts is also to be found the necessity for the metaphysical treatment of the theory of evolution as yet only partially developed by Darwin, Wallace, and their successors.

One may even venture to cite the singular vagaries of Wallace in the matter of spiritualism in evidence of a lack of the faculty of observation in metaphysics on the part of a man who has been so eminent in his observations of purely physical conditions. May not Darwin's loss of enjoyment in music and art after his long application to the observations of Nature possibly indicate a tendency to one-sided development even in the mind of a man so supremely able? Men of far less ability often realize the loss in their power of enjoyment of the functions of the ideal after overmuch devotion to the study of material conditions. This is one of the dangers in dealing with statistics, yet the imagination is an absolutely necessary factor in statistical science. The mere compiler of figures, without comprehension of the subjects of which they are symbols and without capacity to read between the columns, is a mere drudge whose work always needs to be revised and often changed in the relation of all its parts, lest false impressions should be derived from figures which are themselves true. The statistics of a nation are but the trial balance of its accounts, corresponding to the balance sheet of a merchant. Nations may be betrayed by bad bookkeeping, as merchants often are.

It is also a matter of common observation that the man who devotes himself exclusively to the accumulation of wealth loses the very power of enjoyment which might ensue from its possession had he rightly comprehended his own function in the universe.

The mathematics and statistics of the astronomer disclose the order and unity which prevail throughout the universe. Universe itself is a synonym for unity. In my own mind it seems possible to predicate order and unity in the progress of mankind in material welfare on the simple ground that man is a part of the universe. The same creative mind or power by which the world is kept upon its way from an unknown beginning to an equally unknown ending (if there can be beginning or end in an eternal order) directs all the forces of creation of which mankind is a part. It seems to me that the man who comprehends that he himself is a unit and a factor in this great order of creation must find in the revelation of that reason and will by which he is differentiated from all other animals an emanation or inspiration from that higher power which makes for righteousness:

> "High over space and time it rides,
> The high thought that can never alter."

Again, we find in the Hebrew myth the origin of the knowledge of good and evil which has been so fearfully misconstrued in the Christian dogma as the fall of man, the first recorded conception of the development of that mental energy by which mankind became differentiated from all other animals. We also find in the true rendering of the Greek text of the central precept of Christianity—in which, as I am assured by scholars, the word "*agapao*" is more correctly construed in English in the word "service," "Thou shalt serve thy neighbor as thyself"—the very principle of modern commerce by which it lives and moves and has its being, evolving mutuality of benefits through the exchange of products. This concept can be traced far back in Leviticus, in the writings of Confucius, and in the records of the Egyptians.

I therefore venture to submit to the members of this association the suggestion that true as may be the theory of evolution as it now stands, it is not yet complete. It will remain inadequate until some philosophic observer yet greater than Darwin traces and defines the evolution of the mental or metaphysical forces by which mankind will surely attain its full development and dominion. Until the modern development of science and invention of the nineteenth century had become a part of the common practice and common knowledge of the civilized races, only the prophet or seer could forecast the conditions of peace, order, and mutual service which we have as yet so partially attained. Have we not now a basis for an inductive social science in this development? May we not rest assured or continue our work with full assurance that the humane element in the Divinity which shapes our ends and the divine element in the humanity to which has been given dominion over the forces which make for welfare, will be so combined and harmonized that the time will surely come when all mankind shall be free of what has been rightly named the hell of war?

Conclusion.—The ultimate suppression of war by the evolution of the forces of commerce may be well assured. War, however necessary it may sometimes be, must always remain a survival of brute or unintelligent force. Commerce, however restricted by the lack of intelligence among legislators, is yet an evolution of mental force, by which it is directed and by which it will ultimately dominate brute force. War is destructive: commerce is constructive. Every phase of war is of necessity conducted by methods which have no defense in morals. It requires the employment of spies, the use of falsehood, the ambuscade. Its greatest successes are achieved in getting the advantage of the enemy and striking him in the back. The art or invention of war consists in making each instrument of slaughter more and more effective, the advantage in the end falling to the gun of longest range, unless success is attained even under bad management by the yet greater incapacity of the enemy.

Commerce exists by the law of service. Its benefits are mutual. Its conduct demands probity and integrity. "The trust reposed in and deserved by the many creates the opportunity for the fraud of the few." War can only exist so long as the private soldiers are ignorant on the one side or the other. Had not the Confederate private soldiers in the civil war in this country been ignorant of the evil influence of slavery upon themselves they would not have fought in a war for the maintenance of slavery. If the conscript soldiers of Spain had not been kept in ignorance of the abuses of the rights of the Cubans by their own oppression at home, there would have been no cause for interference on the part of this country, and there could have been no war. When the men behind the guns in Germany become fully informed of their own rights, as they are rapidly becoming, they may cease to submit to the domination of the classes who carry the sword. The mediæval Junker who now assumes the powers of emperor will then become as helpless as his mediæval prototype, the knight in armor, became when gunpowder was invented. The brute rule of blood and iron will then give place to the intelligent rule of commerce and mutual service.

Taxes are collected at the barriers which part European nations from each other by duties on their respective imports to the amount of many hundred million dollars, and yet that revenue does not suffice to support the armies which except for those barriers to mutual service would not be required and could not be sustained.

As surely as the mental factor in production giving direction to the forces of Nature evolves increasing welfare, so surely will the brute force of war and the survival of the fighting instinct in man be suppressed by that spread of intelligence and common sense which is generated in the very conduct of commerce itself.

Recent statistics show that since the end of 1869 the postal traffic in France has nearly tripled, the telegraphic network has increased about nine times, the tonnage of the railways and interior navigation has doubled, deposits in savings banks have risen from $150,000,000 to $800,000,000; and other items of economical prosperity have shown corresponding growth.

PLANT LIFE OF THE CANARY ISLANDS.

By ALICE CARTER COOK.

THE Canary Islands have appealed to the world under various aspects. The ancients idealized them, mediævals fought over them, and moderns are analyzing them. The fire-tried rocks, crevasselike gorges, and confused mountain masses make a fascinating field for geologists; curious Coleoptera attract the entomologists; hills, valleys, and shores abound in interesting plants; the climate and meteorological conditions have been the study of many doctors.

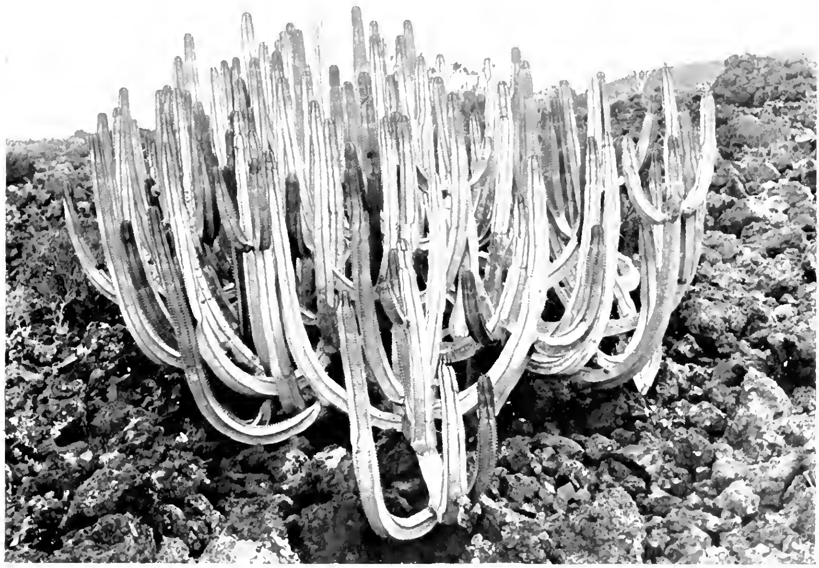
One's first view of Grand Canary is most disappointing. The "Fortunate Islands" of Lucian—abounding in luscious fruits, covered with luxuriant forests, where the sun always shines, and Nature, unaided, liberally supplies all needs—are a mental picture which is sadly shattered by the reality. The low coast is buried in shifting sand blown across from the African desert. Behind it are bleak hills colored a dreary gray by drought-loving euphorbias. We wonder where the materials for such glowing descriptions as Humboldt's, Leclerq's, Edwardes's, and Berthelot's are hidden.

Closer acquaintance banishes our doubts, and we soon learn to love this land of crags, and find from hilltop, in valley, and on seashore views unsurpassed by the oft-sung beauties of Switzerland or Norway.

The flora of the islands was studied thoroughly sixty years ago by Webb and Berthelot, who with indefatigable zeal scoured peak and plain. But they were unable to visit personally two of the islands (Gomera and Hierro), and spent only a short time on Lanzarote and Fuerteventura. The results of their studies of the phanerogams were published in three large volumes with fine plates —now out of print and very difficult to obtain. Since that time various botanists have spent longer or (usually) shorter intervals on the islands, but no other extensive work has been undertaken, and doubtless many plants, either undiscovered by these pioneers or introduced since their time, or reported by them from only isolated localities, remain to be studied; and the scattered results of the different investigators should be incorporated into a complete botany of the archipelago.

The flora of the archipelago includes, according to a recent publication, twelve hundred and twenty-six species of vascular plants; four hundred and fourteen of these are found nowhere else in the world, or only in Madeira, the Azores, or the Cape Verd Islands. These three island groups together with the Canaries constitute the so-called "Atlantic Islands"; all are of volcanic origin and have many features in common. They are, moreover, connected by a narrow submarine plateau which, perhaps, argues a former means of more intimate communication.

The general character of the Canary flora is that of the Mediterranean region. Some species show Indian or South African relationships; still fewer have American affinities. The Gulf Stream still brings drift, including seeds and the branches of trees, from the Bermudas by way of Madeira to our islands. Columbus, who made frequent visits to Gomera, found on its shores fragments of West Indian



Euphorbia canariensis, growing on bare volcanic rocks.

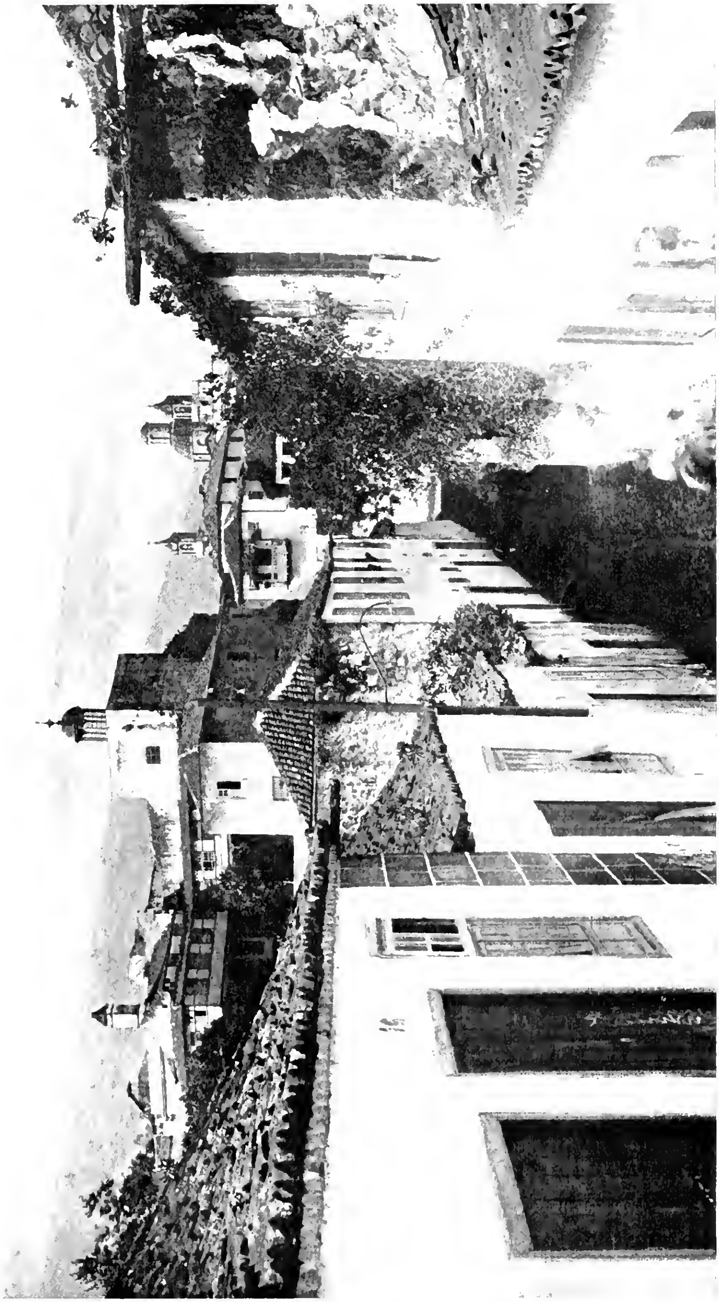
plants, and was thereby strengthened in his belief in a western continent. An occasional east wind—such as sometimes brings armies of grasshoppers—may carry seeds from the Sahara region. Indeed, the woolly seeds of *Gomphocarpus fruticosus* are said to have been brought on the spiny legs of the grasshoppers. But the prevalent winds and ocean currents of to-day form a barrier between the Canaries and the continent, and among the sixteen hundred and twenty-seven species enumerated from Morocco by Ball, only two hundred and sixteen are found on these islands. That the former more effective means of communication must have been of very remote date is clearly evidenced by the great development of peculiar species of continental genera. Moreover, Saporta proves that types now found only in the Canaries (or perhaps also in Madeira, the Azores, or Cape Verds) existed in Europe in the Tertiary period. Such are the native laurel, viburnum, and pine. The persistence here of these ancient types speaks strongly for the constancy of the climate—to-day a strong attraction to invalids—for the average summer and winter temperature hardly differ ten degrees.

The great age of the archipelago is further indicated by the marked individuality of the flora of each island. The species have had time to develop in various directions under the influence of the different conditions to which they have been exposed, and the difficulty of obtaining foothold in the rocky, volcanic soil (pointed out by Christ) has doubtless often prevented the intermixture of the parent and derivative forms, so assisting in the formation of new species. For it must have been only rarely that the seeds or fruits brought from one island to another, or from the mainland, have found themselves in places favorable to development. So species-making has progressed, and as a consequence we find Teneriffe with twenty-seven species known from no other region, Grand Canary with seventeen, Palma with eleven, Gomera with ten, Hierro with three.* Fuerteventura and Lanzarote, on account of their greater proximity to the African coast, have a somewhat more continental aspect of vegetation than the more westerly members of the group. They have together thirty-two species which are either confined to them or found very seldom on any of the other islands. Other peculiar species are common to two or three islands only.

The soil is very rich. With irrigation three harvests a year are regularly gathered on Canary and Teneriffe. The water supply is largely kept up by the cloud belts, which even in the driest seasons form almost daily over the higher mountains, feeding the springs there which are the life of the land. But, as has already been said, the rocky, volcanic nature of the coast forbids the entrance of many plants, and this fact has had great influence on the character of the flora. The craggy hills and stony shores have a decidedly desert aspect, and adaptations to drought in the form of fleshy, hoary, and coriaceous leaves and stems abound. Euphorbias take the place and have the appearance of the cacti of American deserts. Fleshy *Crassulaceæ* of the *Sempervivum* group are more abundant here than in any other part of the world. There are twenty-two species of them which are found nowhere else. Such fleshy plants are not confined to the volcanic wastes and shores. They project from the

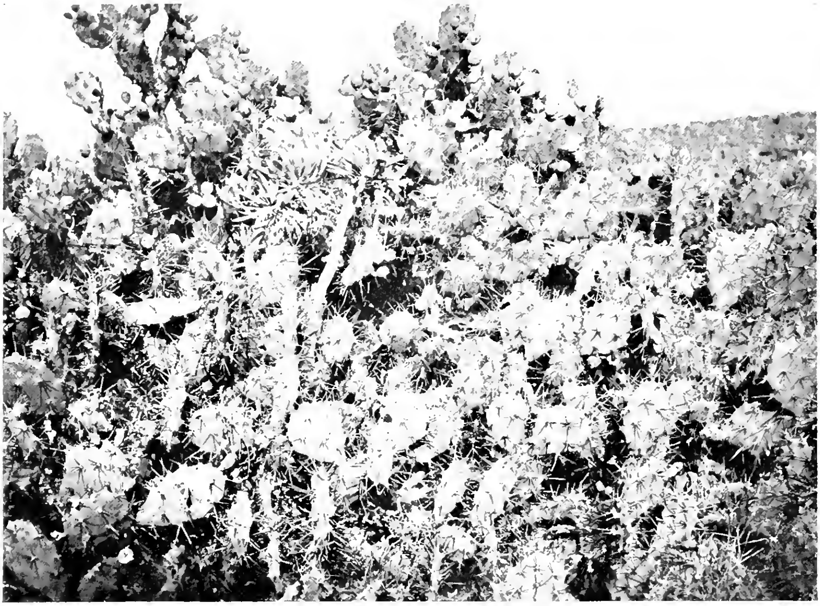
* The number of peculiar forms on these two very fertile islands will doubtless be increased when they are more thoroughly studied.

most precipitous and rocky sides of the gorges. The urban flora, which makes Laguna and other old towns so picturesque, and which Berthelot describes as largely a duplication of that of the ruins



VILLA ORATAVA AND THE PEAK OF TENERIFFE; also showing *Senecio* and *Sempervivum* growing on the tiled roofs.

of the Coliseum of Rome, consists conspicuously of fleshy-leaved *Sempervivums* and *Senecios*, whose roots penetrate the tiles of the houses and the stones of the streets. It is curious how many of these fleshy plants have their leaves growing in rosettes, producing a simi-



Opuntia tuna, the wild prickly pear with bright scarlet fruits.

larity between the members of widely separated orders (e. g., *Euphorbia balsamifera*, *Sonchus Kleinia*, species of *Sempervivum*, *Senecio*, and *Statice*). Is this also a means for the reduction of transpiration?

The same question (this time as regards the flowers) applies to the species whose blossoms close soon after noon. The volcanic wastes, brilliant in the morning with the bright flowers of *Helianthemum*, *Fagonia*, *Calendula*, *Sonchus*, and *Anagallis*, are in the afternoon like a house where the lights are gone out, for all the blossoms have gone to sleep, and there is nothing in sight but brown soil and dull-green leaves.

The curious plants with twiglike leaves seem also to have been provided against too great loss by transpiration. Such are *Plocama*, a strange rubiaceous shrub which looks like a diminutive weeping willow; *Genista rhodorhizoides*, called by the insulars "retama," whose flowers appear even in the dry season, and, in the time of rain, whiten the hills; *Spartium junceum*, an even more perennial bloomer, with brilliant yellow blossoms brightening dusty waysides;

Sonchus spinosus, of the volcanic regions, generally afflicted by the dodder which bears its name; *Asparagus*, *Ephedra*, etc.

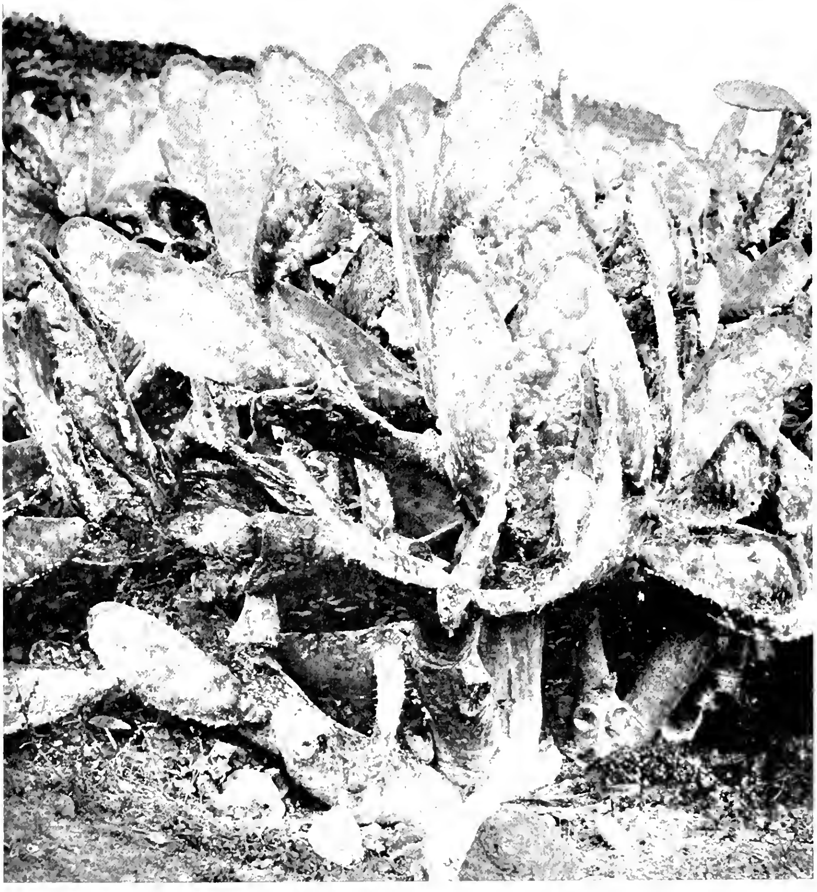
As one travels from the shore to the interior, the flora slowly changes as the temperature falls. In Teneriffe there is a gradual and complete transition from subtropical to purely arctic vegetation. Valleys, fields, hills, and gorges have their own characteristic plants.

The hillside flora is an interesting one. Often the whole lower part will be covered with an ugly growth of *Opuntia*, the prickly pear. There are two wild species, both very abundant and greatly esteemed for the sake of the pulpy fruit, which in the drier islands, where rain sometimes does not fall for several years, serves as a substitute for water. One was formerly extensively cultivated as the host-plant of the cochineal insect, but the discovery of aniline dyes has nearly ruined this industry. Still many fields exist, and the bare-footed women are yet to be seen passing between the spiny rows, putting the insects on each plant by hand. In the wet season, after being sown with the parasite in this way, the branches are tied up in

COCHINEAL CULTURE. The "newly planted" insects protected from rain by cloths.

white cloth to prevent the insects being washed off by rain, and a field so doctored is ridiculously suggestive of a regiment of bandaged feet.

These prickly things are disagreeable enough to the climber, but above them there is a most attractive region. *Asphodels* bloom in prodigal luxuriance. *Gladioli* have a brief period of gaudy predominance. Fragrant white *Amaryllidaceæ* are there, and the dainty-flowered *Romulea*. Hidden among the rocks grows the little native Jack-in-the-pulpit. The common brake, *Polypodium*, and *Davallia*



COCHINEAL CULTURE. Old plants of *Opuntia ficus-indica* with the "ripe" insects surrounded by a white, cottony, protective exeretion.

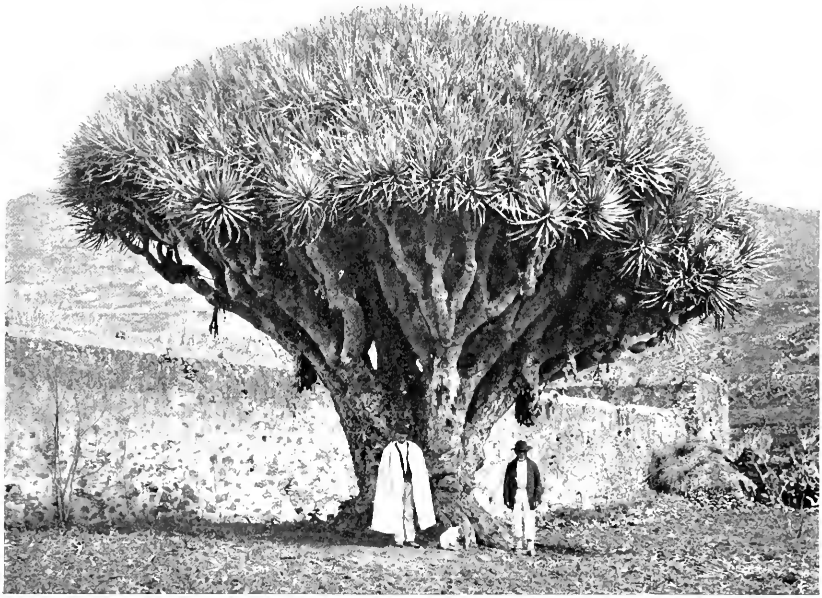
are here as everywhere among the rocks, and more rarely the sweet-scented fern and a species of *Notholæna* peep from the chinks of the crags. Gray clumps of the giant Canary *Euphorbia* rise sometimes to a height of twenty feet, and among the great columnar branches twine coils of spiny *Rubia*. There are several woody species of dock often seen on the steeper hillsides, and occasionally a shrubby *Convolvulus*. The *Echiums* reach great development on the islands. There are several peculiar species. The immense spikes of white or blue flowers are a common and striking feature of the landscape. Shrubby *Hypericums* also abound, both on hillsides and in barrancos.

The so-called "barrancos" are a rich field for the collector. They are deep, narrow cracks between hills which have been sundered by volcanic disturbance. Erosion has had little or no part in their formation. Many of them are not watered at all, and if followed to their sources are found to end blindly among the hills. In some the winter rains collect and remain as stagnant pools or slow-flowing streams through a part or the whole of the year. Others are beds of perennial brooks fed by springs among the hills, and sometimes, in seasons of heavy rains, the waters rise above their narrow channels and rush in floods to the sea, causing great devastation among the fields and homes of the farmers. Teneriffe, Canary, Palma, and Gomera are supplied with such streams and springs. The whole island of Lanzarote has only two insignificant and inaccessible springs; Fuerteventura is slightly better off, while Hierro is entirely dependent upon rain water, which is carefully stored in cisterns.

Valleys, of which there are notable ones—such as that of Oratava, called by Humboldt the finest in the world—are distinguished from barrancos by greater breadth and less precipitous sides, and are not necessarily volcanic in their origin.

The exploration of a barranco is a fruitful occupation. Rare orchids and many ferns spring from between the damp rocks. A shrubby crucifer is occasionally seen on precipitous ledges, and more commonly an equally curious spiny and woolly-leaved composite. The blackberry, which is common in all sorts of localities, here takes on peculiar forms, and leafless suckers thirty feet long swing down the bare cliffs, seeking rooting place.

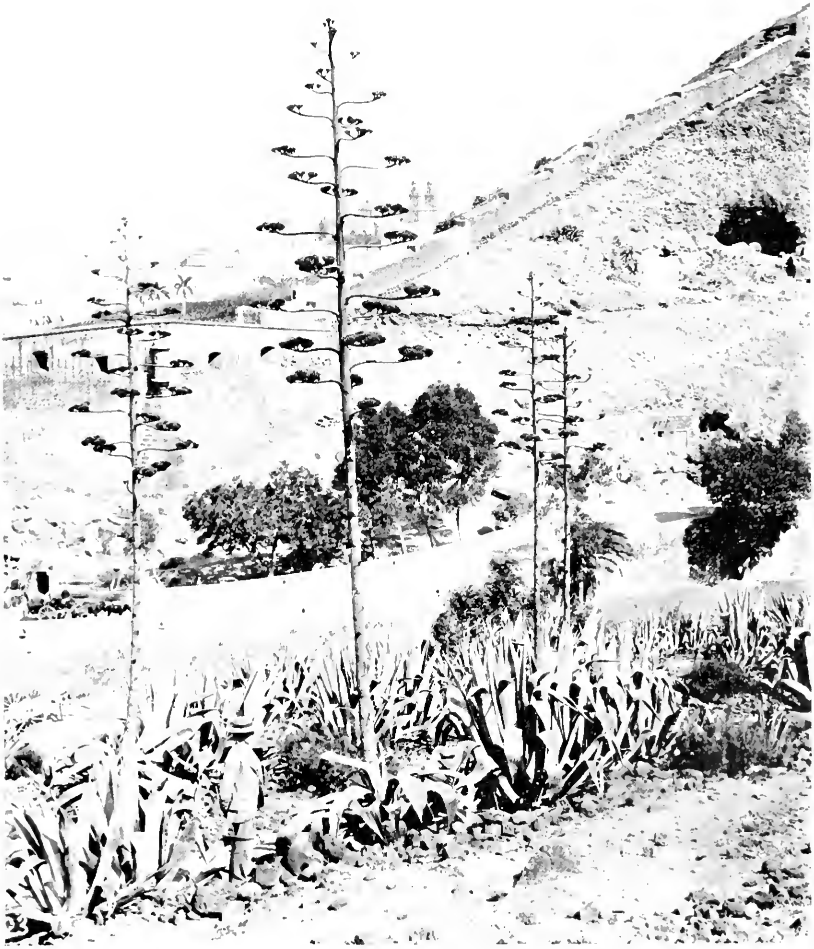
The bottoms of the watered barrancos and valleys are scenes of tropical luxuriance. The carpet of vivid grass is studded with loosestrife, oxalis, and clover. Wild forget-me-nots love the turf closest to the springs, and our garden nasturtium flings bright-flowered trailers profusely over the banks of the brooks. Maidenhair fronds grow in delicate beauty under the dripping ledges of the rocks. The tiny-flowered speedwell carpets retired nooks, and a species of *Lathyrus* with large, royal purple blossoms tangles itself around the canes. Here and there are clumps of palm and of native willow, rarely a specimen of the once common *Dracæna draco*, the famous dragon tree which yields the red gum once so esteemed as a dye and used by the aborigines in embalming their mummies. This tree is by some thought to symbolize the dragon which guarded the golden apples of the Hesperides; for the ancients tried to make old Atlas and his daughters inhabitants of our islands. To moderns this tree is chiefly remarkable on account of its exceedingly slow growth and the very great age which it attains. A specimen at Orotava was estimated by Humboldt and others to be from six thousand to ten thousand years old. This individual was hollow, and had been an object of veneration to the Guanchees since immemorial times; their Spanish conquerors turned it into a chapel. It was blown down in 1868, but



THE DRAGON TREE (*Dracæna draco*) AT LAGUNA, TENERIFFE.

numerous existing trees of much smaller size are still held to have an age of from two thousand to four thousand years.

There is an oak which seems to be thoroughly naturalized in a few places, and a silver-leaved poplar has monopolized whole valley sides. Near the aqueducts and brooks buttercups, vetches, flax, clover, catchfly, sweet clover, sorrel, and plantago abound. In the drier barrancos grows an acacia with globular, orange-colored balls of sweet-scented flowers, also a native sage and the tamarisk tree, with an occasional sturdy castor-oil plant. Very rarely one is fortunate enough to meet with a specimen of a species of juniper formerly forming great woods, now almost extinct on the islands. The cultivated fields and the roadsides have a flora of their own. Among the beans planted as fodder, the white-flowered sweet pea grows luxuriantly, sweetening the air. Vetches, geraniums, morning-glories, larkspur, poppies, and other highly colored flowers rush into bloom on the first approach of spring, making the fields look like veritable gardens of the gods. The roadsides and hills and neglected fields produce numerous gorgeously colored yellow, purple, and red



The Agave in Blossom. A Spanish fort and the city of Las Palmas in the background.

thistles, of a great variety of genera, very beautiful to look at, when one has not been trying to pick them.

Some plants which have been introduced for cultivation have become partly or completely naturalized. The aloe, which we know as the "century plant," makes hedges along the pathways, and is planted up the mountain sides in rows. It is used as fodder for goats and as thatch for peasant houses, and from the fiber are made baskets, mats, and fish cords. The flower stalks shoot up to a height of fifteen to twenty feet in an incredibly short time, and like mammoth candelabra, as they look, are a striking feature of the landscape. The graceful pepper tree, commonly planted along the highroads, seems to be wild in a few localities. Large groves of magnificent chestnut trees are found on Canary and Teneriffe. The fruit is gathered and sold in great quantities. The almond industry also flourishes in certain regions, and the beautiful trees cover the valleys of a most charming part of central Grand Canary. Fig trees were introduced by some of the earliest European adventurers, and have now become thoroughly established, their fruit being one of the staple foods of the islanders. Oranges and bananas, the chief exports of the country, only grow when planted. Tomatoes, the third great product, are occasionally wild.

But the collector's richest fields are the forests. It is impossible to picture to one's self the paradise these islands must have been before the conquering Spaniard wantonly destroyed so much of the woodland. Fuerteventura and Lanzarote are now entirely destitute of native trees, and with the trees went many precious springs, so that these two islands are now practically desert. The chaplains of Béthencourt, who were in Fuerteventura early in the fifteenth century (1402), describe it as "covered with rich vegetation; lentiscos, olives, date palms, tamarisks, and cardos (*Euphorbia canariensis*) made dense woods," and as having numerous brooks and abounding in herbs and plants and fragrant flowers, which gave to the island a charming and agreeable aspect. Pedro Gomez Escudero, writing of Canaria in the same century, says: "The whole island was a garden, all covered with palms; because from one place, which is called Tamarasaite, we took more than sixty thousand little palms, and from other parts an infinite number." And Dr. Chil says: "After the conquerors and their descendants had for more than three hundred years declared war to the death against the forests, yet at the beginning of this century many leagues were so covered with dense woods that, in going from Telde to San Lorenzo, one arrived in this latter village after a summer day's journey without having seen a ray of sunlight, having passed continually beneath a copious foliage where plants grew perennially fresh and luxuriant." These incontestable facts seem hardly credible, for one would need an abiding supply of scientific enthusiasm now to stay long enough among the scorched rocks of Fuerteventura to make the careful study of their life which is needed. Hierro and Palma are still well wooded, and the extensive forests and abundant water supply of Gomera make it, in Dr. Chil's estimation, the most beautiful member of the archipelago. Only scattered tracts of woodland remain in Canary and Teneriffe.

TAFIRA, GRAND CANARY. The hill in the background is of volcanic ashes and is covered with vineyards; on its left slope are a few specimens of *Pinus canariensis*.

The native pine is a stately tree with wide-spreading circular crown. Its nearest relatives are Mexican and East Indian species. It still covers large tracts of land, and one may ride for hours over the needle-covered ground where hardly any undergrowth breaks the pleasant monotony of the uniform, soft brown. The Canary tamarisk grows in clumps in the drier barrancos, and is also found in the groves of wild olives, *Lentiscus*, and *Bosea* which still exist as remnants of the woods which once covered the hills around Tafira. The wiry stems of a twining asclepiadaceous plant (*Periploca*) wind around these low trees, sometimes making impassable thickets. There are fine forests in Los Telos and near Firgas in Canary, and still more beautiful and much larger ones in the vicinity of Laguna, Teneriffe. Du Mont d'Urville says of one of these (*Agua Garcia*) that it recalls perfectly the forests of the isles of the Pacific Ocean and of New Guinea. One may ride all day through the half twilight of the dense woods. There are four native species of laurel, belonging to three genera, which here attain superb size; two species of tree heath, two of holly, a beautiful *Prunus*, and an arbutus tree whose bright orange fruits resemble miniature oranges. The forest flora has a dense undergrowth of native viburnum, shrubby species of the mint, and umbellifer families. There are brooks and beautiful waterfalls, and on the banks of these ferns grow to a height of from four to seven feet. Around the bushes and trees twine the European ivy, and the curious *Canarina*, a large-flowered member of the morning-glory family, and *Danaë*, a plant of the smilax tribe, whose flowers spring from the margins of broad-leaf-like stem expansions. One of the loveliest of the forest flowers is a large, pale-violet geranium with anemone-like leaves. But mere enumeration can give no idea of the beauties of these wonderful woodlands. Where there have been forest fires or clearings, a host of weeds spring up which, Berthelot says, gain predominance over one another in a certain definite succession, leading gradually to the reformation of forest.

Some of the most curious plants of the island flora have a limited distribution. The crater of Badhama in Canary has one or two species unknown elsewhere. Near the great rock of "Saucillo," a pillar of stone, near the center of the same island, one or two unique species have been found. The great crater of Palma, one of the largest and most perfect in the world, is the cradle and only home of others. Above all, the grand old "Peak" and its circle of surrounding mountains, the Cañadas, have proved most prolific in peculiar forms. More thorough exploration may perhaps extend some of these limited areas, but probably will not contradict the extreme isolation of many species. The careful study of the distribu-

THE CRATER OF BANDAMA, GRAND CANARY: 900–1,400 feet deep; the bottom is inhabited and cultivated.

tion and relationships of the flora of this ancient archipelago still has in store for him who can undertake it many most interesting and instructive discoveries. A complete knowledge of the present condition and past history of the plant life of one such small part of the world would be of infinite help to the comprehension of all larger regions.

THE PHILOSOPHY OF MANUAL TRAINING.

By C. HANFORD HENDERSON,
DIRECTOR OF THE HIGH-SCHOOL DEPARTMENT, PRATT INSTITUTE, BROOKLYN, N. Y.

V.—THE PLACE OF MANUAL TRAINING IN A RATIONAL EDUCATIONAL SYSTEM.

I HAVE tried to show in previous papers the grounds upon which manual training rests its educational claims, and to point out some of the results of this training. It remains for me to indicate the place which manual training ought to occupy in the whole scheme of culture. I shall not consider formal education *plus* manual training, but rather a system of education in which manual training forms an integral part. So considered, the question becomes a very comprehensive one, for it amounts to nothing less than an examination of our whole scheme of secondary education.

It has been insisted upon all along that education is a process, a tool, a means to an end, and not in any way an end in itself, not something fixed and sacred, but something quite fluid and alterable. And, further, it has been suggested that education is but another name for the process of evolution made conscious, and must consist in such control of the environment as will bring about the desired human reactions.

The problem before us is quite definite. Given babies of three and four years, what shall be done with them up to eighteen years, so that they shall evolve into desirable types of men and women? The present system, as you know, is somewhat elaborate. The kindergarten, elementary school, and high school cover just the ground we are considering. It is a continuous, well-co-ordinated process, and some of its results are quite beautiful. But I believe that it is not the best. The problem is to build up a system which shall be in accord with our accepted philosophy of life, and shall satisfy the ethical and social ideals of the heart. At three and four, what have we given? At eighteen, what do we want? The answer to these two questions is the educational data. How shall the material given grow into the material wanted? The answer to this question is the educational method. It is this latter answer that involves the application of manual training.

I shall not speculate very long upon the material of babyhood. Clever men and women are at work upon this problem, and they have already made preliminary reports of the highest interest and value. Now that mothers have been enlisted in the work and have been encouraged to record observations made in their own nurseries, the data will doubtless grow apace, and soon lead to wider knowledge. I recently spent a morning at Miss Aborn's model kindergarten in Boston. The children were from three and a half years up to six. The drama was full of action, full of life, full of suggestion. When twelve o'clock came, and the little people marched out of the room, I felt very much as you do when the green curtain goes down at the theater, and the play is at an end. Teddy and George and Hazel and the rest remained very real figures in my thought for many days. The impression made by such practical studies as these is a double one. Looking at the children alone, the one great fact that absolutely forces itself upon your attention is their intense individuality. Each little person is a bundle of possibilities, but each bundle is so different! You can imagine no one process able to deal successfully with all of them, or indeed with any considerable number of them. You are face to face with the great fact of heredity, which can not be ignored and must not be belittled. Fate, or destiny, or Karma, or predestination, or whatever you choose to call it, accomplished more than half her work when the child was so born, and can well afford to hand him over ironically to the schoolmaster. Looking too steadily at this great fact robs one of hope. So much has been done and settled once for all, quite placed beyond the chance of our control, that it seems hardly worth while to work and struggle over what is left. Yet fate is not altogether unkind. The very persistence that baffles us, gives a permanence to the type which in a longer view is touched with promise.

And then, there is the other impression. Looking at the teacher and remembering that it is the outer world that is to react upon these little organisms, and noticing how completely she may control this outer world, and how skillfully she may direct its reactions, one is struck anew with the tremendous forces in the hands of education. In the kindergarten much more than in the elementary schools one finds a flexibility in the educational process that is a promise of high efficiency, for it not only allows for the intense individuality of each little person, but builds upon it. The direction of this constructive process will depend upon what we want at eighteen years, and this question of what we want is always pertinent, for in such an elaborate process as modern secondary education there is a certain inertia, and it seems unavoidable that much should come to be done that has no direct bearing upon what we now want. Familiarity dulls our power of observation, and we are apt to drift into a state of mind where, as Professor James would say, inconsistencies cease from troubling and logic is at rest. But even when we are aroused, we evoke a picture of our wants in which it is easy to mistake the values. My present purpose, however, is not to evaluate human qualities, but to seek out and emphasize those that are essential, separating them very rigidly from those that are secondary and unimportant. I restrict myself to the narrower task because from a monistic point of view these human qualities are so bound up with one another, are so thoroughly but different aspects of the same unit, that they can not be stated in squence. They do not follow one another. They coexist. It is a single panorama, human life, crowded with different elements, but making only one picture.

The advantage of thus defining what you want at eighteen is that no scheme of education will be tolerable which does not lead by direct and scientific methods to the desired results. It is possible, of course, to introduce various elements into the scheme of instruction, and allow the principle of natural selection to work, trusting that in the end there will be a survival of the fittest. But this is scarcely evolution made conscious. It is only consistent with an expediency system of morals, which makes life a daily, hourly experiment, and rests upon no underlying principles.

At eighteen, boys and girls stand on the verge of manhood and womanhood. Goethe says, "Be careful what you pray for in your youth lest you get too much of it in your old age." What these boys and girls pray for at eighteen is pretty well settled, and they will be pretty sure to get it. The best part of life is still ahead, but the tendencies are already there, and that is after all a large part of education. You have perhaps heard of the country girl who was asked what her brother was doing at the university. She replied naïvely that he was learning to be a student. He was a lucky fellow if his sister were right. I find life, myself, a tremendous experience, and very, very full of interests; but when I look at the natural history of these interests I can trace nearly all of them to some beginning, however faint, in the nebulous thought region of sixteen.

The ethical ideal that I have tried to place before you is that of a perfect human organism exercising its functions in the fullest possible measure. If I may use a biblical expression, it is the being perfect even as God is perfect. I believe, as I say, in this divine perfectness, not as a thing to be gained here and now, all at once, at an emotional revival meeting, but something to be grown toward and cherished as the ultimate ideal, something that is to come as the result of the operation of adequate causes. The special characteristic of this perfectness is its inwardness and its unconsciousness. As the flower blossoms and the tree grows, as the earth moves and the star shines, all as the result of an inner quality, all in fulfilling the law of life, so the soul of man when it turns from the piety of the cloister to the piety of Nature is under the stress and strain of no moral conflict, but is at peace. Morality spans the difference between what is and what ought to be. When these coincide in the perfect life, morality has fulfilled its function and must cease to be. The gods are not moral. To attain the divine perfectness is to outgrow morality. These young people of eighteen, in whom we are interested if they are to come into the perfect life, must do so as the result of their own spontaneity, and as unconsciously as possible. The process of education which is to endow them with a perfect organism and plant in them the seeds of the complete life fails unless it leave them spontaneous and wholesomely unconscious of themselves. One of the most dangerous dangers of the schools, if I may so express it, is self-consciousness. It mars nearly all whom the schools touch, and makes unendurable the teacher of too long a term of service.

The term organism, once for all, stamps the man or woman, boy or girl, as a unit, and we may speak of the bodily, emotional, and intellectual functions of the organism without being misunderstood. We may conveniently enumerate under these three heads those essential human qualities which are of prime importance in the educational data. The bodily life includes birth, nutrition, growth, reproduction, death. We may limit nutrition, restrict growth, avoid reproduction, but we can not escape the first and last of these great functions, birth and death. Yet complete morality is only satisfied with the complete discharge of all these functions. The morality of birth lies with our ancestors. They owe it to us, as we owe it to our children, to give birth only to sound, true bodies. Yet a perfectly healthy man or woman is a rare sight. The morality of nutrition and growth is the morality of hygiene and health. It is satisfied only with strong, sound, beautiful bodies, beautiful not only to look upon, but beautiful in the perfection with which they operate, the sound digestion, strong pulse beat, free circulation, deep breath, keen hearing, sharp eyesight, delicate touch, discriminating taste, quick will, co-ordinated movement—a long list, truly, but not longer than the requirements of the perfect life.

The morality of parenthood is bound up so closely with the emotional life, and is most holy when most closely bound, that it seldom finds distinct utterance, and such utterance as we have is mostly false—on the one side, the celibacy of religious orders; on the other side, a reputed duty to the state or to the race. I find the sanction of marriage and parenthood to reside in the individual. Men and women are better into whose lives the mystery of birth has come, better by reason of that tenderness which it calls forth, and better by reason of that irresistible appeal to love and sympathy which a child alone can make. A life into which this holy experience has never come is not complete, whatever may be its other compensations. And I should deplore the higher education for both men and women if it made them less ready to meet the experience of parenthood, deplore it, not from the point of view of society or the state, for with the continuance of the race I feel that we have consciously nothing to do, but deplore it for the loss that it meant in their own lives.

The life of the organism begins in mystery, in birth. It ends in mystery, in death. But death may be terrible, or it may be beneficent. It is terrible when it comes as an interrupter to the full activities of life, and more terrible when it comes through slow, wasting disease and decay. But death is beneficent when it comes at the close of a complete, well-rounded life, comes as a savior from the infirmities of too great age. What is so universal must be good.

A scheme of education which neglects any of these functions of the complete bodily life, or fails to inculcate sound ideas regarding them, is sadly deficient, and can not be called rational. It would be a denial of the very philosophy upon which the new education rests.

The demands of the emotional life are no less exigent. Every human action has back of it a feeling, a desire. Where these desires are sluggish or wanting, the action is corresponding. We must never forget that we can only do what we want to do. It may seem a trivial statement upon which to base so much, but it is practically at the basis of all of psychology. However perfect the organism, the complete life is impossible unless back of the organism is the enginery of keen appetite and manifold desire. The whole human drama depends upon just this, upon mere sentiment, if you choose. This emotional life upon which so much depends, upon which everything depends, is wrapped up in the organism itself, is a part of the very flesh and blood, and can not be separated from it. It is only convenient to name it aside from the more obvious bodily functions. The same is true of the intellectual functions. I am naming them last not because they are least, but because they are greatest, and in the sequence of life they are the fruits of the others. The school works for those as the gardener works for his most perfect fruit. But if it work rationally, it must work, not from the empyrean downward, but from the earth upward, through sturdy limb, and branch, and leaf, and blossom.

The educational process itself is only highly evolved when it too recognizes in the most practical way the idea of causation, and adjusts its acts to ends. I often think that the friends of goodness miss the realization of their aims by looking too steadily at the dazzling ideals by which they are led, and not steadily enough at those humble means which, in the unalterable sequence of cause and effect, must first be realized. The process by which thought is excited in the brain is quite as definite as the process by which an electro-magnet is energized. You must have the magnet and you must have the exciting cause. You must have the brain and you must have the stimulus, an inner something induced by an outer something.

But about the data of education we are pretty much agreed. Out of the material of babyhood, half plastic, half stubborn, we are by our scheme of education to evolve the potential men and women who knock at the doors of our colleges. Looking at manual training as a method, and comparing the material given with the material wanted, it is very clear that manual training can only form a part of the complete method. To span the gap entirely, and cover the fourteen years between babyhood and college, manual training will have to be incorporated into a scheme of education more thoroughgoing and more psychological than any that has yet been proposed. If genius be the seeing eye, the feeling touch, the hearing ear, the efficient brain; and if the highest and most complete manifestation of our human nature depend, as we believe that it does depend, upon the sensitiveness and soundness of the organism, the educational process which is thus to unfold and perfect the human spirit must include the cultivation and development of all the faculties—touch, taste, smell, hearing, sight, movement—that they may comprehensively and accurately report the outer world; must include the cultivation and development of the emotional life, that it may stimulate the senses to the full exercise of their powers, and, finally, must include the cultivation and development of those intellectual faculties which convert this rich phenomenal material into an evolved humanity. I can not in passing forbear the criticism that our current schemes of education, however lofty their ideals, devote themselves too exclusively to the intellectual life, and do not sufficiently concern themselves with the materials out of which that life is built, the sense impressions of the outer world, or with the tool that builds it, the human organism with all its emotional and artistic possibilities. Nor can I, in declaring manual training to be inadequate to the full demands of a rational education, omit to emphasize that it is the only scheme, including sloyd and the kindergarten, that has attempted to build up the educational process on organic grounds, and that it is inadequate, not because of any fundamental mistake in its philosophy, or inaccuracy in its methods, but simply because these methods do not yet go far enough. You know, perhaps, the rallying cry of manual training—put the whole boy to school—but in reality it does not yet do this. It puts his hands and by necessity his eyes to school, and I shall always feel, no matter what the future of manual training may be, that it has done yeoman service in breaking ground along rational, causational lines, and in inviting our attention to the immense possibilities of a culture that is organic.

The rational scheme of education to which such an examination as we have just been making would unavoidably lead us, must include manual training as an integral element. If we substitute for manual training some more general and comprehensive term, such as faculty training, organic training, or, better still, if we dismiss all special terms of any kind whatever, and use education to mean the conscious process of human evolution, we shall have reached the rational scheme of education itself, and may feel that our search is ended. In such a scheme, manual training must occupy a most prominent place, for it has to do with the most obvious forms of touch. I wonder if you ever reflected that our entire contact with the outer world, our entire knowledge of it, is in the last analysis dependent upon but one sense, the sense of touch, and that the sensory nerves, those telegraphic lines between our consciousness and the outer world, respond to but one operator, direct contact? Yet this is strictly so. We see, because waves of light break upon the shores of vision; we hear, because waves of sound strike against the ear drum; we smell, because minute particles of the odoriferous substance, or perhaps because peculiar and as yet unnamed waves induced by such a substance, impinge against our noses; we taste, because of the direct impact of food and drink against the sensitive nerve ends of the tongue. We have but one sense, a tactile sense, and if instead of manual training we should say tactile training, we should pretty nearly hit the mark.

The full organic results which this rational scheme contemplates can never be reached, I am afraid, through the current curriculum, or through anything likely to grow out of it. The whole idea is too radically different. The present curriculum makes a brave assault upon the intellectual life along a road cut straight through the empyrean. The new education is after a still more complete intellectuality—and we are apt to forget this when the industrial view presses—but it proceeds along the road of the organism. It is not, then, simply choice that would lead us to part company with the old curriculum. It is something more imperative. It is bare necessity. And the radical scheme which I am about to propose must be accepted in some such spirit, not as indicating an idle love for things that are new, but because the things that are old will no longer serve.

In the kindergarten it is self-directed play and work; in sloyd, self-directed hand work; in manual training, technical hand and tool work that form the nucleus of method. In a rational education such as I have tried to suggest, it must be self-directed work so arranged as to develop the whole organism, and bring out the moral and æsthetic and emotional and bodily sides of life quite as thoroughly as the intellectual.

To carry this scheme into effect will require a very radical disposition of the school days. If we assume that the college has been rationalized, and I believe that to be the case at Harvard, and at other places where an elective course of study allows the freedom of the unfolding spirit, then I should put it as one of the first requisites of a sound system of secondary education that it should be broadly and thoroughly preparatory to the college. All the children will not go to college, but as we cherish the ideal of a liberalized and cultured America, we want an increasing number of them to go, and in any case we want the very best education possible for both classes of children—for those who go to college and for those who do not. And I should hold that either the colleges were gravely at fault, or our ideals of middle-class life were gravely at fault, if one educational path led to the one and another educational path led to the other. I can not, therefore, sympathize with that present tendency in public education which is attenuating the culture side of our high schools, in order that they may serve more immediate technical and commercial ends. I can not feel that it is in the province of the public high schools, or of the State that stands back of them, to turn out shopkeepers, clerks, bookkeepers, or artisans. The community life is impoverished by such partial products, when it ought to be enriched by the full measure of a human life. That education will be the best, will be the most truly educational, which leads to the college, even though it find the doors closed.

I have expressed the hope that a deeper realization of the dignity of human life will make the ripe culture of the college more increasingly imperative for every child, and I believe that this result will come about with the growth of the social conscience, and with the increase of that spirit of brotherhood which is even now appearing as a bit of leaven in our midst. I came up from the subway the other day with that exultation in my heart which I think the modern man feels as well as the Greek when he emerges from the nether world into the open sunshine. At the mouth of the pit a little figure was sharply outlined against the sky. It was the figure of a mere child, a little boy. His face was pale and worn. He was standing there drinking in the chill of the pit, attracted by the hope of selling his papers. I could not help saying to myself:

"Heaven help us all, this good city of Boston, this rich Commonwealth of Massachusetts, this boundless wealth of America, that we should so starve our children, these children of the State, starve them both in body and in soul!" Their only crime, poor little ones, is that their fathers are idle, or ill, or dead. Did you know that savage tribes are less unkind? I met an old woman on the street. She had an honest, patient face, and sad, appealing eyes. She was very frail. Her dress was much too thin for the bitter east wind that was then blowing. She carried a very heavy bundle, and was fairly staggering under its weight. She was suffering visibly. On the other side of the curbstone another woman of the same age was driving past. She was quite alone, save for the coachman, and had ample room. She did not stop. She passed quickly. No one was surprised. No one noticed it. Yet both were women. Both had been the possible mother of our Lord.

But these are gentle sights. You may see them for yourselves any day on the best of our many highways. If it were right to occupy your time and so play upon your feelings, I could take you to highways less esteemed, and show you sights less gentle. But perhaps this is enough. The point I want to make is this: that the rational scheme of education that we are seeking will include the cultivation of a social conscience which will make sights such as this impossible. We want a scheme that will concern itself with the helplessness of childhood and old age quite as devotedly as with the buoyant self-sufficiency of youth.

I take it, then, that this scheme of education is to prepare all boys and girls to enter college, and to open the door to an increasing number of them, and that it is to include with just as loving care the children of the poor as those of the more fortunately placed. And I take it that the fourteen years which it contemplates—from four to eighteen—are to be just as jealously guarded as a miser does his gold. For these years are of all the most valuable. The growing organism is more plastic than at any other time. The very motion of growth makes those molecular rearrangements possible, upon which skill and knowledge and character depend. You know that a piece of iron may remain idle in a warehouse for years and suffer no change of internal structure, but when this same piece of iron is put into a bridge, and subject to the incessant vibration of wind and traffic, it rapidly becomes crystallized, and must be replaced from time to time by more fibrous metal. The moving particles are more responsive to the crystallizing force. This is not an analogy, but a strict parallelism. The movements of growth make possible the physical changes in the organism. The priceless years are those under twenty. It must not be thought for a moment that I conceive education to stop at eighteen or even at twenty. There are mental functions the most important and valuable of all that do not come to anything like full fruition for a score or more of years. A modern man living the most evolved life is now said to be in his prime at sixty-five. But I do mean that this subsequent life of fulfilled promise is largely, almost entirely, dependent upon the early life. The impressions were recorded then, the senses were cultivated then, the motor nerves were habituated then; in a word, the organism was prepared for the intellectual life, and the intellectual equipment pretty well determined once for all. To the after years remains the utilization of this equipment, a utilization whose quality and whose extent will depend upon the stimulus and circumstance of later life. It is well recognized among musicians that to play the violin successfully one must begin early in the teens. And it is so with many other arts. The highest performance will result when with the other organic equipment is wrapped up a potential stimulus, fundamental and deep enough to operate in after life, even against unfavorable circumstances, against grief and loneliness and disappointment, and still come out the victor.

Literary critics wisely discriminate between books which possess or do not possess that subtle something which we call the literary quality. The books which have this quality have been well described as the literature of power, for, however unliterary the reader may himself be, they take hold of him and influence him in a very real way. The books that are only tolerable because they record certain facts of value, the material out of which books might be made, rather than books themselves, have been described once for all as the literature of information. To serve the ends of the complete life we want in our schools the literature of power, and in quite as imperative a way we want the curriculum of power, as opposed to the curriculum of information. I have told you earlier how little value I place upon the informational results of the elementary schools, and how profoundly I mistrust them in failing to awaken a more insatiable intellectual curiosity. It has been my good fortune to have traveled quite extensively in this country, literally from Maine to California and from Georgia to Vancouver, for I have wanted to know what we meant when we said *America*. And as a result of this experience I have to report a very low standard of intellectual life among the youth of America, a very tepid curiosity regarding the things of the spirit. We are prone at Cambridge and at other centers of culture to take too favorable a view of this matter. I think that Cambridge is not typical of the culture of America any more than Oxford is typical of the culture of England. At both places we are studying high tide.

It is easier in the face of such failure, it is a much smaller pang to one's conservatism, to strike out from the current curriculum many of the old informational studies, and to substitute for them a training which is largely bodily and emotional and artistic. Reality and sincerity are the two things that we most want in life. The current objections to ideal schemes of organic education are that, with the rapidly turning wheel of fortune in this country, a course of instruction covering fourteen years—that is, from four to eighteen years of age—can not be taken by any large proportion of the children, and even for those who do start out with a reasonable expectation of completing such a course, interruptions are very likely to occur. And the question is pertinently put, What is to become of these children if they are suddenly thrown out upon the world before your carefully co-ordinated scheme of education has done its perfect work, and they have had little or no informational studies? I want to anticipate this objection, and to do it very thoroughly and very clearly. The answer is twofold.

In the first place, with the growth of educational and social ideals, the State will not leave the education of its children to such precarious circumstances. We are already wealthy enough to have all our children withheld from industrial occupations until they are twenty; and when the social conscience becomes sufficiently sensitive to do this we shall be still more wealthy, for we shall have more efficient and intelligent workers. It is a rough guess, but I should say that at the present time half of our workers are busy, not in supplying absolute human wants or even capricious wants, but are kept busy simply because the work of last year was so poorly done. The work of plowing, harrowing, rolling, planting, and harvesting a crop of wheat is practically the same whether you get sixteen or thirty-two bushels to the acre. In the case of material upon which human labor is afterward spent the case is even more striking. Good cloth, for example, will easily wear twice as long as poor cloth. For a given amount of wear poor clothing must be looked upon as a luxury. In addition to the extra work at the mill in producing two yards of poor cloth in place of one yard of good, there is precisely twice the amount of work in the tailoring shop in making up the two suits. There are, of course, clever politicians who would argue that such an abundance of work for the masses is a national blessing. But I do not belong to their company. I do not believe in outwardly directed, compelling, industrial work any more than I believe in suffering and disease. I believe in self-activity, in inwardly directed work that means the expression of ourselves in action, and I believe in the leisure to grow wise.

Thoreau found that by working six weeks he could maintain himself a year. This meant six-fifty-seconds of his time. He was satisfied with very little—with less, perhaps, than was quite wise. If we more than double his figures, and remember that co-operative labor is far more productive than Thoreau's solitary hoeing, we may agree that one quarter of the waking life must go for bread. But we have still a large margin. If we allow the full measure of life, say fourscore years, one quarter of it would be just twenty years. A man working full time from his twentieth to his fortieth year ought still to preserve both his youth and old age from industrialism. Or working industrially for half the day, which would perhaps be wiser, his term of industrial service would stretch from twenty to sixty years of age, and would still leave the extremes of life free for preparation and reflection. I believe this to be a complete answer to the objection, and I have an unquestioning faith that society will some time, when its conscience is aroused, limit its industrialism to the years of maturity and of strength, and will not bind its burdens upon tender childhood and infirm old age.

But the answer, I said, is twofold. You may not share the social optimism that I have been setting forth. The second answer is quite as complete as the first, and is applicable to society as it is, or even to a society still more selfish and unchristian. The second answer is that, no matter when interrupted, a rational scheme of organic education is still the best that could have been given up to that time, and for its justification does not need academic completeness. I may say, in passing, that this is not true of the present curriculum. While the schools under the present lowly evolved social conditions must teach in a measure as if each utterance were to be their last, much of the work must, nevertheless, depend for its value upon a reasonable degree of completeness. This is particularly true of classical lines of study. Even in Germany, where the classics have a hold far ahead of anything they have here, educational philosophers are urging with increasing insistence that the main value of classical study lies in the content and only incidentally in the discipline. And you may know that in obedience to this thought the study of Greek is being urged more than that of Latin because the Greek ideals of literature and art and morals and life are so immensely superior to the Roman.

This thought, carried to its extreme, will of course land us in the position of the scientific humanists—if I may so name my own party—who bring to the study of classical writers an almost passionate devotion, but who study them solely for their content, and therefore in translation, in their own modern mother tongue, be it English or German or French.

A child can not enter into Greek as literature with less than from four to six years' study. If this be interrupted, the discipline of course remains, but the main value has not been appropriated. This is also true of modern languages where they go along side by side in too attenuated courses. It is wise, I think, in our present social state, and perhaps it would be wise anyway, to make each day rich in its own rewards, each hour, each lesson, to teach, though without any loss of serenity or faith, as if each occasion were the last, and must contribute such content as it has.

If we worked in the spirit that I have tried to make clear to you, the early years of childhood would be given to manual training enlarged into faculty training—would be given, that is, to organic education, and to the cultivation of the sentiments, and not to the pursuit of knowledge as such. Knowledge may be better than riches, but children are little qualified to use either, if the knowledge is at second hand. It is quite surprising how happy a child can be and how wisely occupied without knowing whether the moon be made of green cheese or not; and for my own part I do not think that it much matters whether he ever knows, unless he be prompted by an inner curiosity to inquire. Children are organically impressionable and alert, and they have a fountain of feeling that may be so nourished that it will keep fresh and green the years of later life. They have, too, an immense appetite for the concrete world, but they are satisfied with a very small seasoning of the abstract. They are not logical, and I think the attempt to make them so, on such a slender experience of life, is not only time-consuming, but absolutely disastrous to the best results in later years. The hope and promise of the future lie in keeping children children, and boys boys, and girls girls. It is quite fatal to have men and women prematurely born.

The enrichment of the curriculum along organic lines can only be carried out at an expense of time, but just so soon as we are persuaded that this is what we want the time can readily be found. The old curriculum must be heavily pruned in any case, and this will make room for better things. We shall want to omit two classes of studies altogether: first, those that are abstract; and, secondly, those that are involved in other studies, or in a general experience of life, and would be learned by the children themselves a year or so later. To sweep away these two classes of study from the elementary school —happily, they have never been given place in the kindergarten—would leave a large gap, and would make us very rich in the opportunity for more profitable organic work. Here is the list of elementary studies: reading, spelling, English, modern foreign languages, Greek, Latin, writing, arithmetic, geography, United States history, civil government, drawing and science lessons (usually physiology, with special reference to the shocking effects of alcohol and tobacco).

This certainly invites a willing use of the editorial blue pencil. What shall we cut out under the first head, as being too abstract? I should say all mathematics, all systematic history and civil government, all grammar (this would exclude the classics), and all mechanical drawing. Under the second class, studies involved elsewhere or better learned by implication, I would cut out formal spelling, formal writing, and formal political geography. I seriously propose, then, and I ask your very serious consideration of the proposition, to cut out mathematics, history, civil government, grammar, classics, mechanical drawing, spelling, writing, and political geography—almost the whole equipment of an elementary school. We have left of the old curriculum only the speaking, reading, and writing of English, and of French or German; the study of science (preferably *not* physiology), and free-hand drawing. This fragment, poor as it may seem to you at first, could yet be made the material of a rich culture. When you add to this the cultivation of the body, and the faculties of touch, sight, hearing, smell, taste, speech and movement, and the acquisition of those accomplishments which from their organic nature must be learned, if at all, in childhood, such as instrumental music and singing, you will find that the days will be more than full—full not of weariness, but of delight. The studies which I have so mercilessly cut out from the curriculum may safely be left to the high school, and some of them left out altogether. Should Jack or Margaret fail to reach the high school, I am still very strongly of the opinion that the acquisition of those accomplishments and powers that I have here suggested would enrich their lives with a graciousness and success that could never have been extracted from the old studies.

Let us look at this new curriculum. To speak English correctly in a clear, pleasant voice, to read it intelligently and agreeably, to write it plainly and without ambiguity—this in itself would be a liberal culture, which few of us attain to. But the end is not yet. Think of what is involved in our reading. We can read stories of our country, of the men and women who have made it great; we can read descriptions of colonies and explorations, and later states, we can read its best and most stirring literature; and we can do all this in the presence of pictures of the men and women and places, and of maps of the lands, and can get a deeper and more human knowledge of America than could be gained by any amount of unemotional history and civil government and geography. In the same vivid way we can study the history, geography, and civilization of other times and places, not as something to be mechanically learned, but as something to be experienced, something to lay hold upon our sentiment and affect our life.

I believe that this sentiment study of the English language should be the foundation stone of modern education. In a smaller measure, but in the same spirit, a modern foreign language may be taken up and entered into and possessed, and especially if but one be taken up at a time. I have omitted spelling, writing, and geography from this new curriculum, because they are better taught as involved in the other work. Spelling at best is a mechanical virtue. I happen myself to be a good speller, but the hours I spent with the spelling-book were numbered. I have learned to spell because much reading has familiarized me with the appearance of words, and I happen to have a visual type of memory. I recognize words now much as I do maple or oak leaves, and with as little difficulty. I am disposed to think that the testimony of others would be similar to mine. In the same way it is hardly worth while to have a separate copy book when all the written language work should be an exercise in writing, or a separate atlas when all reading involving places is done in the presence of a large map. This is what I mean by cutting out studies that are better taught by implication. And in defense of this suggestion, I would call your attention to the fact that the best things of life—courtesy and morality and taste and religion—are not formalized. They are taught by implication and by example.

The science work offers another fine chance for correlation. It should be thoroughly of the surface, and should have to do with the tangible things that interest children, plants and animals and stones, as they touch human life. No skeletons, no systems, no schemes of classification, but flesh and blood and realities all the time. The fatal blight on nearly all elementary pedagogical work is our passion for systematizing, a passion doomed to disappointment, and the forerunner of many dreary failures. One can only classify when one has a lot of material. The children haven't this. They must first get it. The quest will occupy them at least up to the high school. The science work had much better begin with some observational and in a large way experimental branch, such as physiography. Physiology is not superficial enough, and can not be well taught in the absence of an elementary knowledge of physics and chemistry.

The drawing, which I would have entirely free hand, is most valuable when used as a means for the expression of the child's own ideas. Let him draw what he likes, and let the teacher help merely in the method of representation, and then chiefly by suggestion. But these ideas, I am glad to say, are already being worked out in some of our schools. You may have seen the curious pictures that children make of soldiers marching, or of a ball game, or you may have been amazed at their original conceptions of animals and Indians and other creatures dear to a child's fancy. The results are undoubtedly wild, but they are full of promise.

The main point in these suggestions is that the language and science and drawing, thus cut down to the possible and essential, shall be as sincere and as real as the best insight of the teacher can make them. We can do all this and have plenty of time left for the cultivation of the body and the senses.

And we must begin this bodily culture by getting on good terms with our body, by admitting it to honorable fellowship with the mind. We must not be ashamed of our brother, the body. We must want it to be as subtile and pure and strong and beautiful and unashamed as is our spirit. It is a poor education which does not teach boys and girls to walk and run, skate and swim, ride and row, throw and jump, for upon these physical powers joy and health and life, the full and complete life, depend much more than they do upon such formal studies as arithmetic, for example. This bodily culture has an assured place in the rational curriculum, a scheme which fails signally if it does not produce vigorous bodies and warm hearts quite as surely as informed minds. Our motto is the one that you may read at Herder's grave in the quaint old Stadt-Kirche at Weimar: "*Licht, Liebe, Leben.*"

This increased time also makes possible the enlarged faculty training which a rational scheme demands. The present manual-training work has only to be enlarged so as to include all the faculties, speech and hearing, taste and smell, as well as touch and sight, and to do it not as so many drill exercises, but along the line of human interest and motive. It may seem to you a little fanciful that I include the sense of smell as a serious object of culture. But experiment shows that much of the gratification we get from food is wrapped up in the odor, and our life depends upon our food. Further, odors are the carriers of many helpful and delightful memories. A keen sense of smell means enlarged life, besides being a source of direct pleasure, and a safeguard against noxious influences.

All the senses are to be brought to a high state of perfection, so that they may comprehensively and accurately report the outer world, and by their mental reactions may build up a nerve tissue in the brain of high sensitiveness and power. The possible exercises along these lines are simply unending, and the more intimately they are prompted by the artistic conception of life, the more wonder-working will they be. From this point of view singing is quite as integral a part of voice culture as speaking, while instrumental music not only offers an opportunity for valuable æsthetic culture, but as well a physical co-ordination of sight, hearing, and touch that we simply can not afford to neglect. And all this work, if it is to lead to the highest results, if it is to give us complete men and complete women, must be constantly touched with emotion, with the sentiment of kindness and love and unselfishness and justice and reverence. As I conceive our human needs and human possibilities, the very place where manual training, or rather a thoroughgoing organic training, would be of the utmost use, is the very place where in our whole scheme of secondary education it is found in the least measure—that is, in our elementary schools. When the high school is reached, there ought to be no change in the organic character of the work, but it will be safe to introduce a limited amount of formal and abstract study—geometry, algebra, arithmetic, grammar, history, civics—and to make the science work somewhat more analytic and searching. I must believe, both as a result of my experience with such measure of organic education as our present manual training, in tool work, music, and art represents, and as a result of my firm faith in the continuous and unalterable operation of cause and effect—I must believe, I say, that boys and girls under some such rational scheme of organic education as I have outlined would come to the college at eighteen, sound, vigorous, sensitive, well-equipped, magnificent material out of which to frame magnificent men and magnificent women.

My own conception of life is avowedly that of an artistic and moral possibility, and not at all as a commercial venture. I have come to believe that the wealth of the world is human; that the estimable things of life are personalities, are beautiful men and beautiful women and beautiful children, and I am quite willing that the scheme of organic culture which I am here advocating should stand or fall with this artistic and moral conception of life.

I believe most profoundly that the education which is to regenerate and redeem will be brought about by the setting up of permanent changes in the organism itself, changes brought about by the motive power of the affections, and through the cultivation of the senses, and having for their end and purpose the realization of a high social and moral and artistic ideal. And I believe, further, that in manual training we have the open door to a more rational and thoroughgoing education, and that we have only to enlarge manual training into a more complete organic training to make it satisfy the educational needs of the human spirit.

A RING or circle of raised earth at Todmorten, Yorkshire, England, which has been popularly regarded as a Roman camp, has, upon excavation, been found to be a prehistoric burial place of the bronze age, and to have contained at least six urns, with other relics.

WEATHER FREAKS OF THE WEST INDIES.

By F. L. OSWALD.

A UNITED STATES army officer, who describes the trials of garrison life in the far Southwest, remarks that the valley of the Rio Gila, though an inferno of dyspeptics, would be a paradise of weather observers, as they could stereotype their reports for a year in advance, and then go to sleep, merely leaving instructions to be waked at the approach of the one annual rain shower.

With a similar precaution for a possible lucid interval of showers, certain districts of western Oregon might enable an employee of the Signal Bureau to indulge at least the luxury of hibernation; but with every mile farther east the use of stereotypes would become more precarious, and the busiest American colleague of those Pacific sinecurists would probably be a "forecast manager," stationed on the southeast coast of Cuba.

Weather changes depend upon a variety of local conditions, modified by external influences, and on the two main islands of the West Indies the aggregate of those factors is complex indeed. A number of densely wooded mountain ranges, varying from low hill chains to Alplike sierras, alternate with arid plains and reeking jungles, and air currents from the eight principal points of the compass are apt to cause as many different modifications of humidity and temperature.

These imported meteorological tendencies have often to be taken into account to explain the curious weather freaks of special districts. The almost infallible visitations of cold waves that interrupt the summer heat of our Atlantic coast States about the beginning of July have been ascribed to the transit of iceberg chains drifting southward after the melting of their arctic moorings; but in the province of Santiago de Cuba these cooling and even chilling breezes come from the southwest, and have been traced to a reduction of temperature caused by the tremendous rainfalls in the coast forests of Honduras and Yucatan.

Straight west winds, on the other hand, often raise the mercury thirty degrees above the average of the summer season. The Gulf of Mexico has failed to neutralize the sirocco breath of the burning sand wastes flanking the valley of the Rio Grande. In the coast towns of Puerto Principe southern breezes may cool a midsummer night sufficiently to drive the natives from their house-top dormitories, and make foreigners supplement the scant bed cover of their *posada* with the contents of the dry-goods trunk; but the next night the northward shifting of the sea wind will illustrate the wisdom of the architect who has crowned the conveniences of the dwelling house with a domestic summer resort. The interior of the building becomes absolutely untenable, the prejudices of the night-air-dread yield to the instinct of self-preservation, and before the noon of the next day the sweltering tenants begin to suspect the influence of a volcanic catastrophe or the possible correctness of Professor Falb's hypothesis of calorific meteor clouds.

But solar agencies are, after all, sufficient to account for the grievances of the atmospheric conditions. A brisk east wind will carry samples of African summer climate, sand haze and all, two thousand miles to seaward, and it might be questioned if the gehenna of the Great Desert could have aggravated the horrors of that afternoon of June 17, 1859, when the air waves from the Mexican alkali plains roasted the pears in the orchards of Santa Barbara, California, and blistered the arms of fishermen in San Pedro Bay.

The increasing frequency of droughts in the northwest provinces seems, however, to be mainly due to local causes. In the course of the last two hundred years the sugar and tobacco planters of western Cuba have cleared some five thousand square miles of once densely wooded coast plains, and a considerable portion of that area has shared the fate of the neglected grain fields on the east shores of the Mediterranean; uniform crops have at last exhausted the fertility of the soil, and winter rains have seamed the hill slopes with arid gullies. But in summer the moisture-freighted sea winds approach the thirsty coast lands in vain. Ascending air currents, caused by the refraction of sun rays from the treeless plain, sublimate the humidity of the atmosphere into a transparent haze, or waft the clouds across the low mountain ranges and the farther foothills of the island, which here measures hardly fifty miles from shore to shore.

From the terrace lands of San Cristobal (eighty miles southwest of Havana) heavy banks of clouds may often be seen rolling up from the Caribbean Sea, and twinkle with flashes of electric fire as they approach the chain of low islands which in a former geological period seems to have bridged the strait of Los Pinos. The afternoon heat increases with every minute, and all atmospheric auspices appear to herald a thunderstorm. Far in the south the horizon is streaked with evidences of a heavy shower, and thunder peals echo along the coast cliffs; but the sky overhead is still clear, and as the clouds approach the treeless *vega* their shadows pale, their masses dissolve and pass the island in the form of feathery cloudlets, high sailing and wholly revoking the promise of rain.

From the summits of the central sierra those same clouds may, perhaps, be seen lowering as they continue their northward course, and lavish torrents of rain on a reef of unappreciative rocks in the Strait of Florida. Billions of gallons for the felucca skippers who fill their water barrels by means of rain sails, but not one drop for the parched plantations of the tree-destroyer.

Less easy to explain is the mania for cloud bursts which in certain years seems to seize the climate, both of eastern Cuba and northern Santo Domingo. As a rule, the rainy season begins about the middle of June and continues till late in September or that part of October when lucky Colon realized the dream of his life, and for the next ten weeks had cause to consider the climate superior to that of the Andalusian garden lands. But there are summers when the American colonists hesitate to aggravate the temperature of the national holiday with fireworks, and when heretics and true believers have to combine their prayers for showers enough to save the pineapple harvest.

In such years droughts or dryish sultry weather may continue to the end of July, but before the middle of August Nature evinces a disposition to make up for lost time, and monstrous thundershowers occur day after day, till the roar of the sierra brooks can be heard from a distance of several miles. And the land's appetite for these potations appears to grow with every indulgence. The first sensation of drowning is said to be pleasant, rather than otherwise, but that rule admits of an exception in the case of a wanderer caught in a Cuban *chorasso* and feeling his influenza-resisting ability yield to the persistence of the merciless shower bath till the remains of his vital vigor flicker on the verge of extinction. Yet, during the intervals of these celestial waterfalls the atmospheric condition may not appreciably differ from those of other years; the same cool nights, the same mist-dispersing land winds and balmy mornings; warm but breezy forenoons, the cooling sea wind subsiding about 11 A. M.; then clouds and boding thunder growls. At 2 P. M. the thermometer may indicate 95° in the shade; the exact average of normal years at that time of a summer day; but again the extravasation of moisture, which, according to the rule of averages ought to be limited to a good, brisk shower, will come in the form of a deluge. After four or five weeks of such excesses the weather does begin to recover its temper, and a peculiar cool vapor, hovering about the drenched woodlands, seems to counteract the formation of waterfall clouds, the noonday hours still grow sultry, and thunder mutters its warnings on general principles; but the natives decline to stampede; experience has taught them that the wrath of Nature has been propitiated, and that the peril of atmospheric dam-breaks is over for that year.

Torrent summers occur about once in four years, and while they last the discomforts of travel in the interior of Cuba can hardly be exaggerated. The railroads of the coast plain have become bayous, and mountainward tourists need their water boots in every glen; the gnat veil of ordinary years has thickened to heavy banks of gnat clouds, and the nights are made ghastly by the serenades of renegade tomcats that have exchanged the shelter of their native ranchos for the freedom of the woods, but have to wait for the cloud-dispelling moon to celebrate their declaration of independence.

The supposed rain-attracting excess of heat has, however, nothing to do with the intervention of rainy summers. In the western provinces, where rain is often sorely needed, they are rare—much rarer, at least, than in the wood-covered southeast. Their recurrence seems somewhat to depend upon the above-mentioned cold-air waves from the woodlands of Central America, cool weather in June having a tendency to postpone the beginning of the rainy season and to increase the vehemence of the eventual downpour. In other words, the early showers of Yucatan and of the West Indian Islands are apt to occur in alternate years, but there are summers when cloud bursts break out without any other premonition but the steadily increasing sultriness of the weather during the latter half of July.

Hurricanes are still harder to predict. Experience has proved that they are generally more frequent in Santo Domingo and Porto Rico than in the western Antilles, but the occasional destructiveness of their rage in Cuba is attested by numerous *cadenzas*, or tracts of leveled forest lands, from Santiago to Pinar del Rio, and their genesis is still rather obscure. As a rule, the equalization of extreme contrasts of temperature is attended with violent gales, and in early spring northwest storms, traversing the mainland from Hudson Bay Territory to southern Texas, may approach the threshold of the tropics nearly a hundred degrees cooler than the atmosphere brooding over the coast plains of San Salvador, where pears begin to ripen in April. And the fortnight following the vernal equinox is really a season of shipwrecking gales, in east America as well as in western Europe and the Asiatic coast lands of the North Pacific. But the tornadoes proper, the wall-breaking and tree-uprooting whirl storms of the West Indies, are more frequent in August than in April, and may even assume their most portentous forms in September, when the summer sun at last prevails against the mists of the rainy season, and the *vegas* are some twenty or thirty degrees warmer than the Texas prairies—a mere trifle compared with the contrasts of early spring.

Moisture would seem to play almost as important a part as heat in the generation of cyclones, and Professor von Tschudi called attention to the fact that the dry if not wholly rainless coast regions of Peru enjoy a remarkable immunity from destructive storms.

Cold winds become afflictive only on the highest plateaus of the

West Indian sierras, and could be made to serve a sanitary purpose in the *valles ventosos*, or wind gaps of the Cuban coast range, where the eastern trade wind pours as through a funnel, all the day long, for at least eight months out of twelve. The half-wild cattle of the uplands wander miles to seek the air currents of these glens in midsummer, and can be seen standing motionless, facing due east, like orthodox Mussulmans, to enjoy the blessing of refrigeration, while the air of the grassy table-lands round about trembles under the rays of a vertical sun.

On the crest of the Sierra Maestra, at an elevation of nearly eight thousand feet above tide-water, winter winds become chilly enough to discourage permanent settlements, though herders camp there at a safe distance from the showers of the rainy season; but more grievous than any kind of air in motion are the *ahogassos*, or spells of stifling calms, which in early summer often continue for days together. The afternoon heat becomes insupportable on such days, at least to foreigners, who crowd the verandas of the seaport hotels, plying their fans with desperate energy, while the indolent creoles hang in their hammocks, trying to counteract the feeling of discomfort with nicotine fumes.

SOME PSYCHICAL ASPECTS OF MUSCULAR EXERCISE.

By LUTHER GULICK, M. D.

IN the studies that have been made in physical training in this country, the standpoint taken has been almost exclusively physiological. It is my conviction that, while physiological considerations must have a prominent place, psychical considerations will prove more definite, tangible, and important guides as to the nature of the physical training that should be given to children.

The subject under discussion is rather a new one. I have chosen, therefore, to treat one division of it at greater length than the others. A complete statement of any one of the six heads of my paper would involve extended investigations that have not yet been made. All that I hope to do now, even upon the one subject to which I shall give most space, is to indicate the importance of the problems, the directions in which solutions may be sought, their relations to physical education of children, and the kinds of material that will give us the larger notion of physical education. I shall leave till the last the discussion of the play instinct to which your chief attention is called.

1. What is the nature of muscular force? What relation does

this have to psychical force? The modern view of physiology demands that we shall interpret the beginnings of every activity of the individual in terms of protoplasm. It is difficult at first sight to understand the relation between the muscle cell and the gray cell of the brain. It is not so difficult, however, when we remember that both were originally undifferentiated protoplasm, having common properties: both were able to contract, and both to co-ordinate. Gradually the one cell specialized so that this contracting function superseded and dominated all the others, while in the other case it was the co-ordinating or directing or automatic function that was given the first place. Whatever of vigor there was in the original protoplasm we find in the specialized cell of the adult body. Vigor is at bottom one thing, and we find that vigorous psychical force tends to be found in the same individuals in which vigorous physical force is found. When an undifferentiated bit of protoplasm contracts—as, for example, an amœba—what happens? This is the simplest term of muscular contraction. All we can now say is that the mass does not change, the total volume remains constant, the ultimate particles rearrange themselves. This may be done so as to overcome resistance, and thus becomes work. That these particles should be able to arrange themselves, in opposition to mechanical force exerted upon them from the outside, indicates that there is something besides mechanical force within the cell, something besides physical force. It can hardly be regarded as mere chemical force, for in the case of many of the lower forms of even single-celled organisms there is a high degree of adaptation of means to ends, indicating psychical activity. To work out this relation of muscular to psychical force would, I think, throw light upon some of the interesting questions as to why some races are fitted to survive and others are not; as to why weak-minded individuals are so often those with flabby muscles; and as to why there is such a close connection between vigorous doing and strong willing. These matters are related not merely to the individual, but to the whole race, and, indeed, to the whole series of which the human race is but a part.

2. Of how much importance is physical exercise in the development of the brain? The modern school of psychologists tell us that from one third to one half of the brain surface has muscular functions; that this great fraction of the brain is concerned with making muscles contract, each little spot being concerned with its own muscle or group of muscles. This does not prevent these parts of the brain being also used in other ways. This we know less about. We do know, however, that it is necessary to have muscular exercise of any group of muscles, if the corresponding nerve center is to be developed. Careful examinations have been made of the brains of those who had

very early lost a limb, and it has been shown that those brain centers that normally would be active in the management of the muscles of this limb were never developed. In order, then, to the full development of the whole motor area of the brain, there must be a rich and full exercise of the muscular functions of the body. Not merely must each muscle become powerful, but the faculties of co-ordination and control must be developed. These appear to be even more related to the finer organization of the nerve structure than does the exhibition of power. We are accustomed to speak of the hind brain as largely co-ordinating, the mid-brain as largely motor, and the front brain as probably inhibitory. I am inclined to think that investigation will show that not only the hind brain and the mid-brain, but the inhibitory brain as well, are related to muscular control; that the path toward perfect control, including inhibition, is the path of perfect control of muscle, the inhibitory centers themselves are related to the control of the muscular centers, or the muscles themselves. There are some nerve centers having to do with muscular contraction that ripen without ever having the muscles concerned in active operation. For instance, the respiratory center: the newly born baby finds both his neural and muscular respiratory apparatus in perfect condition for operation. It may be that when a sufficient number of thousands of years have passed, the whole brain will be in the condition that the respiratory and a few of the other brain centers are now. Physical education then will be nil, and we shall look to physical exercise merely as a hygienic measure to insure health, all the neuromuscular mechanisms ripening and coming into perfect function through the inherited discipline furnished by countless generations of ancestors. In the present day, however, varied muscular exercise is an absolutely necessary element for the development of the brain, and upon the right development of the brain is dependent the large bulk of our psychical activities.

3. The subject of fatigue must interest all physical trainers. Muscular fatigue, as we usually speak of it, is our consciousness of the partial exhaustion of the motor centers of the muscles that have been worked. It is thought that we do not often experience in ordinary life genuine fatigue of the muscle cell. This is not the only form of fatigue. When certain brain centers are fatigued, we can then turn to other centers, centers concerned with the operation of other muscular groups, and operate them. When these are fatigued we can turn to still others, but, long before there comes the exhaustion of the motor elements for all the muscles, there is another fatigue that supervenes, so that muscles that have not been concerned in the activity can not be operated with either power or accuracy. I do not believe that it can be shown that this is due merely to the pres-

ence in the circulation of the fatigue stuff produced by the exhausted muscles, or other nerve centers, although this is undoubtedly an element. If we call this will *fatigue*, it then becomes of importance to find the point in the training of the muscular system at which the maximum benefit to the physical organism can be secured without appreciably lessening the power of the individual, as shown by his willing ability. To use a less technical illustration: I may direct my mind to mathematics until it is fatigued; I may then turn to philosophy, and then to music, and so forth, but before all the abilities of the mind have been exhausted there is the fatigue of something that is back of all this. One may call it fatigue of the attention, or of the will, or, with Marie de Manaceine, a fatigue of the consciousness.

Most of us know in a practical way that there is such a thing as fatigue of the emotions. The relationships of these forms of fatigue to neuro-muscular fatigue will give us important light upon the subject of educational gymnastics. We have one evidence that these forms of fatigue are cerebral, even if not psychical—the fact that when muscles are operated by automatic centers the amount of expenditure can be vastly increased without fatigue—but when the consciousness must come in and either enforce or inhibit or alter in any way the automatic process, fatigue is greatly accelerated.

4. Muscular exercise is definitely related to the hygiene of the brain. That part of the nervous system that has to do with the control of the circulation of blood—the vaso-motor system—has been characterized as "the hub about which organic life revolves." It is certainly true that whether in the domain of intellect, feelings, or will, alterations in the circulation of the blood in the brain as a whole or as parts, and in the circulation of the blood in the viscera, are made. Our higher faculties appear to be related, not only to the brain, but to the sympathetic nervous system, having to do with the vaso-motor apparatus. The facts have been established that it is only in connection with exercise that the whole circulatory apparatus, as well as the vaso-motor system, comes to its full development. The balanced distribution of the blood to the body is definitely related to the power and regularity of the heart, and to that vaso-motor education that comes in connection with varied muscular contraction. In this field, empirical knowledge has gone far ahead of scientific investigations.

There are, however, simpler aspects of the relation of muscular exercise to the brain hygiene. The quality of the blood is directly affected by exercise and breathing. Deep breathing is promoted by exercise. The demand for oxygen and its supply in the system are both increased by oxygen. The power of the heart, and the healthy tone of the venous system, are both related to a moderate amount of muscular exercise, and these are all largely facts in the hygiene of the brain.

5. Muscular contraction appears to be closely related to the genesis of all forms of psychic activity. Not only do the vaso-motor and muscular systems express the thinking, feeling, and willing of the individual, but the muscular apparatus itself appears to be a fundamental part of the apparatus for these psychical states. Without the muscular system, material for psychic activity can not be secured. All three of these processes—thinking, feeling, willing—are more or less remotely connected with a rehearsal in the body, both neural and muscular, of the acts by which the original material for the mental process came in. As President Hall puts it, we think in terms of muscular action, more or less remote, and all the parts that were concerned in the original activities are more or less active in the thought. Nerve currents are constantly going to muscles and coming from sense organs, all being a part of the thinking apparatus. If this is true, the fullness of the neuro-muscular experiences during early life would appear to be related to the opportunity of later psychic range. This is borne out by the fact that both in animals and in men, taken at large, the scale of intelligence corresponds to the scale of wideness of range in muscular co-ordinations. The more complicated the neuro-muscular apparatus, the higher the intelligence. It is true that in the individual life we profit mainly by our racial inheritance of all these complicated mechanisms, but even here we may expect to find that the individuals who live a rich psychic life have been, on the whole, those who during early life have had the rich and full experience in regard to muscular co-ordinations. It is not, however, merely in terms of intellect that the muscular system is important. The sensibilities, or feelings, or emotions, are definitely related both to muscular and to visceral states. We are accustomed to think of the expression of the body, particularly the expression of the face, as merely the outward manifestation of the inward state. The modern psychology, however, is telling us that this muscular contraction is a necessary part of the feeling itself, and that where the muscular expression of the feeling can be inhibited, the feeling itself is not the same. Rage is not rage until it expresses itself in muscular action of some form. It may be merely in the stiffening of the whole body, the clinching of the hands, or holding the jaws firmly together. Here, again, do we find the richness of feeling associated without exception in races with a fine development of the neuro-muscular and vaso-motor systems. This is related to muscular exercise. When we come to the regal faculty, the will, our modern psychology again tells us that will must express

itself in terms of muscular activity, and that power of the will in its origin bears a relation to firmness of muscle, to power of muscular contraction.

In passing rapidly over these large subjects, I am aware that I can do nothing more than to suggest the larger outlines upon which we must work for years before securing satisfaction and final results. My immediate attempt is to put in these terms of physical training the conclusions and inferences that the modern psychology has already laid at our doors.

Your attention is particularly called to my next subject. I believe that we shall find in the play instinct a clew that shall lead us to a rational plan of physical education—a plan that will fit in as an integral part of the present-day educational movement.

6. *The play instinct.* By the play instinct, I mean that which prompts the young child or animal to its chief activities for the first part of its active life, as well as to those activities to which adults turn for recreation. Play is associated in the child's mind with fun, and with independent activities. The more the play is controlled and demanded of the child, the less is it play and the more is it work. It is the child's self-activity; it is the free operation of his own will or fancy; it may demand all the muscular and mental qualities of work, but it is not work so long as the child is free. The reactions of the individual vary much in free activity from what they do in enforced activity. My father used to remark upon the quick fatigue that would overtake me when laboring with a hoe, and the endurance that I had when operating with a baseball bat. This problem has been too much for most parents. The voluntary control of the will in the one case is an entirely different matter from the free play of both will and attention in the other. As soon as activities are done for profit they are no longer play, although they may be enjoyable. When an adult exercises for health, he is not playing unless there is the spontaneous enjoyment in it that is characteristic of play, and which makes it appear worth while for its own sake.

Let us ask first in regard to the facts of play. What are the plays of childhood and youth? Do they form a logical and coherent whole? Is there any orderly progression? If so, whence do they start, and to what do they lead? The facts which I shall give under these heads are drawn, first, from an observation of my own five children; second, from my own experience as a boy; third, from observation of the children of Springfield; fourth, from a study of the plays of English preparatory schools; fifth, from an examination of boys' books; sixth, reports of child study, in regard to infant activity.

For convenience, I shall divide the life of the child into periods. Hard-and-fast divisions can not be made, not only because they do not exist, but because children vary so much—some are precocious, others are slow. All that is attempted is to have years in which it is possible to recognize certain great groups of activities. In this classification, it must be remembered that each group includes all the preceding. The individual loses nothing as he grows. Everything that he has acquired remains to him as a joy and a recreation if it is in the right relations. The baby will play with sand for hours, making marks with his fingers, picking up a handful and letting it trickle out. Such simple plays as these never lose their interest. I have watched individuals sitting on the seashore playing with the sand for an hour at a time; so that when I shall attempt to define the plays of adolescents, let me not be understood as meaning that these are the only plays of adolescents, for adolescents do all that the preceding groups have done. That which I shall attempt to describe will be the plays that the adolescents have that are not found to any particular extent before adolescence, and which may thus be called characteristics of adolescence.

The divisions that I have made are: (1) Babyhood, approximately from birth to three; (2) early childhood, three to seven; (3) childhood, seven to twelve; (4) early adolescence, twelve to seventeen; (5) later adolescence, seventeen to twenty-three.

It is evident by this time that I am using the word play in a broad sense, including games, but not limited by games. I do not care to discuss the whole subject of games, but am concerned with those that involve muscular activity and co-ordination.

How do babies play? They love to rattle paper, to take hold of things, to muss paper up, to pick things up and drop them, watching the result, to roll a ball, to push and pull things around with their hands; they delight in playing with sand and dirt, and stones, and bugs, toddling after the hens; they delight to splash water, and many other such simple activities. They all seem to care for anything involving accurate muscular co-ordination.

During early childhood—three to seven—children enjoy building with blocks. At first the buildings are simple and regular—the blocks stood up in rows more or less equidistant The idea of regularity appears to be definite, but little idea of symmetry until the latter part of this period, and then I suspect that it is the copying of older children. Children enjoy swinging, are fond of climbing, will climb low trees, will climb chairs, will climb banisters, experiment with jumping from chairs, with jumping from steps. All our children have gone through a stage of wishing to cut things. The attachment for dolls comes in the latter part of this period among girls. We started with the idea that, until puberty, boys' and girls' minds were just alike except so far as they were trained differently by their parents. Wishing our children to have vigorous, robust bodies, we endeavored to have them live the kind of free life lived by boys, and gave them no dolls, but the instinct of the girl turned to dolls like a needle to the pole. There is nothing so fascinating to them as dolls. The doll life during this period is not complex. Such simple plays as "patty-cake" come soon after three, dissecting maps and such things a little later, "drop the handkerchief" later yet. The child is immensely inquisitive, and wishes to find things out. Its play is much influenced apparently by this feeling. I do not think that the destructive play of boys at this period is merely destructive; it is related to the acquisition of knowledge and the construction of other things. Children are interested in but not sympathetic with animals and bugs by Nature. They will play with flies, pulling the wings off to make them tame, and many other things, indicating a total lack of appreciation of the suffering of animals. Children before seven rarely play *games* spontaneously. They do so sometimes under the stimulus of older children or of adults. The same fact may be stated in regard to competition. The plays before seven are almost exclusively noncompetitive. Comparing the plays of this period with those of babyhood, I would say that they were far more constructive, far greater in range; that the muscular movements involved were larger, more powerful, more sustained, but still of much the same character. Unless influenced by adults, there is but little fine work with the fingers and wrists, not very much of delicate co-ordination. The movements are the larger movements of the trunk, shoulders, and elbows. It is a time of great activity. There is but little sitting still, or keeping still, when awake.

During what I have called later childhood—from seven to twelve in girls—we have the height of the doll plays, elaborate housekeeping arrangements. Two of our children are now in this stage. They have secured all of the broken dishes, bits of tin, and other things that can be used for housekeeping, and in old boxes, in imaginary houses, or whatever is available, are going through with these elementary housekeeping arrangements. At about ten the interest in dolls seems to wane, but taking its place there is an interest in babies. It is a common thing to see girls at this age asking to borrow neighbors' babies to wheel them round in baby-carriages, to play with them, to swing them. Every one of our babies has been borrowed by neighbors' children of about this age. Boys do not borrow our babies; it is distinctly a feminine instinct to play with babies. Boys want knives, to whittle, all sorts of plays with strings, flying kites. The ball games are played, "one old cat," an elementary baseball game, swimming and rowing. Boys delight in the use of tools during this period, and in building all sorts of things; making little streams and dams, paddle-wheels and boats, simple machinery of all kinds. Many games are now played: "duck on the rock," "black man," "blindman's buff," "crokinole," "croquet," "leapfrog"; simple feats of all kinds, turning somersaults, rolling over backward, marbles, "mumble the peg," "prisoner's base," "puss in the corner," "tiddle-dywinks," "touch wood." Girls play some of these games: hunt the handkerchief, many games in which the circle is used, one individual running inside or outside, hide and go seek. These games are almost exclusively *individualistic* and *competitive*, forming a strong contrast to the plays of early childhood. The distinction between girls and boys in the plays of this period is marked. Boys play games in which competition is more intense, muscular co-ordinations more accurate, and the constructive work more definite and logical.

During early adolescence—from twelve to seventeen—is pre-eminently the group game period: baseball, football, hare-and-hounds, hockey, lacrosse, basket-ball, all sorts of tournaments. It seems to be the age for the formation of gangs. Boys love to play Indian; they have their "pals"; play robber, and sometimes act it. The predatory instinct develops early in this period. Most boys steal apples or watermelons, or something of the kind, not because they want them, but because of an inherent demand. It is a special period for the love of outdoor life; camping out appeals to the boy strongly; to build fires. He now enjoys fishing. He is possessed with a great desire to hunt, to fight Indians, and to discover the north pole. Adventure of all kinds fascinates him. His spontaneous reading reflects these same plays. Stories of chivalry, of adventure, of discovery, fascinate him. He loves animals often—some particular dog, or cat, or horse. He favors strange pets. If he has the opportunity, he will probably have the "hen fever," or something analogous, and a garden that he will take care of with great diligence for a little while. This is a large group of plays. Two elements seem to predominate: (1) that the plays are predominantly team games, in which the individual is more or less sacrificed for the whole, in which there is obedience to a captain, in which there is co-operation among a number for a given end, in which the play has a programme and plan. The second characteristic is, the period, with reference to its place, seems to be all of savage outdoor life—hunting, fishing, stealing, fighting, hero-worship, adventure, love of animals, etc. This characterization obtains more with reference to boys than to girls. I have not studied the plays of girls for this period.

During later adolescence—seventeen to twenty-three—there is a development of these same plays and games, but they are sufficiently different, so as, I think, to warrant making a separate group of them. The plays are pushed to the limit of endurance and strength, as they are not during the earlier adolescent period; they correspond more to organized savage warfare—for instance, college football. There is a depth and intensity about it that older people can hardly realize, unless they have themselves been through it. It seems to be a real thing, and not merely a game. Wrestling, fencing, and boxing have their chief attraction during this period. The whole nervous and muscular apparatus having been fairly well constructed during later childhood and early adolescence, is now tested and knitted together with vigor and given endurance and staying power.

Comparing now the three major groups—early childhood, later childhood, and adolescence—it appears that the plays of early childhood are individualistic, noncompetitive, and for the accomplishment and observation of objective results. The plays of later childhood are individualistic, competitive, involve active muscular co-ordinations and sense judgments. The plays of adolescence are socialistic, demanding the heathen virtues of courage, endurance, self-control, bravery, loyalty, enthusiasm, and the savage occupations of hunting, fishing, swimming, rowing, sailing.

How do we account for this group of phenomena, this orderly, progressive, intense series of activities of children? There appear to be four theories: (1) That of Spencer. He says that play is the superfluous activity of the cells of the body; that it represents the expenditure of that force that is not demanded by either growth or by labor. This, it appears to me, is insufficient, because feeble, exhausted, or sick children play. Children will play often when the muscles involved are so nearly exhausted that they can hardly be made to contract, when there is evidently no superfluous energy present. This theory will not account for the definite, progressive character of the plays of childhood. (2) Professor Lazarus says that play is the aversion to idleness. The question is at once suggested, Why should we object to being idle? This, like the preceding, may be true, still it is insufficient to explain the facts. (3) Mr. Karl Gross, in an eloborate study of the plays of animals, advances the theory that plays are prophetic—that is, that the young rehearses the performances that it must do when full grown. He accounts for the strength of the play instinct by the fact that those animals that have played in this particular way, rehearsing the activities of adult life, have been better fitted to perform these actions during adult life, and have thus survived the others. The theory appears to me incomplete. In civilized man the plays of adolescents and children rehearse the activities of savage man, not of the adult civilized man. This theory would fail to account for the orderly progression of the plays throughout child life. It would not explain the enjoyment of the adult in play. It does not attempt to explain the reason why play is fun.

The theory itself appears to be at variance with our modern thought of psychology. (4) There is a special group of plays, particularly among adults, that Professor James claims as being a development of the æsthetic feelings. They consist of ceremony, of the dance, of gorgeous rites and festivities. It is the individual's share in the collective life, as James puts it. We find these both in animals and men, but they are hardly the side of play that we are discussing. (5) Different writers on psychology, particularly James, have advanced the idea that plays are genetic. We are familiar with the thought that the body, in reaching the adult stage, must briefly rehearse the history of the race. The body starts from a single cell, and with greater or less faithfulness travels the road to adult life that the race has traveled. I do not know of any scheme of physical training that has been deliberately founded upon this conception of the genetic psychology. It appears to be not only true that the body rehearses the life of the race; it appears to be true that the mind must do so also, and that the plays of children are the rehearsal of the activities of the race during forgotten ages—not necessarily the selfsame activities, but activities involving the same bodily and mental qualities. Putting it exactly, play is the ontogenetic rehearsal of the phylogenetic series. It could not be true that our savage ancestors should have depended for their livelihood upon such a game as "one old cat," that boys play during later childhood, but it is true that their lives depended upon the quick-sense judgments, the ability to strike with rapidity and vigor, the accurate muscular co-ordinations, the spirit of individualistic competition that characterizes the child play during this period. Many of the plays of adolescence, on the other hand, certainly represent the identical occupations of our far-removed ancestors, and the play of adult life when fulfilling most perfectly the conditions of play, expresses itself in these elementary forms: hunting, fishing, sailing, swimming, mountain-climbing, and the like.

Why should there be fun in connection with play? We are accustomed to associate pleasure, partly at least, with the discharge of the highest function of which the individual is then capable. I believe that upon this ground the fun of play can be explained. It represents the deeply founded functions of the race. During play the child experiences the deep satisfaction of living through and satisfying these elemental, racial functions.

Plays are progressive, and that which is the greatest fun at one period is not the greatest fun at another, because the life itself is progressive, and, while play is interesting to adults, normally developed individuals should find their chief enjoyment not in play, but in the discharge of the higher functions of present-day living. Recreation will be found by reverting to the more perfectly organized centers that have to do with the simpler occupations of preceding generations.

How important, then, is play! I attach to it great importance, for in order to live out the fullest life it is necessary that the individual go through the life of the race; without play it is not possible to achieve full-orbed manhood and womanhood. It is an interesting fact—of which, however, I do not know any scholarly investigation having been made—that the plays of the children of any given race are related to the complexity of the life of the race—that the children in highly civilized races have a far higher play life than do those of savage life. The plays in civilized lands certainly last during a greater number of years; there is more to rehearse than there is in the savage life. Not only is the period of infancy prolonged in civilized life, but we have already crowded back into comparative youth those plays that do not come to savage children till later.

Adults who never played as children are woefully handicapped in many directions—handicapped by the inability not only for recreation, but for many of the psychical activities that enrich life. My own father played but little as a boy. During later life he tried to play, but it was work. It was pathetic to see him try to play lawn tennis. It was easier and more agreeable for him to study Sanscrit than to bat a ball over a net. His hands were never trained to all the nice adjustments involved in the use of tools. He never understood mechanical things, and this I believe was somewhat related at least to his not having, from the years of seven to twelve, the kind of plays that I have spoken of as belonging to this period.

Play during childhood and adolescence represents the form of activity that alone can secure a whole-souled later life. Play is spontaneous, whole-hearted, from inner not from outer causes. It is the poetic or creative in the individual at work. Duty can never secure the same work that play can from a child. This spirit is the true spirit for life. So long as one is driven by outside forces, by the consciousness of duty, the whole self is not engaged. But when one's work is done in the play spirit, with the enthusiasm and delight of the plays of childhood, then we have the fullest development of and product from the adult. The capacity for this appears to be related to the play life of childhood and youth. To love one's work better than any other occupation, to go into it with all the play spirit, is indeed to be a poet in one's own line. What relation do the facts of which we have been speaking bear to the physical education of children?

The development of the brain may be assisted and helped much by such manual training as is now being done in some public schools. Quick sense perceptions and rapid co-ordinations demand plays and games and *places for them*. The child is going through the out-of-door stages of the race. The sedentary life does not call for the development of muscle, heart, lungs, bones, viscera, and brain. This must come to the individual as they come to the race. The rational system of public-school physical training will provide not only for the physical development that comes through formal gymnastics, but it will put in the foreground the development of the play instinct. We shall see that the right of natural order is adhered to in the gradual unfolding of the individual in its plays and games.

With speech and writing we have means of perpetuating and communicating knowledge that enables the race to progress far faster than was possible when each achievement was won only when it became incorporated into the neural structure of the race. With the increasing sum of knowledge that seems necessary for the adult, it is becoming increasingly difficult properly to fit the youth for life. We must crowd the studies back into earlier and earlier years. This education we may call organic. I plead for the old organic education, somatic development. This superorganic education is of no avail unless the individual has those inheritances from the race that fit him to live. Muscular activity and play form the fundamental basis of the psychical nature; and yet both of these we seem to be trying to crowd out. Our beautiful cities are growing up without playgrounds, and yet there is nothing in all the world more dear to us than the wholesome development of our children. We demand that children shall sit still in school; this seems necessary, but it would be quite possible to secure all the results of the superorganic education, and to have at the same time children who have their right and full development, through play and muscular training.

It seems to me that this matter of play is related to the deeper problems not only of education and psychology, but to religion and sociology as well. Our schools may train the intellect, but the great bulk of the training of the will and feelings, both of which are higher than the intellect, receive their chief development through play.

Muscular activity may not be so important for adults, but it is fundamental in youth and childhood. Civilization—city life—is taking away both muscular work and play.

What will America do for her children? How much are wholesome, wholly developed children worth?

A French ecclesiastic recently, in one of his sermons, told what he said was an authentic story of Le Verrier, that when one of his friends, congratulating him after the discovery of Neptune, remarked, "You are very near the stars, my dear friend," "I hope," replied Le Verrier, "to get farther than that; I expect to go to heaven." Le Verrier was an earnest Christian and profoundly spiritually minded. He is said to have had a large crucifix placed in the instrument room of the observatory.

THE EVOLUTION OF COLONIES.

By JAMES COLLIER.

IV.—THE LAW.

IT is the great unquestioned addition to Darwinism made by Haeckel that the history of the embryo is shown to recapitulate the history of its ancestral species. As stated by Haeckel's authorized expositor, Mr. Lester Ward, the law has a fascinating simplicity. The development of successive species being the mechanical cause of the development of the embryo, every transmutation undergone by the former in the course of ages is passed through by the latter. From the primary cell onward, the successive species are faithfully reproduced by successive stages in the growth of the embryo. Man is thus first of all an amœba, he advances to the humble condition of a worm, is transformed into a lamprey, grows into a kind of fish, is fortunately only a bit of a reptile, is promoted to be a marsupial, a lemur, an ape, a man-ape, before he emerges in distinctly human form. So far, Haeckel. Other naturalists find the parallel more complex. In no case, according to Prof. Henry Drummond, is the recapitulation of the past complete. "Ancestral stages are constantly omitted, over-accentuated, condensed, distorted, or confused; while new and undecipherable characters occasionally appear." Haeckel has no difficulty in accounting for these new and undecipherable characters. They are the priceless records of formerly existing but now extinct species. By their aid we can recover the vanished past. It was a wonderful feat when Kant predicted, from certain disturbances in the planetary orbits, that the planet Neptune would one day be discovered. It was a great thing when Owen was (rightly or wrongly) believed to have reconstructed the moa from a thigh bone, or when from a few small molar teeth found in Germany and North America two lost species were built up. Haeckel has shown a still more daring exercise of the scientific imagination in confidently assuming the existence of species of which no trace has ever been found. Of the twenty-one species between the moner and man nearly one half are hypothetical. Not even their fossil remains have been discovered. But the German idealist betrays no doubt of their reality. That they are vouched for by answering stages in the growth of the embryo is evidence enough. In at least one case later research seems to have vindicated his prevision.

The analogy is strictly limited to species in the line of descent. No creature is the inheritor of the whole pre-existent organic creation. Man himself, the crown of Nature and its lord, is heir to only three of the seven animal subkingdoms. Never having been a vegetable, from one entire kingdom he is altogether cut off. Nor was he ever a zoöphyte, a mollusc, a fish, a reptile, a whale, a carnivore, or a rodent, and the palpable moral and physical characteristics of certain of these species which are plainly inherited at times by man (for who has not made acquaintance with the human mollusc, or come into unpleasant contact with the tiger, wolf, fox, ox, or dog type?) may be explained as reversions to species which the human pedigree just touched as it skirted their base.

Lastly, it is consistent with the analogy that the embryo should sometimes outstrip its parent species. Each generation being an advance upon its predecessors, each new embryo must possess new potentialities of development. Even in apparently stationary species there will usually be a capacity of adjustment to changed circumstances.

In the parallelism between the embryo and the species lies the key to colonial evolution. The genesis and growth of each colony repeat the origin and development of its parent state. There is again, no exact reproduction. Much in the history of every country belongs to what we call the chapter of accidents because we have not yet found its law. This may or may not be reproduced in a colony. There is also a good deal in the history of every colony determined by local circumstances. For all such it would be in vain to look for an analogue in the mother country's development. On certain lines the analogy conspicuously fails in appearance, but even on these there will always be discoverable traces in the new of the corresponding stages in the old country. In others it would be a mere academic exercise to trace fantastic resemblances. None the less is it true that up to the point in the growth of a colony when it ceases to be dependent on its metropolis the political and social evolution recapitulates in a few years the entire evolution which the mother country may have taken centuries to accomplish.

Colonial history will thus reflect light on national history, and national history profoundly studied will make colonial history luminous. What would not a Mommsen or other reconstructor of ancient civilizations from often enigmatical inscriptions on chance-found stones have given to discover such a wealth of material in the correspondence of Romans and provincials, in dispatches, books, pamphlets, and newspapers, as we possess in relation to the early foundation of colonies? In a sense he already possesses it. It is ancient history that we are studying when we peruse these modern records. The beginnings of extinct states rise again before our eyes. Obscure struggles, "battles of kites and crows," the long travail of national growth, will emerge from the dark. More than this: as the biologist assumes the existence of undiscovered species, the historian of colonies, finding in colonial history facts which have no answering stages in the history of the parent state, will point out the lacunæ and predict that, when that history has been more closely studied, corresponding facts will be found. Only the surface of history has been scratched. Within the last thirty years the early constitutional history of France and Germany has been rewritten by Waitz, Roth, and Sohm. Yet the documents possessed by these scholars were, most of them, at the command of earlier scholars. It was the key that was wanting, the point of view that was false. So may colonial history (or may we call it coloniology?) furnish new means of reading the past.

It is necessarily only of the mother country that the colony repeats the development. The Phœnician, Greek, and Roman, the Spanish, Portuguese, French, English, and Dutch colonies are radically unlike one another in their origin and growth. Where they resemble they are but repeating the story of universal humanity. There have been agrarian agitations in New York and Australia, and Gracchi in New Zealand, but they do not reduplicate those of Rome. Nor were the tribunes of New Amsterdam Roman tribunes.

It is, finally, in perfect consistency with the analogy that the colony should often outstrip the parent state. While still dependent, it may develop institutions in advance of any to be found in the mother country, and after emancipation it may be a social organism of a higher type. The Australasian colonies have far surpassed Great Britain in the liberal character of their legislation, and in the United States the feeling of equality between man and man has gained a vigor never likely to be attained in the countries which contributed to the colonization of North America.

Sergeant Charles Floyd, one of "the nine young men from Kentucky," of Lewis and Clark's expedition, who seems to have been a very useful member of the company, died rather suddenly while the expedition was on its way, on the banks of the Missouri River, August 20, 1804, and was buried on a high bluff about a mile above the place of his death, which was named after him; while the stream next above was called Floyd's River and the opposite bluff was named Sergeant's Bluff. Floyd's Bluff is now included within the limits of Sioux City, Iowa, but has been much changed by the wash of the river. In 1857 the grave had become so exposed that the remains were removed to another part of the hill. The Floyd Memorial Association was organized in 1895 for the erection of a monument to the deceased sergeant, whose name has become identified with the history of the city, and to establish and maintain a public park at the place where he is buried; and final memorial services were held at the grave on the anniversary of his death in 1895, with several memorial addresses and a historical address by Dr. Elliott Coues, under whose direction a full account of the proceedings has been published.

YOUNG GREEK BOYS AND OLD GREEK SCHOOLS.

By FREDERIC E. WHITAKER, M. A.,
INSTRUCTOR OF GREEK AT BROWN UNIVERSITY.

FROM the little tot who cries for the moon to the Edisons and the Huxleys, from the tattooed savage to the inventor of the wonder-working telegraph, all mankind lives to learn and to transmit its knowledge. New conditions permit improved and more ingenious methods, it is true. The Egyptian conjurer with his character-written bark in pure water solution has given place to the learned physician with his thousands invested in brain and apparatus. Yet some provision has always been made for the rearing of the young. First, the mere satisfying of his wants; then a training in the arts of war; then the arts of peace, husbandry and agriculture; and at last the fine arts, oratory, painting, architecture, sculpture, and music.

Under the stimulus and guise of religion most of the humanities reached a high stage of perfection in the East; thence the torch of civilization and knowledge was borne to its empire in the West. The Indian, Persian, Phœnician, and Egyptian legacies in the course of time became the inheritance of Greece. How little Hellas improved the dowries of her elders the world can attest—her Demosthenes, the world orator; her Zeuxis and Apelles, the possessors of those lost arts of coloring; her Pheidias, the inimitable modeler; her Socrates, the logician of history; and her Homer, holding by conquest the imperial right to the kingdom of literature.

History is the story of the hits and misses of the world. The simple and early developments of education are much the same among all peoples. The problems that perplex us to-day were troublesome to the earlier civilizations, and, though the principles by which they solved them may seem to differ from ours, we are such slaves to educational aristocracies that anything that will help free us from the bonds of present jealousy and prejudice, though hoary with age, should be eagerly welcomed.

Egypt and Persia contributed most largely to Grecian learning. Egypt's portion, enriched by all the royal patronage of the Ptolemies and learned Pharaohs, came a polished gem ready for its rich setting. To the Nile-land more than to any other did this classic people owe the great debt. And yet hardly less was contributed from the Persian store—that old Asiatic education so uniquely described by Herodotus, "to shoot, to ride, and to tell the truth."

It may be interesting to know from what sources we derive our scanty knowledge of Greek schools and education. The inscriptions, the evidence of the classic authors, and the researches of the archæologists are the sole means of enlightenment. Naturally enough, the most desirable information, the common everyday facts, are difficult to obtain.

A training of the youth, at one time military in its nature and very similar to the German system, was required of the grown-up youth or *ephebi*. These requirements were hung up in bronze or carved in stone to be read by the Greeks, not yet favored with the printing press. These announcements were continued even after the compulsory military service had been discarded and other studies had taken their place. These enactments, together with the Parthenon frieze procession, furnish us almost our only information of the Greek college system proper.

Plato and Aristotle, in their ideal "states," have given us some knowledge of a reliable nature; though we can not depend on them any more than we could twenty centuries hence on Bellamy's Looking Backward as a mirror of nineteenth-century life. In his Protagoras, however, Plato's account of the Greek boy's training is both clear and practical. The comic poets furnish us more valuable information, though party spirit and satire oftentimes make the "find" doubtful. Herodotus, Xenophon, and Pausanias yield by far the most valuable intelligence that we derive from written evidence.

The vase paintings, gems, urns, and temple friezes which the excavator of to-day is continually bringing to light in great numbers are a most sure and interesting source of information. Athens Sparta, Mycenæ, the islands of the Greek seas, and even Italy have produced many a powerful witness from their buried past.

As the education of a child begins with the very first admonition in its infancy and ends only with the grave, a few hints about the Grecian baby may not be amiss. On the fifth or seventh day the infant went through the ceremony of purification. This was called the "run-around day," because at that time the child was carried several times around the burning altar. The family on this day enjoyed a festive meal; the doors were decorated with wool for a girl and with a crown of olive for a boy. On the tenth day the young hopeful was named; a sacrifice was made, and another feast was held. At this time the infant was given presents of metal and clay, and the mother received painted vases from relatives and friends. The classic baby was not unlike that little monarch of to-day—the joy and the terror of his subjects. The mother's love was as great and the helpless innocence of the child as powerful then as now. The scene in the sixth book of the Iliad, where Hector's infant screams with fright at the fluttering plume on his father's helmet, and the hero lays it on the ground to embrace the boy; and the affection and motherly anxiety of the Lament of Andromache, have touched the sympathy of the centuries. In Herodotus's story of the infant Cypselus, the baby's smile turns the hired assassins from murder to pity, and destroys their courage till, passing him on from man to man, they leave the child unharmed. Euripides represents Iphigenia bringing her infant brother Orestes to plead for her, though she is already doomed to the sacrifice, a more powerful appeal to the feelings than the most studied eloquence.

Whooping-cough, measles, scarlatina, and mumps are not spoken of, but that other modern necessity—sleeplessness, walking the night with child in arms—had reached a high degree of cultivation. The Grecian husband, lord of his household, relegated crying child and martyred mother to a separate sleeping room, while he slept "far from the madding crowd." The unpractical old bachelor Plato, in his ideal Republic, urges that two or three stôut nurses should always be in readiness to carry about infants, because they gain so much spirit and endurance by this treatment.

The antique cradle was a flat swing of basket work, as seen in a British Museum terra-cotta relief, in which the infant Bacchus is being carried. Another kind of cradle, in the form of a shoe, also made of basket work, was provided with handles, allowing it to be carried or suspended by ropes and rocked. In the opening scene of Theocritus's Little Hercules, Alcmena uses the bronze shield of the slain Pterelaus as a cradle for the infant hero and his brother; and as she rocks the mighty arm she sings the little lullaby so charmingly paraphrased by Tennyson in the cradle song in The Princess. Nurses and governesses of native birth were often employed by the rich. The highest tone, however, had created a demand for the Spartan nurse, her treatment insuring the child the greatest physical endurance. Archytas, the philosopher, has received deserved praise as the inventor of the rattle, which has saved so much in fret and furniture.

The exposure of children to inclement weather, cold, and fatigue was as strongly advocated by the ancient pure-air enthusiast as by the modern theorist, and generally led to the same result—the destruction of the weak and sickly. Yet this outcome was not at all unpopular, especially at Sparta, where physical vigor, not intellectual prestige, was required. The custom of exposing sickly or deformed children to the wild beasts on the mountains was practiced throughout Greece, and advocated by the greatest moralists. Though the horror of the practice can hardly be reconciled to our Christian training, there is a justification, or rather explanation, all powerful, when judged by the standards of long ago. The father had absolute power of life and death over the child. The state could only in extreme cases interfere with the disposal of the children, and then only when its interests were impaired. A strong state with mighty warriors was a more effective argument than a sickly family. Then, too, the lack of commercial pursuits among the upper-class Greeks made their seeming cruelty only prudence or at the most selfishness. Socrates, comparing the feelings of his pupils, when reasoned out of their darling errors, to the anger of the young mother when her firstborn is torn from her, furnishes almost the only adverse mention of this practice.

The time at which children shall begin school was as perplexing a question to the ancients as to us. Some educators argued that the child's introduction to books should not begin before the seventh year; the really vital point that some are too young at seven while others are too old was, as now, skillfully lost sight of. Hence the carelessness and indulgence of parents often left an unoccupied period between infancy and school days, which the boy or girl employed in sports—those unconscious educators of the young. There is hardly any modern sport that was not in vogue in ancient Greece. Hopping on one foot, top-splitting, ball playing (both with football and some systematic game with small ball), playing at king, taking prisoners, and catching the knuckle bones of animals on the back of the hand—our jackstones—busied the younger boys and girls. A game is described exactly like the modern Canadian game of "lacrosse." The real, wide-awake boy, however, indulged in beetle-flying, by means of a long thread tied to its tail, sometimes varying the sport by attaching a lighted wax taper—a game still practiced in the country and frequently the cause of extensive fires. This last game might be compared to young America's harmless amusement of tying lighted firecrackers to a kitten's tail. Throwing dice was a favorite pastime with the young as well as with the old. The best throw—three sixes—was called the "Venus" throw; the lowest—three ones—the "dog" or "wine" throw; this last throw evidently meant liquid refreshment for the company. Among the false dice in the Royal Museum at Berlin there are a number "loaded," and some on which the four occurs twice. The Italian game of *morra* was known to the ancients. The two players, opening their clinched hands with lightning speed, cried out the number of fingers instantaneously. From vase painting and written evidence we have conclusive proof that cock-fighting was indulged in by old and young. Themistocles, after the victory over the Persians, made provision for annual festivities of this sort. The birds were fed on garlic, before their fights, to increase their fierceness. Metal spurs were used, and wagers made on the result, the same as in our refined nineteenth century.

The extraordinary care that the Grecian boy received in his formative years made his moral training more effective than that inculcated by the most careful of modern parents. His general education, coupled with skillful and continuous physical instruction, produced a moral cultivation very similar and fully as strict as that the Christian father deems necessary for his daughters. A pedagogue, generally an old and trusted slave, led the boys to school and called for them after it closed, carried the books, looked out for the little boys, kept the older ones from fighting and falling into bad company, and had a general oversight of their conduct and street form. He was by no means a schoolmaster or even a private tutor, not even being allowed to enter the schoolroom. Oftentimes ignorant in the extreme, he was chosen simply because of his loyalty to the family, and sometimes, I fear, because he was unfit for any other occupation. Though the butt of the boys' ridicule, and bitterly assailed by the comic poets and low wits of the day, he did an incalculable service in preventing vicious companionships and keeping pure the minds of those intrusted to his charge.

The child was never sent off to boarding school, but boys attended the day school; town life prevailed; besides, that sentiment that zealously guarded the boy's purity with a pedagogue from his sixth to his sixteenth year could brook no intermission of personal oversight. Education was essentially private, the state having jurisdiction simply over the moral and not the professional standing of the teacher. Though the Greek as well as the Roman school opened very early in the morning, there appears to have been an afternoon session. By a law of Solon, the schools were not allowed to open before sunrise or to hold their sessions after sunset. A state fine refused admission to all except teacher and pupils; the false display of the unpractical public examination day was thus avoided. Outside of music and athletics there were no competitive examinations. The classical schoolman refused promotion for lifeless knowledge, and with keen insight into the real essentials of education demanded a *living* grasp of the subject. Every respectable town had its school. The large cities furnished their schools with all the necessities and many of the ornaments. The poorer towns often held their recitations in the open air, and when the hot weather came on took advantage of the colonnades and shade of public buildings. A similar custom at the celebrated Winchester school in England gave rise to the "cloister term."

There was always an altar to the Muses, the goddesses of learning, or busts of Mercury and various heroes, philosophers, and patriots as reminders to the boys. The master sat on a high seat; the boys sometimes on steplike benches, but usually on the ground

round about him. The schools, except in occasional cases, do not seem to have been crowded. No furniture, as desks or tables, were used, such things being unknown in the country. The universal Eastern custom prevailed, while reading or writing, the book or roll of parchment was held on the knee. Water was kept for the thirsty boys. There seems to have been but one master—seldom any assistant—who, like the old pedant in The Deserted Village, was supposed to know everything.

In the lower schools, the "spare the rod, spoil the child" doctrine was a Median article of faith. Flogging seems to have been popular, or at least in great demand, in both Greek and Roman schools; even the learned Horace, in his epistles, says, "Well do I remember what Orbilius, good at flogging, told me when I was a little boy." In many late writers the severities of the schoolmasters are noted. In one of the Pompeian pictures is represented a schoolmaster flogging a boy held upon the shoulders of a second boy, while a third holds the victim by the heels. Though the ferule seems to have been the favorite instrument of castigation in the Roman school, Lucian and Plutarch have noted the use of the sandal in both domestic and scholastic corporeal correction. The sounds of woe prevalent in satirical pieces prove that Stoicism did not prevail among the whining schoolboys, though there is no reason to suppose that the penalties were any more severe than ours of two decades ago.

To the common-school education in the most brilliant age of Athenian glory—the time of Pericles—there were but three departments; no language course, as all barbarians were supposed to learn Greek, and no true Grecian would degrade himself by studying a foreign tongue. The so-called exact sciences had not yet obtained recognition. The three R's were letters, including reading, writing, counting, and learning of the poets; music, including singing and playing on the lyre; and gymnastics, which included dancing.

Probably at home or before the child knew its letters it was taught to repeat verses from the poets. The analytical mode of teaching the alphabet, by which a word is made to represent an object and then is resolved into its component letters, was not used. The individual letters were learned, and then put together to form syllables and words, called "syllableizing." To add interest, Callias wrote his so-called "grammatical tragedy" or poetical A B C book. Each one of the letters spoke in the prologue, while the chorus combined vowels and consonants into words. With a touch of humor, it seems to me, this old versifier has made the consonants, without sound, represent the male characters; but the vowels, which furnish sound for themselves and all the other letters, and are said to do much more talking, take the female parts. Remnants, discovered only a decade ago, prove the use of pictorial illustrations to teach young children. The subject chosen is, as usual, taken from Homer. One fragment represents the priest Chryses praying the king Agamemnon to ransom his daughter. Under the king, priest, and wagon-load of ransom we read the words "Agamemnon," "Chryses," "the Ransom." Not only correct pronunciation, but well-balanced intonation and rhythm, were demanded by the Greek ear. Reading aloud and learning the poets were great aids to this end. The children, and those who were older, were taught to recite verses from that—to them—inspired Greek Bible, Homer's Iliad and Odyssey. The Greek required his son to memorize the great masters' poems, not only as an intellectual acquirement, but as an incentive to holy living; and so thorough was the training that Niceratus can say in Xenophon's Banquet, "Even now I could recite the whole Iliad and Odyssey." Both of these books, some eight hundred and fifty pages of close modern type, are claimed to have been handed down by sheer memory from father to son. Though such cultivation seems miraculous to us, whose memory powers have been weakened by writing and the printing press, a striking example of its probability is seen in the story circulated about the romantic marriage of the rich German merchant, the renowned Dr. Schliemann. The doctor once said, report has it, before a party of Athenians, that he would marry the first woman who could recite the Odyssey. One day a fair Greek girl appeared before him, unintroduced, asked if the promise was true, recited her Homer, secured her home, and a wife's share of one million dollars.

Writing in ancient Greece was not for a long time considered a very important essential to the average man; probably being deemed servile, as the business writing was almost entirely confined to foreigners and slaves. In time, however, it came to be considered an ornament for the rich and people of leisure, though even the great orators and scholars employed private secretaries on almost every possible occasion. We must not think of the Greek boy as using pencil and slate or even pen and paper. The first companion of the schoolboy in his writing was the wax tablet—a thin, oblong board covered with wax; sometimes a single piece like our slate, and sometimes double, like the book slate of to-day. When two tablets were joined in this way they were provided with raised edges, to prevent the waxed surfaces from sticking together. The stylus was used to write upon the wax; it was a sharp-pointed instrument of metal or ivory, in shape much like our pencil, but with rounded end; the point cut through the wax, and the blunt end was used to erase and rub the wax smooth for future service; so this combination lacked none of the advantages of the slate and pencil. The master wrote words for the boys to copy, and often held beginners' hands; the letters were sometimes cut deep in the wax, so that the boy could easily trace them with his stylus. A set of wax tablets with verses from Menander, evidently the furnishing of a schoolmaster, has been found in a grave in Egypt. One of these tablets has the approval "Diligent."

Though the tablet was cheaper and more common in daily life, both papyrus bark and the hides of animals (parchment) were used. Herodotus mentions the use of paper made of the bark of the Egyptian papyrus plant called "*Biblos*," our Bible, which not only means, from its Greek use, "the Book," but farther back in its history is the name of this papyrus plant. The stalk, about three feet long, was cut lengthwise, and the different layers of bark, generally about twenty in number, were carefully severed with a pin and afterward plaited crosswise, pressed, and perforated with limewater till the required consistence was obtained. The finest paper was obtained from the innermost layer; the outer layer was used in making rope. The use of the hides of goats and sheep was fully as ancient, and differed from the papyrus in allowing writing on both sides, while the bark paper allowed it only on one side.

Pens of split and pointed reeds with black and red inks were used on the papers. Quintilian prefers the tablet and stylus, and objects to the pen and paper, as the frequent dipping into the ink tends to distract continuous thought—apparently a queer objection, but our greatest American essayist, Holmes, in his Over the Teacups, makes the same comparison between the steel pen and the stylographic: "And here let me pay the tribute which I owe to one of the humblest but most serviceable of my assistants, especially in poetical composition. Nothing seems more prosaic than the stylographic pen. It deprives the handwriting of its beauty and to some extent of its individual character. . . . But abuse it as much as you choose, there is nothing like it for the poet, for the imaginative writer. Many a fine flow of thought has been checked, perhaps arrested, by the ill behavior of a goose quill. Many an idea has escaped while the author was dipping his pen in the inkstand. But with the stylographic pen, in the hands of one who knows how to care for it and how to use it, unbroken rhythms and harmonious cadences are the natural products of the unimpeded flow of the fluid which is the vehicle of the author's thoughts and fancies. . . . Its movement over the paper is like the flight of a swallow, while the quill pen and the steel pen and the gold pen are all taking short, laborious journeys, and stopping to drink every few minutes."

The ancient book was made of parchment; sometimes attached to a wooden roller, but more often a simple roll, whence our word *volume*, the rolled or revolved thing. The title was a small tag attached to the roller or to the parchment itself. The volumes were kept in a round box which the pedagogue carried for the boy. This arrangement of the rolls in round boxes is still preserved in the Vatican Library at Rome.

The schoolboy's arithmetic consisted of the science of abstract numbers—regarded as especially difficult and seldom acquired by the ordinary man—and the art of reckoning, common to the pursuits of everyday life. The Athenians, who had obtained a wide reputation as bankers, must have acquired proficiency in the keeping of accounts. To the science of abstract numbers is due much of the architectural excellence of the Greek temples and public buildings, whose dimensions were based on some mathematical theory, and in at least one instance—the celebrated Temple of the Olympian Zeus—multiples of seven and five have been found to be the governing principle. The boy was taught to add, subtract, multiply, and divide; though the lack of our Arabic system of notation made the operation much more difficult than now. Mother Nature, here as everywhere, taught the first lesson. The pupil used his fingers in counting, and "counting by fives" came to be the fixed expression for all counting. The units were represented by the fingers, a bent or crooked finger having a fractional significance. Our old-fashioned word *digits* (fingers) is a telltale relic of this mode of reckoning. The time-immemorial practice of counting by fives and multiples of five has survived to this day, and forms the basis of all calculation, pure and applied, and will maintain its sovereignty as long as mankind has fingers and toes.

The Greek boy made straight marks for numbers; at first five lines (| | | | |) meant five, and then two lines at an angle—the outline of the hand outstretched in counting that number (V); two of these angles with their vertices together (X) meant ten. The higher numbers, as the hundreds and thousands, were represented by the initial letter of the word, as in the Roman system of to-day. The abacus and pebbles were used as an aid in computations with large numbers. The abacus, so called from its resemblance to the marble slab at the top of the Doric pillar, was said to have been introduced by Pythagoras, but was probably of Egyptian origin. There were several forms of the abacus, but the kind most common in the Greek schools was, in principle, exactly like the counting-frame "John Chinaman" uses when he reckons up our laundry bill. There were several straight furrows set with pebbles, a row for each of the orders of units, tens, hundreds, and so on: at the left side of each furrow there was a special division where each pebble meant five of its respective order. Thus 5,839 on the abacus would be—

Thou.	o		M.
Hun.	o	o o o	C.
Tens.		o o o	X.
Ones.	o	o o o o	Units.

Numbers were often represented by the letters of the alphabet; the first ten characters stood for the numbers from one to ten; the eleventh character signified twenty; the twelfth, thirty, and so on; eleven was represented by the letters for ten and one. Thus—

1, 2, 5 in the Greek notation is α', β', ϵ'; but 125 is $\rho\kappa\epsilon'$, in which

$$\begin{array}{rcr} \rho & = & 100 \\ \kappa & = & 20 \\ \epsilon & = & 5 \\ \hline & & 125 \end{array} \qquad \begin{array}{c} {}_{,}\alpha\omega\rho\zeta' \\ 1897 \end{array}$$

Geometry, though advocated by the philosophers as good discipline for boys too young for philosophical and political studies, was not taught in the common schools, but became a favorite study of the university scholars. Over the door of Plato's lecture-room was written, "Let none ignorant of geometry enter here." The absence of the great number of compulsory studies which the modern boy is forced to taste, but seldom till his university course is enabled to digest, is a marked and praiseworthy feature of ordinary Greek schooling.

The importance assigned to music and gymnastics forms the most noticeable contrast between old Hellenic training and ours. Music in its strict sense was practically synonymous with culture, and not only gave color but formed the basis of the educational theory. Real music does not cease with the song or the performance on the instrument, but wields its subtle though powerful influence in making our lives in harmony or at discord with pure thought and noble action. When we speak of the influence of music we think of it as a recreation, but a pastime, indeed, which affords harmless amusements, and brings boys within the refining influence of their sisters and young lady friends, seldom anything more. The Greek thinker held that music not only had a refining influence, but that continuous playing of warlike tunes really made men warlike, and that passionate and voluptuous music made men passionate and voluptuous. The Grecian father was as particular about the kind of music his boy heard as we are about what our sons read. There are as many Captain

Kidds and Red-handed Rangers in music as in literature. Yet it is not the words, but the air or complexion of the piece, that forms the objectionable feature. The compositions of certain authors in a sad vein always make us mournful, while the productions of other artists have a melancholy spirit that brings heart-satisfying consolation in the greatest grief. One composer makes us laugh with childlike joy; another makes us weep. One brings out the divine in our nature; another brings out the fiend. Beethoven ennobles and Offenbach degrades. Though some airs are moral and others are immoral, the different effects of different music upon the mind can not be told in words, and therein consists its very danger; no explanation can be made, no warning given. "Home, Sweet Home," with its simple yet soul-stirring melody, frees men from their baser selves, and often turns them from intended crime, while the Mexican and Hungarian band music, which has become so popular of late, has exactly the opposite effect. The Gypsy bands, which at home are employed almost solely in playing for the National Dance, begin with a calm and grave measure, which, by gradually accelerated movements and flourishes, added to suit the players, at last reaches an intoxicating pitch of deliriously exciting complexities. Such music drives men to the beer gardens, not to the churches. Plato, the Grecian Moses, would have held up his hands in holy horror.

The Greek public put music under state control, as the Chinese of to-day are said to do. Though Chinese music may not be to our taste, it is at least simple and free from those eccentric ornamentations that mean danger to the youthful mind. Why should America proscribe obscene literature and exempt immoral and degrading music? The lyre was the principal instrument of school use. It was originally formed by stretching from seven to ten strings across the hollow tortoise shells which may be found ready for use in any of the Grecian rivers. It was used not only in song accompaniments, but was of special value in the reciting of the poets, giving rhythm and correct balance to the metre, and by its changing tones interpreting variations of feeling.

But the gymnasium, in our sense, is the one great respect in which Greek education for the boy differs most from ours. The Greeks, as no other nation of antiquity, believed in physical training and continuous and complete bodily development. They held that gymnastics not only meant health with its attendant happiness, but that the absence of them made the coward and the loafer. The running race was of value not only because the Greeks attacked the enemy on the run, but because the consciousness of bodily strength gives a boldness of spirit and a clearness of intellect that make hardships endurable and loyalty supreme. Sparta made physical excellence paramount to all else; to her, strength of limb and elasticity of movement meant mighty warriors and national supremacy. At Athens physical and intellectual training were given equal attention, though brain was always superior to brawn. The national games at the great festivals, which crowned the victors with divine honors, kept religion and sports so intimately connected that obedience to the gods could not be separated from devotion to the state and duty to one's self.

Though American rush and push have made our country first in the contest of the nations, hurry may be the bane as well as the boon of our civilization. Bodily weakness and hereditary disease have followed in the wake of material wealth and intellectual vigor. Generations of overworked and unexercised men have left us the legacy of shattered nerves and enfeebled hearts; with characteristic vigor we press on till a little extra strain on this already overstrained system destroys the life that a little daily exercise might have saved for years of usefulness.

At the first school day the physical training in the *palæstra*, under special instructors, was begun, and never ceased till old age called a halt. The *palæstra* was for boys, and was purely a private enterprise, while the gymnasium was under state control and frequented by the youth and older men. No outsiders were allowed at either the boys' or men's gymnasium. Every day the boy was trained in one or more of the so-called "five exercises," which included leaping, running, throwing the discus, casting the spear, and wrestling. Bars of iron with knobs at the ends like our dumb-bells were used to aid in leaping. Before wrestling, the body was well rubbed with olive oil, to which sand was added to afford a good hold. A flesh-scraper removed the oil after the contest. Boxing, and boxing and wrestling combined, were deemed necessary only for the professional athlete, and were not taught to boys, as likely to disfigure their faces and create quarrels and ill will. Outside of Sparta we hear very little of outdoor sports, as hunting and riding, but probably owing to the fact that elsewhere Greek life was essentially "town life." Boys are always attended by overseers in their games, and seem never to have indulged in those sports in which they elect and obey their own leader and fight out their own battles. In all the schoolboy's physical training the motto was "Health, not display."

Unfortunately, the Greek schoolmaster, at least in the common schools, was neither held in high repute nor very well paid. The teacher's income depended on the number of pupils enrolled; though the tuition was probably due monthly, there was great irregularity in its payment. Demosthenes, in the noted case against his guardians, accuses them of letting his teachers go unpaid during the whole of his minority. Lucian, in his satires, describes kings as beggars or primary schoolmasters in the lower world. A comic writer is quoted as saying, "The man is either dead or teaching the alphabet." Orators and noted men accuse each other of having followed this profession. Horace's master Orbilius wrote an autobiography under the title of "The Man acquainted with Grief." The great university teachers, however, were held in high regard, and their pay was oftentimes enormous. Though Plato, the rich *savant*, worked for love, and gave his services to his pupils, the professor's chair in late Athenian glory often paid a twenty-thousand-dollar salary. Gorgias, the great rhetorician, is said to have received one hundred thousand dollars a year for his lectures. The philosophers did not believe in bartering their bread and salt for empty praise.

When Pericles, in his famous funeral oration, reminded his Athenian hearers that their city was a school of Greece, and that the indestructible monuments of their greatness, all over the world, would make their people the admiration not only of their generation but of all posterity, he unconsciously uttered words richer in prophecy than the oracle itself; for not only did Athens become the leader of Greece, first in literature, art, invention, and social progress, but for centuries she has led the nations of the world in all that civilization and cultivation deem greatest and best. The physical, intellectual, and moral superiority which the old Greek school could justly claim as its own, though but a few pages from the history of the nation's service to mankind, formed the basis of that university system which was not only the first in the world, but was gifted with philosophers of such power and artists of such renown that every branch of science and æsthetics, which we deem so much our own, is eagerly seeking for the mystic wand which will bring to view those arts, long lost, but not yet despaired of. The chemist searching and seeking with tireless experiment for the art of tempering copper; the economist spending time and intellect on the various monetary questions; the advocate of equal rights for equal sexes; the statesman studying trade policies and race problems; and the sculptor striving by his colored statues to get nearer Nature's self, are but working out again the problems whose solution constitutes the treasures of little Athens, queen of reason, arts, and letters, and whose influence on the civilization of the future is as yet unsearchable. The ivory palaces, bright with gold, have indeed fallen to decay, but frankincense and myrrh still exhale their everlasting perfume amid the beauteous ruins.

THE FIRST HALF CENTURY OF THE AMERICAN ASSOCIATION.

By Prof. DANIEL S. MARTIN.

THE recent jubilee meeting of the American Association for the Advancement of Science, held at Boston, where the society was organized fifty years ago, is a memorable event in the history of science in this country, and is well deserving of careful notice. It has been somewhat fully treated of, indeed, in several of our magazines and leading papers, and the general aspects of it must be familiar to most of the readers of these pages. But some consideration is due to so interesting a topic from a review entirely devoted to scientific objects, and it is proposed in this article to give not only some historical aspects of the association and its half century of work, as has been done in most of the articles and addresses that have appeared, but also some suggestions as to the influence that it has exerted on the country, and how that influence may and should be increased in the years to come.

The association itself was the natural and indeed the necessary outgrowth of the earlier organization known as the Association of American Geologists and Naturalists, which held its first meeting at Philadelphia in 1840. That movement began two years before, in 1838, in the suggestion of such a body as eminently desirable, by Prof. Edward Hitchcock, of Amherst College, in a letter to Prof. Henry D. Rogers, of Philadelphia. The two brothers Rogers took up the suggestion earnestly, and, with the active efforts of Professor Hitchcock, brought together the first gathering, which was a notable one both in itself and in its subsequent results. These were foreshadowed at the very outset; the original idea was for a conference of geologists only, but the inevitable expansion was seen in the name selected, in which the words "and Naturalists" were soon added to the proposed title—"Association of American Geologists."

There were eighteen students of the science present at that first meeting, in the Franklin Institute at Philadelphia, Professor Hitchcock being chosen to preside. Among them were nearly all the men actively interested in geological studies and in the early State surveys then beginning or begun. Of that circle of founders only one remains, Dr. Martin H. Boyé, then of Philadelphia, but lately abroad. Prof. James Hall, the veteran head of the New York State Survey, and for some years past the Nestor of American paleontologists, lived to within a few weeks of the Boston jubilee meeting, and his presence was looked forward to with peculiar interest; but he was taken away only a short time before, to the great regret of many who had hoped to see and hear him there.

At the first meeting Professor Hitchcock laid before his co-laborers in geology an account, with specimens, of the fossil foot-prints of the Connecticut Valley sandstone, which have since become so celebrated and so closely connected with his name. The next year the meeting was again held in Philadelphia, and the third year in Boston. On that occasion (1842) the brothers Rogers—Henry Darwin and William Bartón—presented to the body their immortal achievement, wrought out together over a vast field, of the structure of the Appalachian mountain system. Both were then young men, but little over thirty, and had labored with true brotherly as well as scientific co-operation, Henry in New Jersey and Pennsylvania and William in Virginia. A most interesting account of their joint presentation of this memorable investigation was given in a letter from one who was present at the time, Mr. John L. Hayes, and printed in the memorial volume, Life and Letters of William B. Rogers, by his widow, published by Houghton, Mifflin & Co. After referring to the eminent men present—Dr. Morton, of Philadelphia, presiding, already becoming noted in the young science of anthropology, and the brilliant address of Professor Silliman, of New Haven, and others active in various departments of science: Hitchcock, Jackson, Emmons, of Taconic fame, "the brilliant French astronomer Nicollet, the mineralogist Beck, the paleontologist Hall, the microscopist Bailey, the zoölogist Gould, the philologist as well as naturalist Haldeman," and others, among them Mr. (afterward Sir) Charles Lyell, of England—he goes on to give the first place of interest and importance to the work of the brothers Rogers, and after describing it enthusiastically closes with the following words: "The brothers by their happy and amiable faculty of working in concert, more than duplicated their individual power. In making their joint exposition, William Rogers took upon himself the more modest but really more difficult part of describing the phenomena, leaving to his brother the part of explaining the theory. . . . Nothing could be more pleasing than the working together of these minds toward the same end."

It will be apparent to any one from these accounts of those early meetings, both their topics and their *personnel*, that there was not only ample scope for such an organization, and both need and readiness for it, but that it had in it from the first the germs of a wider association that should take in all departments of science, and give similar opportunities to all the scattered workers and students of the land. This fact soon became evident, and the idea was taken up earnestly by the Rogers brothers and actively pressed to its accomplishment. Henry D. Rogers was more prominent in the first stages of the movement leading to the earlier association, while his brother William became strongly identified with the later steps that merged it in the wider organization which has now existed for half a century. For eight years the Association of American Geologists and Naturalists met as such, and then in 1848, in the city of Philadelphia, the new association, under its present name and with nearly its present constitution, took its place. William B. Rogers, the retiring president of the earlier body, turned over the chair to Dr. W. C. Redfield, of New York, the first presiding officer of the American Association for the Advancement of Science.

Six members of this first meeting are still living, two of them in Greater New York: these are Dr. Boyé, already named as the sole survivor of the founders of the previous association; Prof. Wolcott Gibbs, of Newport, R. I., the retiring president at the recent meeting; S. L. Abbott, of Boston, and Epes S. Dixwell, of Cambridge; and the two New York members, Prof. Oliver P. Hubbard, of Manhattan, long and actively connected with the New York Academy of Sciences, and Dr. Charles E. West, of Brooklyn, the veteran educator, student, and public-spirited citizen.

In reference to the place of holding the jubilee meeting in the present year, Boston and Philadelphia both had claims to the honor. It was decided in favor of the former, however, as the real birthplace of the association; because, although the first regular meeting was held in Philadelphia in 1848, yet the body was organized and its constitution adopted in Boston at the last meeting of the previous association, in 1847. Strictly, perhaps, the celebration of the semicentennial was due Philadelphia, but there does not appear to have been any other than friendly rivalry in the case; Boston was enthusiastic for it, and Philadelphia consented, and through her representative, Dr. Daniel G. Brinton, the well-known anthropologist and ex-president of the association, expressed her warm and earnest congratulations.

The arrangements for the meeting had been planned on a scale of elegant and even elaborate hospitality on the part of the city and all its institutions of science and education. Regret was expressed to the writer by a leading member of the local committee that, at the season when the Association met, so many of the wealthy and cultured citizens were absent and their houses closed that there was far less of elegant private hospitality than would have been gladly offered at a different time of the year. But this fact was really not a matter for regret, as the time of the association was so absolutely filled up with work and with the abounding courtesies and invitations from the city and its institutions that every hour during the week was crowded. One day was spent amid the classic precincts of Harvard University, and another at historic Salem; one evening reception at the far-famed Public Library, and another at the Art Museum, gave the members opportunities of seeing two justly celebrated institutions of their kind, among the noblest in the country; another evening and several excursions were devoted to the remarkable park and water-supply systems of Greater Boston, which for scientific design and execution are in advance of those of any other American city.

In the addresses of welcome at the opening session, by the Governor of the Commonwealth, Hon. Roger Wolcott, and his Honor Mayor Quincy, of Boston, much emphasis was laid upon the public benefits, social and municipal, derived and derivable from the studies and labors of scientists, especially as illustrated in the city where they were meeting, and upon the mutual duties of the scientist and the public—the former to diffuse and extend the results of his researches for the general benefit of his fellow-men, and the latter to honor and encourage in every way the scientific laborers who had done and could do so much for society. These lines of thought will be referred to later in this article. They had a peculiar force and aptness in the city of Boston, where intellectual and scientific culture is so widely diffused, and public enterprises are so largely and so successfully carried out under scientific direction.

The meetings were held in the buildings of the Massachusetts Institute of Technology and the adjacent Boston Society of Natural History. Here, too, there was exceeding fitness. The Society had taken the initiative in planning and preparing the invitations to the association to meet in Boston; while the Institute was largely the life work of Prof. William B. Rogers, who was its organizer and first president for many years. Its two fine buildings are named Rogers Hall and Walker Hall, after Professor Rogers and his successor in the presidency, the late Dr. Francis A. Walker. Professor Rogers, after his early labors in Virginia as an orographic geologist, was called to the headship of this newly founded school of applied science, and remained there till his death in 1882. He always retained his ardent interest in the association that he had so largely helped to establish, was its president in 1876, and welcomed it at its last meeting in Boston, in 1880. The writer has a striking memory of him on that occasion, the aged scientist kindling with enthusiasm during a discussion in the section of geology, and saying that it brought back to him "the glow of a youthful worker among the Appalachian hills." A highly interesting and pleasing feature of the recent meeting was a reception given by his widow to the geological members, at which they had the privilege of seeing and conversing with her personally. The present president, Dr. J. M. Crafts, welcomed the association in behalf of the institution so closely connected with the name of Rogers on the one hand, and with the diffusion and application of scientific training on the other.

A few words must suffice as to the foreign delegates and visitors who were present. Among these were M. Desirée Charnay, of France, eminent as a student of archæology in both the Old and the New World; Prof. Benjamin Howard and Mr. C. W. Cooke, of London; and Dr. A. Sasse, of Zaandam, Holland. The presidency of the association had very properly been conferred upon Prof. F. W. Putnam, whose name has been so closely connected with the history and work of the body for the past twenty-five years, as its permanent secretary; while the retiring president was, as already stated, Dr. Wolcott Gibbs, one of the six surviving members of the first meeting in 1848.

Passing over, for present purposes, any account of the many scientific papers and addresses of high interest that were presented at this meeting, we return to the history and influence of the association. It was the first national scientific organization, bringing together students and workers in all departments and from all parts of the country, and it still remains the only one. It has grown and broadened with time, as might be expected; it has been divided into a number of sections relating to different branches, and it has come to embrace Canada as well as the United States; so that it is not merely a national but a truly "American association." Twice it has met in cities of the Dominion, having been received with great respect and cordiality in both Montreal and Toronto (1882 and 1889).

When it was first organized, there were local scientific societies of high standing that had done excellent work for many years. Of these, the American Philosophical Society at Philadelphia antedates the Revolution, going back to 1769; next came the American Academy, at Boston, 1780; then the Philadelphia Academy of Natural Sciences, the Franklin Institute (Philadelphia), the Boston Society of Natural History, the American Antiquarian Society, Worcester, Mass.; the Lyceum of Natural History of New York (now the New York Academy of Sciences), and others. These had been publishing reports and proceedings, and around them were gathered a large number of able and eminent workers in science. Yale College had become a center of scientific interest, under such men as Silliman, Shepard, and Olmsted; and the American Journal of Science, long spoken of as "Silliman's Journal," was already a medium of general communication among students of Nature. Scientific surveys had been begun in several States, and the great geological and natural history survey of New York was engaging such leaders as Hall, Emmons, Mather, Vanuxem, and De Kay; while the celebrated United States Exploring Expedition under Captain Wilkes, with young Dana as its naturalist, had extended interest into the study of regions hitherto almost unknown or inaccessible.

But some organization for personal intercourse and contact between the workers in varied fields and at widely separated points was becoming plainly necessary. The societies and colleges and surveys were doing good work and gathering about them able men; but they were local and disconnected in their scope, and could accomplish far less for the development of American science than would be possible if a definite system of communication could be established among them all. Such a work was that of the association; the early founders saw the need, and planned well and wisely to meet it; and for fifty years the organization has held on its way and fulfilled its work in excellent measure. But it has had its vicissitudes and its modifications; and it may be well to refer to some of these, and to consider certain aspects in relation to its future usefulness and power.

At the first meeting there were recorded four hundred and sixty-one members, sixty-one being from Boston and vicinity, and fifty-six each from Philadelphia and New York; the number actually present is not on record. The original plan was to hold two meetings each year, one in a Northern city in the summer, and one in the South or West in the winter or spring; this plan was only carried out for two years, 1850 (Charleston and New Haven) and 1851 (Cincinnati and Albany). In 1854 the association met in Washington, with Prof. James D. Dana as its president, while the membership had risen steadily to a total at that time of one thousand and four. It then fell off to six hundred and five, but again rose year by year to nearly a thousand in 1858, when Baltimore was the place and Prof. Alexis Caswell the president. For two years it fell again, and then came the civil war. The place chosen for 1861 was Nashville, but the meeting was given up on account of the condition of the country, and the association did not convene again until 1866. After 1867, when the membership was but little over four hundred, it began again to increase by one or two hundred yearly, though irregularly, until it again passed the thousand mark in 1879 (Saratoga meeting, Prof. George F. Barker presiding), and then leaped to fifteen hundred and fifty-five at the great Boston meeting of 1880. From that time it has varied from sixteen hundred to two thousand and over, the meetings at Minneapolis, 1883, Washington, 1891, and Rochester, 1892, having recorded a total of 2,033, 2,054, and 2,037 respectively.

The attendance at the meetings has varied even more than the membership itself, very rarely reaching or surpassing one half or, in recent years at least, falling below one fifth. From one third to one fourth may be taken as a general average. The causes for these fluctuations are not difficult to trace, although at first sight they are not very evident. The migratory character of the association is to a considerable extent the main reason. It has been the custom for many years to meet somewhat alternately in Eastern and Western cities; and the fact has been conspicuous that the Western meetings have usually been "off years" in attendance. At the same time, if the membership from accessions in the previous year, at a large meeting on the seaboard, has been high, the smaller attendance makes a marked reduction in proportion to the membership. Other circumstances have at times caused increase or diminution in attendance in special ways. Thus the Springfield (Massachusetts) meeting of 1895 was held so late in August that many teachers could not attend it and be at home in time for the opening of their work at the beginning of September, and this palpable error was probably responsible for an unusually small attendance at a pleasant and convenient place. The Detroit meeting of 1897 was overshadowed by the meeting of the British Association at Toronto in the following week, as some who could not attend both occasions chose the latter as the more remarkable. On the other hand, the great Philadelphia meeting of 1884 owed its unequaled attendance, both actual and proportional (twelve hundred and sixty-one out of a total of nineteen hundred and eighty-one), to the presence of a large number of British members who came from the meeting of their association, held the week previous in Montreal, just as some four hundred American members went last year to Toronto.

Whenever the place of meeting is a large city, and particularly if it be one containing important scientific institutions, like Washington, Philadelphia, or Boston, both the membership and the attendance are greatly increased by the addition of many "local" members. Some of these remain permanently, while others drop off in the course of a few years; but the result is a net increase, though subject to many fluctuations, as we have already noted.

One fact is apparent, and very gratifying, from a study of these figures in detail—to wit, that notwithstanding a certain impression to the contrary in some quarters, the association has, since the civil war, maintained a steady though varying growth in numbers, and (when several years are taken together) a fairly uniform proportion of attendance to membership. At the recent meeting, the register of those present showed a little over nine hundred, while the total membership must be considerably above two thousand, and doubtless larger than ever before.

There seems no foundation, therefore, for the idea expressed by some, that the association is losing ground, or failing to meet the objects for which it was designed. At the same time it might, and doubtless should, attain larger growth and wider influence in its new half century, proportionately as well as actually, than it has, and some suggestions to that end will be presently referred to.

Several causes have operated to produce the impression, or the fear, that has been spoken of. We have said that, when founded, it was the only national body of its kind, and also that it is so still. But the developments of science during the last half century have altered the conditions of its existence and its work in some important respects. These marvelous advances have been strikingly presented in the September issue of the Atlantic Monthly, by Prof. W J McGee, under the title Fifty Years of American Science, in which a comprehensive survey is given of the progress of science in its various fields during this remarkable period, with the philosophic breadth that marks Professor McGee's work. He states the share and the function of the association very happily in the following words:

"Since American science was young, the course of research and conclusion has been guided by an association of science-builders, who have freely contributed their mental and moral riches to their younger and poorer fellows. This association has shaped the progress of American science, and its semicentennial anniversary is America's jubilee of Science."

As was said above, however, new phases have developed in the work of the association, some within it and some without, from this very growth of science. The increase of specialism has led not only to a division of the association into nine sections, in place of the two or three of its early years, but to the formation of several separate organizations of specialists, which have been looked upon as tending to weaken, or even disintegrate, the main body. The American Chemical Society, the American Mathematical Society, and the Geological Society of America may be cited as leading examples, while less directly in such possible rivalry stand the American Forestry Association, the American Folklore Society, and the Association of Economic Entomologists. For the most part, however, there is no cause for apprehension from these sources. Most of these societies hold their meetings at the same time and place with that of the association, or on the days immediately preceding, and thus contribute quite as much as they might detract in the matter of attendance and interest. Some of them also pursue the original plan of the association, and hold another meeting at a different season of the year; this is the case with the Geological Society, of which the college and university professors can best gather in the summer, while the field workers in the United States Geological Survey are apt to be far away at that time, and can better convene in the winter or spring. So far as this department is concerned, moreover, and probably in others also, the number of papers offered for reading and discussion is amply sufficient to fill the whole available time of both the Geological Society and Section E of the association; and there is room enough and work enough for all, without fear of conflict. The same is true of Section H and the Folklore Society, and of Section G and forestry; while the stimulus and the freedom of separate and special organizations tend strongly to the advantage of those branches of science, so long as there is co-operation with the general body of the association.

The question has some resemblance to that of State rights, or "home rule," and national unity, in American politics. Elements of advantage and of power there are, in local associations and local pride and local tradition, that are of the highest value, not only to the community that cherishes them, but to the entire nation, and which could not be developed under a centralized government, while they should never be carried to the danger of disintegration. So it is with the specialist societies: so long as they are willing and ready to co-operate with the broader work of the association, each can help the other in the interest of science as a whole.

Another change, of a different kind, has also taken place, and has perhaps weakened the association. Some years since there was organized the more advanced and select body known as the National Academy of Sciences, limited in number, confined altogether to men who had achieved important results, holding aloof from the more popular aspects of science, and standing at certain times in a somewhat advisory relation to the general Government. It had its prototype in the Institute of France, and admission into it is a distinguished honor. Here again was a natural outgrowth of the progress of science, for which the association had prepared the way, much as the college does for the university. But it is a matter for regret that, in many cases, the men who have reached the "inner circle" of the academy have thenceforth disappeared from the association, or at least from active interest in it. This is not a just course; the scientist has no right to withdraw himself from the needs and interests of the people, even under the plea of lofty devotion to science for its own sake. To any who are so disposed, whether consciously or unconsciously, the words of Professor McGee, above quoted, may be earnestly recalled, when he speaks of "science-builders, who have freely contributed their mental and moral riches to their younger and poorer fellows," and also the strong and wise expressions of

Governor Wolcott and Mayor Quincy, in regard to the obligations of scientific men to use their attainments and diffuse their results for the advantage of society. "Science," said the former, "would be less worthy of our regard if its benefits were confined to a single class; but it is open to all."

There are some, perhaps, who feel that the dignity of science is compromised by the popular diffusion of its facts and results. This idea has an ancient flavor, of mysteries and arcana belonging to a learned caste, and too high and sacred for the "*profanum vulgus.*" But it has no right, and should find no tolerance, in this day, and above all in this country of equal rights and free institutions. Even were it not, however, so unmodern and so un-American, it would be impossible now to carry out. The question is only between the diffusion of scientific information among the general public by men of character and attainment, or by shallow and sensational charlatans. Happily, the great majority of scientists recognize and accept their high responsibility and privilege in this regard. But there is a danger and a tendency, among some, to overlook it or to disregard it, and to such the truth should be plainly spoken, while to all it may safely be reiterated.

The American Association for the Advancement of Science embodies this very idea, of diffusing and familiarizing scientific studies and results, under wise direction, among the intelligent and interested portion of the public. It has accomplished this result as no other agency has or could, while its organization is such that it is absolutely guarded against any lowering of its tone. Any person interested sufficiently to subscribe to the very moderate fees is eligible to membership, while the entire direction and control rest with the "fellows," who are students and workers of assured standing in science. Thus organized, it affords the amplest opportunities to the humblest lover of science to learn and to rise, while its officers and directors are men of professional reputation, jealous for its dignity and its influence.

In its migratory character, also, facilities for this result are admirably secured. Not only do the meetings in different cities afford especially favorable opportunities to the members for studying the geological, botanical, and other natural features of many parts of the country, and for visiting collections, museums, and libraries which ordinarily they might never see, but every meeting of the association gives an immense stimulus to scientific interest among the residents of the place visited, and leaves a permanent impression on the community. Quiet local students and workers are called into prominence and "honored in their own country"; beginners in science are quickened and encouraged; and local societies find themselves for the time in touch with the great national association. Nor is this aspect dependent upon a large attendance: indeed, the meetings in smaller cities and at less conspicuous and accessible points have had perhaps quite as important an influence on the country as the great gatherings that are regarded as most "successful." The association has a twofold work—for its own membership and for the public;—and it may be that while the large meetings yield more of enjoyment and advantage to the former, the small meetings have relatively more important influence on the latter.

Amid the overwhelming attentions and courtesies of the recent meeting in Boston, there were some who felt almost embarrassed by the sense of being so largely recipients rather than givers. The circumstances, however, gave this character to the meeting; Boston was able to do it, and proud to do it. Younger or smaller cities, with less wealth of institutions and resources—literary, scientific, and historical—could not do the like. There the conditions would be reversed, and the association would be the giver rather than the receiver. One marked circumstance may illustrate this aspect. It has been the custom of the association to give one or two public evening lectures, "complimentary to the citizens" of the place, on important or attractive scientific topics; these have been prominent features of popular interest during the week of the meeting. This year the only evening lecture was rather for the benefit of the members, an exposition of the elaborate system of parks and water works of the city, in which engineering, sanitation, and æsthetic taste have been united to a degree unequaled elsewhere in the country.

If we turn, in closing, to the future of the association, and present some suggestions as to its enlarged usefulness and success, this would be one of the most important lines of thought—the association as an educating force. Standing as it does between both the local societies and the specialist societies, limited as these are by neighborhood and by subjects respectively, and the more advanced and select National Academy, the association may be likened in position to the college, standing between the schools and academies and the advanced work of the universities and professional institutions. It is the only body, in its very nature and scope, that can bring genuine science before and among the people at large. The "advancement of science" has two aspects—the increase of numbers, of intercourse, and of quality, among scientific students and workers, and the diffusion of sound and accurate scientific information among the intelligent but nonprofessional public. Both these ideas were aimed at in the plan of the association; both of them have been largely realized in its history, but the latter has rather been subordinate to the former. In its new half century, the educational function should doubtless hold a larger place; nor will this involve the least diminution, but rather an increase, in its other aspects of usefulness.

As to how this end may be attained, a few closing hints may be offered. Every meeting of the association should aim to leave a distinct impress on the community where it is held. In a general way, as we have said, this has been done; but it has been rather incidental than designed. Every community has its limited circle of science-lovers, with perhaps a local society, little known, however, and little recognized, amid the interests of business and politics; it has its library and museum, its colleges and high schools, often struggling, with limited facilities, to arouse or to maintain an interest in scientific culture. All such local agencies should receive a definite accession of strength from a visit of the association; this result should be distinctly held in view as one of the objects of the meeting, and the city or town should find itself not only stirred and quickened by the temporary assemblage of scientists and scholars, but permanently enriched and uplifted. The association might well have a special committee, composed of one or two representatives from each of its sections, whose function should be to ascertain in advance the status of local societies and institutions in the place of meeting, and provide for some enduring advantage to them, as a memorial of the gathering and a return for the courtesies and hospitalities of the community. What forms such action should take would depend altogether upon local conditions, and would vary greatly in consequence thereof; but such a policy could not fail of important advantages to the cities visited and conduce to the strength and prosperity of the association.

In the matter of lectures, too, the association can accomplish much. The custom referred to, of giving one or more such lectures by leading members of the body to the people of the city, should be carefully maintained at each meeting. The recent case of Boston was exceptional in its conditions, but ordinarily this should be one of the "strong points." The character of the lectures should be high, and yet popular in the best sense; not merely interesting or attractive, but instructive. There are many important departments of science bearing upon practical questions—of health, of social conditions, of public advantage—upon which either little is generally known or the partial knowledge derived from magazines, newspapers, and irresponsible lecturers is crude and unreliable. To furnish a clear, careful, and "up-to-date" presentation of some subjects of this kind, in a form at once interesting and accurate, should form a part of every meeting, and would be highly valued by the community. Such addresses would probably be widely published by the higher-class newspapers of the country, and would not only be useful to the public, but would bring honor and respect to the association. We are not saying that this has never been done, but that it might be done more and better; and that a definite policy of so doing would be an element of strength to the body and of benefit to the people at large.

Another line of desirable influence would be in relation to local societies. The association from the outset sought and accomplished the great advantage of bringing together scattered and isolated workers in science throughout the land. This social and personal intercourse has been and still is one of the strongest and best elements in the annual gatherings. But the local societies throughout the country are still in much the same isolation as the individual workers were fifty years ago; and some system of communication and co-operation among them would be a strength and a stimulus to all. Why might not the association bring about some method of intercourse or federation among these bodies, that would prove of great interest and value? The several scientific societies of Washington and of New York city (Manhattan) have for some years united in a "Scientific Alliance," or federation, and thereby, while preserving their separate identity, gained the strength that lies in union. Brooklyn has gone further, and merged into its one great "Institute" a number of distinct societies, as departments. These are merely cited as illustrations. But if the association should again have a committee representing its various sections, to consider some plan for co-operation and intercourse among the societies that now know so little of each other's work, the result might have great influence both on them and on itself. A local society in a small place often does excellent work; but it is wholly unknown beyond its own limited sphere. If it were provided, also, in the association that societies as well as individuals could become members, to be represented by one or more of their own members, as delegates, such representatives would come to the meeting, enjoy the interest and receive the stimulus of the occasion, and carry back to their own little circle reports of what they had seen and heard. These suggestions might be greatly amplified were there space to do so, but they can only be outlined here, as indicating ways in which the association might quicken the interest and unify the labors of the scattered scientific bodies of the country, and in turn receive support and advantage from them.

Various other lines of thought present themselves, which it is impossible here to discuss, bearing upon the prospects and possibilities of this great scientific body, upon its duties and functions toward the public and the corresponding duties which the public, and especially the scientific public, owe to it. Its history has been fruitful and honorable, its mission is noble and broad, its future is full of "promise and potency." But, to realize these aright, it is needful that the association shall clearly recognize its obligation as an educating agency and keep in touch with the public, and that the scientists of the country shall sustain it in its work and contribute to it their best endeavors.

SKETCH OF SIR RICHARD QUAIN.

BESIDES being an extraordinarily popular and successful practicing physician, Sir Richard Quain contributed materially by his researches to the advancement of medical science, served the public in many responsible and highly useful positions, and earned a world-wide recognition by his work on the "Rinderpest" Commission.

Richard Quain was born at Mallow, on the Blackwater, Ireland, October 30, 1816, and died in London, March 13, 1898. He came of a family which contributed several eminent men to public life—two of his cousins, Jones Quain and Richard Quain, having distinguished themselves in anatomy and surgery, and a third, John Richard Quain, as a lawyer and a judge in the Court of Queen's Bench. His mother also belonged to an honorable family, that of the Burkes of Mallow, and was a great-grandniece of Bishop Burnet, who conducted the services at the coronation of William and Mary. Young Quain is said to have been precocious in his childhood, to have become thoroughly grounded in English and the classics, and to have distinguished himself at the examinations. When fifteen years old he was apprenticed for five years to an apothecary in Limerick, and gained considerable experience and made sagacious observations even at that age; and he is said to have resolutely fought the cholera when it raged in Limerick. In 1837 he proceeded to London and entered University College, where his cousins Richard and Jones held professorial chairs; was graduated thence M. B., in 1840; gained the scholarship and gold medal, and took honors in surgery and midwifery. He was appointed at that time house surgeon, and one year later house physician, or "resident medical officer," at University College Hospital. This institution was, during the five years he held that position, much thronged with "casualty" patients, the work on the extension of the London and Northwestern Railway bringing a large accession of laboring population within its bailiwick. With the degree of M. D., in 1842, he received a gold medal and a certificate of special proficiency. The next year he was elected a fellow of University College. In 1846 he was elected assistant physician to the Hospital for Diseases of the Chest at Brompton; was for many years consulting physician to the Seamen's Hospital at Greenwich, and to the Royal Hospital for Consumptives at Ventnor. He became a member of the Royal College of Physicians in 1846, a fellow in 1851, and was at different times member of its council and censor, Lumleian lecturer, senior censor, Harveian orator, and vice-president. From 1864 till his death he was one of the most conspicuous members of the General Medical Council, having been appointed crown member seven times, serving as chairman of some of its most important committees, and having been president of the council since 1891. He was one of the founders of the Pathological Society, an early secretary of it, and a frequent exhibitor at its meetings. While exceptionally popular and successful as a practitioner in medicine, a favorite in society, and a recognized authority on tuberculosis and diseases of the heart, Quain, his biographer in Nature says, "was closely set on the public work associated with medicine. Medical education, medical research, medical relief at hospitals—these were the subjects at which he mainly worked, and with an energy and avidity which appeared to grow rather than wane as time passed, and he attained in his old age the highest positions in the profession. A senator of the University of London; chairman of the Brown Institution, with Burdon-Sanderson, Klein, Greenfield, Horsley, and their equally distinguished successors working as professors there; one of the most prominent fellows of the College of Physicians, which was passing through a critical period of its history; and, finally, president of the General Council of Medical Education and Registration, of which he had been for thirty years a member—Quain had his hands full; yet he never appeared to grudge his time to a friend in want of advice; and he was always keen and ready for the latest information in science."

Probably Quain's greatest service to knowledge and to the general welfare was rendered in connection with the investigations of the royal commission to inquire into the nature, causes, and methods of prevention of the cattle plague, to which he was appointed in 1865, in association with Lord Spencer (chairman), the present prime minister, then Lord Cranbourne, Lord Sherbrooke, Dr. Lyon Playfair, Dr. Edmund Parkes, and Dr. Henry Bence Jones. "In the valuable transactions of this royal commission," the Lancet says, "Quain took a very prominent and useful part; in fact, for several months the question occupied almost his whole time. The whole matter was gone into most extensively by the commission, and not the least searching among the frequent questions were those addressed by Dr. Quain to the various veterinary and medical witnesses. He throughout this inquiry showed himself an excellent and logical cross-examiner. Among the medical witnesses called were Dr. Burdon-Sanderson, who made an exhaustive report describing his experiments; Dr. Marcet, Dr. John Syer Bristowe, and Dr. Lionel Beale, who conducted the microscopical part of the inquiry. It is not surprising that after hearing the evidence adduced during the long sitting of this commission Dr. Quain should have sided with the section which desired the extermination of the plague 'at any price.' This was the view of the majority, but throughout the country there was an opinion, founded on insufficient data, that too high a price might be paid even for the stamping out of this fearful disease. This section of public opinion found its spokesmen on the commission in the persons of Earl Spencer, Lord Cranbourne (Salisbury), Mr. Clare Sewell Read, and Dr. Bence Jones. The majority included Mr. Lowe (Lord Sherbrooke), Dr. Lyon Playfair, Dr. Richard Quain, and Dr. Edmund Parkes. Dr. Quain's work on this commission very thoroughly justified his appointment, and his letters to the Times and articles in the Saturday Review went far indeed to change public opinion on the whole matter. The voice of the public at large was at first very strongly raised against the stamping-out recommendations of this commission. These recommendations, as Dr. Quain ably pointed out, would ultimately save many millions of pounds to the country, and the event has proved the correctness of his views. In the conduct of the Royal Commission of Inquiry perhaps the most essential detail is the arrangement of the method and scheme of the investigation. For this portion of the work of this most successful inquiry Richard Quain was in great measure responsible. In the third report of this commission there were a number of valuable drawings illustrating the pathology of the disease, and these were, at the instance of Quain, presented to the Royal College of Physicians of London."

Quain's first important essay in medical science, and the one on which the foundation of his reputation was laid, was his essay—"brilliant research," Nature calls it—on Fatty Degeneration of the Heart, which was contributed to the Transactions of the Royal Medical and Chirurgical Society for 1850, and appeared afterward in an expanded and exhaustive article in his Dictionary of Medicine. "Simple as the doctrine appears to us at the present day," says Nature, "fifty years ago it was a startling pronouncement by a young man fresh from his medical studies that fat may be and often is a product of the decomposition of muscular tissue, and that this change goes on in the living body. The ideas of life, nutrition, and death were greatly influenced by the doctrine. This, let us remember, was many years before Bauer and Voit, working with phosphorus in starving animals, furnished the proof experimentally and qualitatively; and Quain's claim was freely admitted by Virchow and Paget." Previous to this he had published, early in his career at University College Hospital (1845), contributions on Bright's Disease of the Kidneys, and on Injuries to the Valves of the Heart. His Lumleian lecture before the Royal College of Surgeons in 1872 dealt with Diseases of the Muscular Walls of the Heart.

The Dictionary of Medicine, on which Dr. Quain's leisure time had been spent for several years since 1875, appeared in 1882, and met a real want, for Copeland's Dictionary had gone out of date, and Reynolds's System was not intended to be an encyclopedic book of reference. The Dictionary first appeared as a volume of nineteen hundred pages, and was the joint work of a very large number of prominent medical writers, among whom Dr. Quain himself and his editorial coadjutors, Dr. Frederick Roberts and Dr. Mitchell Bruce, contributed largely. The work, according to the Lancet, "admirably filled the want long felt by the medical profession of a thoroughly convenient and at the same time exhaustive book of reference. It had the additional advantage of being thoroughly brought up to the knowledge of the day, for, as its editor remarked in the preface, although it occupied some years in production, each part of it was so arranged as to permit of alteration and addition up to the very time of going to press. The editor's own articles chiefly dealt with affections of the heart." The Lancet points out that Sir Richard Quain's faculty for the arrangement of facts in such an order as to convey them to the mind of the reader in a succession which makes the whole train of reasoning symmetrical is particularly noticeable in the essay on Fatty Degeneration of the Heart, already mentioned, and is also traceable to but little less an extent in the articles on Angina Pectoris, Aneurism of the Heart, and Diseases of the Bronchial Tubes, and in the general remarks on Disease.

In 1885 Dr. Quain delivered the Harveian Oration at the Royal College of Physicians, taking for his subject The Healing Art in its Historic and Prophetic Aspects, and beginning his address with citations of the adverse remarks that had been made as to the progress of medicine by Hoffmann, Gregory, Sir William Hamilton, and others. In refutation of these statements he mentioned many curious and amusing instances of extraordinary superstitions concerning medicine and surgery from which mankind had freed itself. As a speaker he was not eloquent, and it is admitted that there was even a lack of breadth and dignity in his presentation of a subject; yet the Lancet commends the addresses he made at the meetings of the Medical Council as showing his familiarity with the details and the clearness of his memory on all subjects, and as presenting practical and statesmanlike views which were generally sustained by the after history of the affairs to which they pertained. Besides the Dictionary of Medicine, Dr. Quain, with a number of eminent co-laborers, prepared an Elements of Anatomy, which has passed through many editions, and has a high rank in the literature of the profession.

Dr. Quain received an honorary degree of M. D. from the Royal University of Ireland in 1887, and was made a fellow of the Royal College of Physicians of Ireland in the same year; was made a Doctor of Laws of the University of Edinburgh in 1889; in the same year was appointed Physician Extraordinary to her Majesty the Queen; was made a Doctor of Medicine of the University of Dublin in 1890; was elected a fellow of the Royal Society in 1871; was a fellow and late president of the Royal Medical and Chirurgical Society; a fellow of the Royal Botanical Society; a member and late president of the Pathological Society of London, to the Transactions of which he made several valuable contributions; was a member and late president of the Harveian Society of London; and a member of the senate of the University of London. On New Year's day, 1891, he was made a baronet of the United Kingdom.

His medical practice was largely in the higher circles of London society, and he enjoyed the personal friendship of many of the leading men of his time, among whom Carlyle, John Delane, proprietor of the Times, Landseer, and Robert Lowe are named.

Sir Richard Quain had been ill for more than a year previous to his death, and for the last six months confined to his bed. His last appearance in public was at the reading of his paper on the Cause of the First Sound of the Heart, before the Royal Society, in June, 1897, when the president made a special reference to the courage he displayed. The paper had been written in bed, and he had left his bed to present and defend it.

"His life," says Nature, "had been one of ceaseless activity, good health, and overflowing spirits; and when overtaken by disease he appeared not to regard or understand rest, physician though he was." The Lancet says: "To few men in our profession has the gift of every characteristic that calls forth the affectionate esteem of their brethren been so liberally vouchsafed as to Sir Richard Quain. His genial presence and his brilliant power of saying epigrammatic things, and saying them with the true humorous instinct of his race, made him ever popular; while his wide sympathies and unvarying kindness gave him in the eyes of those who had the privilege of personal relations with him something more true and permanent than social popularity, the affection of his younger brethren in the profession of medicine."

Editor's Table.

THE CONFLICT OF MODERN SOCIETY.

CIVILIZATION, whether considered as a result or as a process, may be defined as the improvement of individual lives through social intercourse. It is obvious that the isolated individual can not elevate or develop himself. Growth through society is the law of human nature; and the founder of Positivism had some very plausible reasons for speaking of humanity in the widest acceptation of the term as the "Grand Être." The individual realizes his powers in part through family life, further through national life, and still further through participation in the whole life, past and present, of the human race.

At the same time civilization, as we all know, does not go on continuously. Nations in the past have had their rise, their development, and their decay. They have had their rise when circumstances have compelled special social aggregations; their development during the period when, on the whole, individual characters were improving under social action; and their decay when the latter process has been reversed—when, upon the whole, men and women are receiving more harm than good from their social environment and their general intercourse with one another. Various reasons have been assigned for the decay of the older civilizations. An explanation which, so far as it goes, would apply to all cases is that men have not increased in virtue as they have increased in knowledge and power, and that they have consequently succumbed to temptations arising from the very successes they have achieved in social organization. If this theory is at all correct, a really stable civilization will only be founded when men have acquired the virtues necessary to enable them to use, as not abusing, the varied advantages accruing from their possession of advanced knowledge with its accompanying power over the resources of Nature.

This point of view seems to us, provisionally at least, a serviceable one; and we are therefore prompted to ask the question whether among the most favored nations of to-day public and private virtue is advancing as fast as material development, or whether there is any danger that modern civilization will, some generations hence, perish through the very abundance of the enjoyments and facilities of all kinds which it is furnishing, and will continue more and more to furnish, to the men and women of these latter times. In a word, are we able to stand up against the temptations that our industrial and scientific and artistic development is throwing in our way? If *we* are able, how will it be with our children and grandchildren?

It would be idle and ridiculous at this moment to predict evil of modern society; but it is not predicting evil to point out that, here and there, our moral forces, in the great Vanity Fair of the world as it is to-day, seem to be weakening. We think, for example, that few well-informed persons will deny that the conditions of business at the present time are anything but reassuring. The question which men who wish to be honest are asking themselves is whether business will much longer be possible at all except for the managers of huge capitals. There is much in the conditions of the industrial world, particularly in relation to the treatment of the wage-earning class, which is abhorrent to humane employers; but these very men see no escape for themselves from practices and policies which in their hearts they utterly condemn, save in a complete abandonment of the field of business competition. If some of our leading men of business would speak out frankly all they know, they could a tale unfold which, if not as grewsome as that of the ghost in Hamlet, would be full of baleful significance. The late Mr. Gladstone, toward the end of a long life of most varied experiences, said in reply to the question of a friend that the most serious evil he saw in the world to-day was the prevailing lust of wealth. This was not said lightly, but, as we are told, with an accent of great concern. Socialism and militarism, the aged statesman thought, were both less threatening evils than the accursed thirst for gold. To-day we are breeding up a race of men hardened in advance for the conflict before them. What the practice of the market requires them to do, that they are prepared to do; and whoever else burdens himself with scruples when business is to be done, they will give way to no such weakness. That is not only their secret thought, but almost their open profession. We find in this readiness of the young to accept eagerly the worst that the world of business can teach them a very discouraging sign of the times.

And whence this fierce and deadly determination to amass wealth at all costs? Why, wealth to-day means so much: there are so many more ways than there used to be of displaying and enjoying it, and so much of social distinction attends the possession of it. A man who has no wealth cuts so small a figure in the world. He may be this or that, but who cares much for him if he has no money to spend? So the mammon-worshipers reason, according to the light, or the darkness, that is in them.

This is undoubtedly a weak spot in our civilization. In reply to the question, How is this generation standing up against the seductions of wealth? the answer must be plain and to the point—it is not standing up well at all. The sacrifice of truth and honor to the making of money is widespread, and men justify themselves by the law of self-protection.

It is not only in the sphere of commerce that the spirit which we have described is paramount. It is seen in the professions, even the highest; and money everywhere is becoming the norm and standard by which everything is judged. Its corrupting power in the region of art is one of the main motives of Count Tolstoi's recent book.

Among the striking results of modern scientific development none is more conspicuous than the enormous increase which has taken place in the facilities for travel and communication. The telegraph has established a universal exchange of news, and the columns of our daily papers are overloaded in the attempt to place it all under our eye. We are supposed to be all very "busy men" nowadays, though we do not work so long hours as our fathers and grandfathers; and consequently everything which is brought to our attention is comminuted, peptonized, and otherwise prepared with a view to the utmost economy of effort in consumption. No newspaper would be so barbarous as to give us a narration of any matter, however interesting, without cutting it up into nice little morsels, each with its own catching title. Literature is more and more taking on the forms suited not so much to busy as to idle people;

and college courses are planned less with a view to general culture than to enabling each individual to jump at once on the very thing he wants, or thinks he wants, for the purposes of a practical career.

What has the mental result of it all been? The part which science has played has been to greatly enlarge our means of obtaining knowledge. It rested with this generation to use these enlarged means for wise or for foolish purposes; and we fear it is not possible to read the more widely circulated of our daily papers without concluding that, to a very large extent, the gift of science in bringing us so marvelously into touch with all the ends of the earth, and in cheapening so extraordinarily the means of information, has resulted far otherwise than could have been wished. Our vast intellectual advantages have culminated in the advent and reign of the Yellow Journal, to spread whose malodorous froth over the surface of the land whole forests are tumbled annually into the pulp mill.

When we speak of intellectual advantages, our "magnificent public-school system" should not be forgotten. It probably is as magnificent as the people's taxes expended by the people's politicians can make it; but does it educate? That is a question about which our most prominent educators can never entirely agree. It seems to us to be just a case in which, if the people could rise to the level of their opportunity, they might reap an enormous advantage; but the people do not effectively demand the best education for their children, and they do not get it. They effectively demand not a training for life, not a true education for the mind, but an education for business. Even in our higher institutions of learning, calculations in relation to business largely predominate. And the result is that high authorities in the educational world write articles on "The Increasing Illiteracy of the American People," and experienced professors explain how it is that all the instruction they give to their pupils in English language and literature can not overcome their corrupt habits of speech. But this is not the worst; the worst is that to thousands and thousands what is called education is rather a spur to lawless desires than an aid in the government of life.

The problem of the Sphinx is therefore confronting us as it has confronted other races and periods: how to stand up against the sun of our own prosperity. When it has been a question of enduring the storm and the blast, humanity has never failed; but when the victory over hardship has been won, then another battle has begun, in which, from a national standpoint, the forces of integration and progress have too often suffered defeat. We are enduring the strain of that conflict now, and while it is impossible not to hope for victory, the signs are many that the victory—which must take the form of the establishment of a true moral equilibrium in modern society—will not be achieved without difficulty.

THE BOSTON MEETING OF THE AMERICAN ASSOCIATION.

THE meeting of the American Association for the Advancement of Science recently held in Boston was in many respects a notable one. Marking as it did the completion of the first half century of the life of the association, it afforded a suitable opportunity for taking stock of the progress of science in this country during the last fifty years and for estimating the influence of the association as a leading factor in such progress. The attendance was unusually large, including, along with many distinguished names, members from nearly all parts of the United States and Canada. A good many papers were read possessing, as a rule, a high order of merit, while, fortunately, not a few of them were couched in language that could be readily understood by an intelligent listener, and thus gave added interest to the proceedings.

The association was welcomed by Governor Wolcott in behalf of the Commonwealth of Massachusetts, Mayor Quincy representing the city of Boston, and President Crafts, of the Massachusetts Institute of Technology, where the sessions were held. Though brief, the addresses were in each instance thoughtful and impressive and were heard with keen appreciation by the large audience present at the opening session. A marked feature of all of them was the emphasis with which the speakers dwelt upon the value of science as an agency in education, and the great services it had rendered and was yet to render to the community at large in the improvement of the material conditions of life and the elevation of the intellectual and moral tone of society.

The citizens of Boston, as is their wont, received the association with open arms, sparing nothing in the way of hospitality and good feeling to make the occasion an enjoyable and profitable one to the nine hundred members who were present at the meeting. Wherever the latter appeared, whether in street car, hotel, or at special reception, all were made to feel that they were the honored guests of the city, meeting with a courtesy and consideration that alone would have been a fair return for the trouble and expense their pilgrimage had cost them.

The opportunities provided for social intercourse and recreation were numerous and varied. One day it was a steamboat excursion down the harbor, which could not have been better timed, as it did much to mitigate the effects of the extreme heat which afflicted the city. Another day the entire association was taken to Salem, where, after being bounteously dined, the members were shown the many places of interest, historic and scientific, for which that old city is celebrated. As the guests of Harvard University a day was also given to a visit to Cambridge. Here, under the guidance of members of the faculty, the laboratories, museums, and other features of scientific and educational interest belonging to the university were thrown open for observation. Lunch and tea were served in the great Memorial Hall, and the occasion was fittingly closed with an able address by President Eliot, delivered in Sanders Theater in the evening. Receptions given by Governor Wolcott, Mrs. J. C. Phillips, Mrs. William B. Rogers, the trustees of the Museum of Fine Arts, and the officers of the Boston Public Library were another form of contribution to the enjoyment of the members which was much appreciated. These, with a dinner given by Mayor Quincy to the principal officers of the association and foreign guests, and numerous minor excursions to various points of interest in the neighborhood of Boston, represent but incompletely the hearty and abounding hospitality with which the association was entertained. The kindly and cordial attentions that were everywhere showered upon them could not fail of their effect on the spirits of the visitors. This was seen in their beaming countenances, the uniform jollity that prevailed in spite of the excessive heat, and the felicitations that were heard on every hand at the phenomenal success of the meeting.

In view of this general satisfaction at the manner in which the members had been received and taken care of, and also at the amount and quality of the work done, it may appear a little ungracious to call attention to what seems to us an unfortunate omission in the management of the meeting; and we certainly should not allude to it were it not that, in our opinion, it betrays a growing tendency to abandon, or at least to dwarf, one of the principal objects of the organization.

What we refer to is the lack of provision on the part of the association for the popular evening lectures that were instituted by its founders as a part of its educational work, and that for a good many years formed one of the most attractive features of its meetings.

In the earlier days of the association, and always in the British Association to the present time, popular lectures on subjects of public interest have had a prominent place in the proceedings. Usually given in the evening, they need not interfere with the daily routine, and always, when provided for, they have drawn crowded and intelligent audiences from among the people of the neighborhood, arousing interest in scientific matters that came near being enthusiasm, and so contributing directly and effectually to the object we have specified.

What was done in furtherance of this purpose at the Boston meeting can hardly be said to have been the work of the association. There were, to be sure, two interesting lectures in Huntington Hall the same evening on the value of scientific applications in municipal public works, as illustrated by what had been done in Boston; but these were delivered for Boston, and by two citizens of Boston, the Hon. H. H. Sprague and the Hon. George G. Crocker, and should properly be placed to the credit of Boston, thus increasing rather than diminishing the indebtedness of the association. The same may be said of President Eliot's instructive address before the association at Cambridge, which was indeed a type of what these evening lectures should be, and, in our opinion, was one of the most valuable contributions, at least so far as the public is concerned, to the proceedings of the entire meeting; but it was a part of the entertainment offered by Boston.

The tendency of the association away from its important educative purpose is further indicated by the abolition of the general sessions at the opening of the daily proceedings. These often became occasions for exceedingly entertaining discussions of subjects of general scientific interest, in which the more prominent and experienced members were expected to and habitually did take part. Even the strongest advocates of more room for technical papers acknowledge that the work of the association has of late attracted less and less of popular attention. Whatever force may be given to the plea that many of its most eminent members have been drawn away to the American Academy of Sciences, the fact remains that the time was when, with not half its present membership, the meetings were of far greater public interest than they are to-day; and there was never any difficulty, when they were sought, in finding men abundantly equipped to interest and instruct an intelligent popular gathering. As scientific investigators multiply and research is extended, the number of technical papers presented to the association may be fairly expected to increase; but the number of topics the public will want to hear about will increase with them, and if the technicalities are permitted to crowd out the more popular and edifying features, the educational influence of the association on the people at large can not fail to be seriously impaired, if it is not altogether destroyed.

Scientific Literature.

SPECIAL BOOKS.

MR. *Lester F. Ward*, in the book whose title is indicated below,* gives a very readable summary of his views upon sociological science. He still holds, as he tells us, to the theories enunciated in his Dynamic Sociology, published in 1882; but he does not seem to have obtained in the last sixteen years any additional light as to the form social evolution is likely to take under the influence of the psychic forces which he has described. There is to be a social evolution, so we are given to understand, determined by a social consciousness of social needs ; but he is not able as yet to indicate any distinct dawning of such consciousness. He apologizes for the democratic governments which are to be organs of the expected progress. They will be all right some day, but up to date they are the "most stupid" of all governments. "They have to rely on brute force. They are short-sighted, and only know how to lock the door after the horse is stolen. They swarm and 'enthuse,' and then lapse into a state of torpor, losing all that was gained, and again surge in another direction, wasting their energies. In fact, they act precisely like animals devoid of intelligence." Lest the picture should be too dark, the author adds that "under exceptional circumstances they have displayed signs of collective intelligence." To their credit, however, be it said that democracies are "benevolent," while autocracies are always "rapacious." The democratic legislator knows what his constituents want and tries to get it for them. This is benevolent on his part, and the benevolence of the constituency, we suppose, will be shown in re-electing him. Dr. Pangloss himself could not have imagined a more beautiful illustration of the general perfection of the scheme of things.

The great trouble, however, is that so little mind beams through this benevolence. Mr. Ward acknowledges that this constitutes "the problem of sociology." He has wrestled with it, he says, for many years, and sees no way to increase the intellectual status of democratic governments save by improving that of the people at large. "If," he adds, "the social consciousness can be so far quickened as to awake to a full realization of this truth in such vivid manner as to induce general action in the direction of devising means for the universal equalization of intelligence, all other social problems will be put in the way of gradual but certain solution." It really seems to us as if in this sentence the stream of Mr. Ward's argument were losing itself, like an Australian river, in the sands of a highly Latinized, and all but unmeaning, verbiage. May we not, however, ask the question whether, with a marked increase in the general intelligence and

* Outlines of Sociology. By Lester F. Ward. New York : The Macmillan Company, 1898.

an accompanying improvement in the general morality of the community, there would not be a correspondingly reduced need for the kind of legislation directed to constructive social ends which the author so ardently invokes? The community is to be educated up to the highest point, in order that a highly intelligent legislature may do for the eminently intelligent and moral community what the latter in spite of its advanced education is still not quite intelligent or moral enough to do for itself. We find here a somewhat excessive complication. Besides, why, after all, should a serious writer like Mr. Ward worry about a "social consciousness" of which he can not pretend to assert that any organ exists? He knows perfectly well that consciousness is essentially an individual thing, and that the consciousness which we conceive as residing in one brain can by no possibility be the consciousness of another brain. A legislative committee may wield a delegated *power*, but such a thing as a delegated consciousness never yet existed and never will exist.

We are sorry to find Mr. Ward repeating a statement regarding Mr. Spencer, the incorrectness of which was fully demonstrated by Mr. Spencer himself in an article published in this magazine in the month of December, 1896, on the occasion of the first appearance in print, in the form of an article in the American Journal of Sociology, of one of the chapters of Mr. Ward's present book. The passage to which we refer is as follows: "Herbert Spencer, although he treated psychology as a distinct science, and placed it between biology and sociology in his system of Synthetic Philosophy, made no attempt to affiliate sociology upon psychology, while, on the contrary, he did exert himself to demonstrate that it has exceedingly close natural affinities with biology" (page 94). Mr. Spencer's reply to this was that he had, in the most distinct manner, indicated the dependence of sociology upon psychology, and that, in point of fact, the opening chapters of his Principles of Sociology dealt almost wholly with psychical factors. He adduced numerous passages from his writings proving that he had made his position upon this point perfectly plain. Any of our readers who care to turn to the number of this magazine which we have mentioned can see for themselves how complete was the refutation of Mr. Ward's erroneous statement. It seems to us that, as a matter of courtesy as well as of elementary justice, Mr. Ward should have seen to it that he did not put forth a second time an utterance so ill-founded and injurious. Mr. Ward himself, in the very paragraph in which he makes the allegation complained of by Mr. Spencer, furnishes evidence of its incorrectness. He says that at the close of the third chapter of Mr. Spencer's Psychology the fact comes clearly forth that "the class of attributes in the individual animal with which those of society could best be compared were its psychic attributes." Surely if this was clearly the drift of Mr. Spencer's argument there was no great need of repeated affirmations that a nexus existed between psychology and sociology. Mr. Ward is an industrious writer, and his style is, as a rule, clear and interesting. He seems, however, to take himself a little too seriously. When, in recapitulating (page 164) the conclusions which *he* claims to have reached, he includes the doctrine that "social forces are psychic," he can not fail to bring a smile to the face of any one who has ever read Spencer. The same effect is produced when he says (page 111) that he is the only one, so far as he is aware, "who has attempted to show a way out of the difficulty" connected with the evolution of the human intellect. The book as a whole, however, is highly readable, and, with the reserves we have indicated, may be commended to those who are interested in the study of sociological questions.

The *Text-Book of Zoölogy** of Messrs. *T. Jeffery Parker* and *William A. Haswell* was prepared under peculiar, we might well say unique, conditions. Both authors are professors of biology at the antipodes, Professor Parker in the University of Otago, New Zealand, and Professor Haswell in the University of Sydney, New South Wales. They have collaborated while being most of the time twelve hundred miles apart by sea, and the manuscripts, proofs, and drawings of the book have had to traverse half of the circumference of the globe, or to London, in their journeys between the authors on the one hand, and the publishers, printers, artists, and engravers on the other. Though large and comprehensive, the book has been prepared with strict reference to the needs of the beginner, the mode of treatment being such "that no previous knowledge of zoölogy is assumed, and students of the first and second years should have no more difficulty in following the accounts of the various groups than is incidental to the first study of a complex and unfamiliar subject." Laboratory and museum study is contemplated, and the practice of preceding the study of a given group as a whole by the accurate examination of a suitable member of it is commended. Yet this method of types has its own dangers. "Students are in their way great generalizers, and, unless carefully looked after, are quite sure to take the type for the class, and to consider all arthropods but crayfishes and cockroaches, and all molluscs but mussels and snails, as non-typical." Hence a zoölogy that confines itself largely to types as examples "is certain to be a singularly narrow and barren affair, and to leave the student with the vaguest and most erroneous ideas of the animal kingdom as a whole." The authors, believing that every group which can not be readily and intelligibly described in terms of some other group should be represented in an elementary course of zoölogy by an example, have in the majority of cases described in some detail an example; and in cases where the diversity of organization is very great, two or more examples of every important class. By the time the example has been studied a definition of the class and of its orders will be intelligible, and will serve to show which of the characters already met with are of distinctive importance, and which special to the example itself. To make this part of the teaching more clear, a paragraph giving in more or less of detail the systematic positions of the example, is introduced after the classification. Following the table of classification with its brief definitions, the general account of the group is given, space being allotted to each group, so far as practicable, proportioned to its complexity and range of variation. Following out the plan of deferring the discussion of general principles till the facts with which they are connected have been brought forward, the sections on Distribution, the Philosophy of Zoölogy, and the History of Zoölogy have been placed at the end of the book. But, other considerations being thought more important in those cases, the general account of the structure and physiology of animals has been inserted immediately after the introduction, and the section on Craniate Vertebrata before the

* A Text-Book of Zoölogy. By T. Jeffery Parker and William A. Haswell. New York: The Macmillan Company. Pp. 779 and 683. Price, $9.

descriptions of the classes of that division. The chapter on the Philosophy of Zoölogy includes an exposition of the system of evolution, and that on the history a running account of what each student and author has contributed to the subject. A Guide to Modern Zoölogical Literature is given as an appendix.

GENERAL NOTICES.

The object of Professor *Shaler's Outlines of the Earth's History* * is to provide the beginner in the study of the subject with a general account of those actions which can be readily comprehended and which will afford him clear understandings as to the nature of the processes that have made this and the other planetary bodies. Those series of facts have been selected that serve to show the continuous operation of energy. The author believes that the progress of science has been much retarded by the prejudices that have grown out of the idea that the existing condition of the earth is the finished product of forces no longer in action—the "static conception of the earth," as he calls it. A special attempt is made to guard the student against such misconception by presenting clear ideas of successions of events that are caused by forces operating in and on the sphere, of which what relates to the work done by the heat of the sun is the most interesting. The influence upon the history of the earth of the fate of man is also made prominent, and the author has sought to show the way in which geological processes and results are related to ourselves. Lastly, writing for the beginner, Mr. Shaler has avoided going beyond his depth. It is greatly to the advantage of the book that the author commands an easy, flowing style that is an attraction in itself. The first chapter opens as An Introduction to the Study of Nature, which the author insists, in the second chapter—Ways and Means of Studying Nature—should be begun outdoors with familiar objects. Next an account is given of the realm of the stars, and this is followed by a general description of the earth. The chapter on the Atmosphere includes so much more than is indicated by the bare title as to embrace all the work by the air, rain, rivers, lakes, the sea, and the geological work of water. The chapter on Glaciers is also correspondingly comprehensive, and could not be passed by without a notice of the Glacial period and the causes of the peculiar phenomena it afforded. In a similar vein are considered The Work of Underground Water, The Soil, and The Rocks and their Order. Here the length of the story already told compelled the author to stop, without presenting the accounts he had contemplated of the geological ages and the succession of organic life. The book is a full one as to all the subjects it covers.

* Outlines of the Earth's History. A Popular Study in Physiography. By Nathanial Southgate Shaler. New York: D. Appleton and Company. Pp. 417. Price, $1.75.

As in the volume on Aristotle of The Great Educators Series Mr. *Thomas Davidson* tried to give an account of ancient classical and social education, so in the present volume * on *Rousseau* he has endeavored to set forth the nature of modern, romantic, and unsocial education. This education originated with Rousseau. The proper consideration of it involves the necessity of taking Rousseau's life into the review, and this is dwelt upon at considerable length, with the end of showing that his educational structure "rests, not upon any broad and firm foundation of well-generalized and well-sifted experience, but upon the private tastes of an exceptionally capricious and self-conceited nature." Hence Mr. Davidson is moved to say that if his estimate of Rousseau's value as an educator proves disappointing to those who believe in his doctrines, he is more disappointed than they are. In estimating the measure of Rousseau's influence, the author finds that upon religion it was incalculable, "supplementing, and in some ways counteracting, that of Voltaire"; in art and literature, it has been "almost paramount throughout Christendom," and, on the whole, beneficial; in the sphere of economics, "though entirely averse to socialism and anarchism, he was in a large degree the parent of both"; in politics he was the father of democracy;

* Rousseau and Education according to Nature. By Thomas Davidson. New York: Charles Scribner's Sons. Pp. 253. Price, $1.

and in education his influence has "been powerful beyond measure." He may fairly be called the father of modern pedagogy, despite the fact that most of his positive teachings have been rejected. This has been brought about by the stimulus he gave to thought and to the revision of the old theories and methods, to which extent "his work was invaluable."

A comprehensive and instructive book, and, withal, curious and various, is Prof. *Alfred C. Haddon's The Study of Man*,* which forms one of the volumes of G. P. Putnam's Sons' "Science Series." The author, though accomplished in the science, does not offer the work as a treatise on anthropology or its methods, but merely as a collection of samples of the way in which parts of the subject are studied. The book is not intended for students or for scientific experts, but for the amateur and the "intelligent reader." The author's wish has been not merely to interest his readers but to induce them to become workers. Accordingly, being so completely versed in the subject that he is able to do so without abating one jot of scientific accuracy, he divests his style of conventional formalities and, becoming a friendly guide, makes various excursions into the subject, "not with the object of attempting to learn something about anthropology, not for the erection of an academic study, but for the simple purpose of explaining ourselves to ourselves. Our immediate object, then, is to try and discover what the immediate significance is of certain of our bodily peculiarities, and of a few of the innumerable objects and actions that we see around us" The theory of evolution throws a bright and far-reaching light on the problems of anthropology; and though we may not be able to explain the processes of or the reasons for evolution, there can be no doubt as to the fact of its occurrence. The vast importance of the study of children is recognized. From the nursery we are taken by the author to the school and the playground, endeavoring to discover in them evidence as to the direction of man's upward progress. Then reference is made to primitive survivals in child life, showing the persistence of savage psychological habit in children, and of savage and barbaric practice in their singing games. Other vestiges of the evolutionary progress are found in the backward people among ourselves. These features, after the discussion of the general subject and of the facts given by physical measurements, mark the general outline of the author's treatment. As special features and illustrations, we have chapters, highly suggestive, on the evolution of the cart, the Irish jaunting-car, toys and games, cat's cradle and kites, tops and the tug-of-war, the bull-roarer, the singing games of children, courting, funeral, and other games, showing how these severally embody in themselves the history of steps in man's advance from savagery up. The last chapter embodies practical suggestions for conducting ethnological investigations in the British Islands.

For several years much interest has been taken in American schools by British and Canadian educationists. Ontario has repeatedly found it profitable during the past twenty-five years to take notice of the school work done in many of the neighboring States; and our educational men have frequently been invited to address conventions of teachers in the province. In furtherance of the acquaintance thus sought, the author of this book * visited various places in New York for the purpose of gaining a knowledge of the schools of the State, and also studied the methods of some of the more important centers. Besides reporting what he saw of the work of the normal schools, high schools, manual training schools, and kindergartens, he has thought it well to combine with that object some description of the educational system under which they are conducted. The author thinks that no part of the republic presents a more valuable study to one interested in education than New York, and that no other part of the Union has made so much progress in education within the past dozen years. Yet the Canadians generally, and some others, regard their system

* The Study of Man. By Prof. Alfred C. Haddon. New York: G. P. Putnam's Sons. London: Bliss, Sands & Co., pp. 410.

* The School System of the State of New York (as viewed by a Canadian), Prepared under the Authority of the Honorable the Minister of Education, as an Appendix to his Report. By John Millar, Deputy Minister of Education. Toronto: Warwick Brothers & Rutter. Pp. 304.

of education as, upon the whole, superior to the system which prevails in any one of the States. But the educational methods of both countries are closely associated with features of their political systems; and "neither the United States nor Canada can adopt, without radical changes of another kind, some of the admirable features of the educational system which exists on the opposite side of the international boundary line."

The office of education is, according to Dr. Harris,* "to bring the child most expeditiously into a correct understanding of his relation to the race and into a helpful activity within civilization. The school with its various courses furnishes only one factor in this process; the institutions of family, church, and state, art and religion, play and work, each help in the development. The study of this mental unfolding and the influence of each modifying force is one of the provinces of psychology and one of great value to the educator. But of more importance to him than any theory of growth or classification of faculties is the profounder task accomplished by this science "in showing the ability of the mind to grasp ultimate reality." The old and new psychologies are sharply distinguished in methods and results. The former, whether rational or empirical, proceeds by introspection, and finds an independent self-activity with three modes of knowing: that of *sense perception*, which dwells upon things as realities; the *understanding*, which investigates relations; the *reason*, or insight, which apprehends absolute principles. The "new psychology," including physiological investigation and child study, exhibits the conditioning of man. As the old philosophies teach him what he is and should be, the new explain how he may grow to his full stature. There is also the dangerous possibility of arrested development, which further experiment may show him how to avoid. Too much memorizing or calculating at an early age brings the child into a rut of thought from which it is not easily extricated. Even scientific study may accomplish this by sharpening the mind to notice mere likeness or difference, and to search for causal relations. The new psychology has this field of research, and can also instruct in regard to the care of the nervous system, and give us a store of pathological knowledge, but Dr. Harris considers it "safe to assert that no positive results in pure psychology will ever be reached in its laboratories." It is by means of introspection alone that we arrive at the highest stage of thinking, *θεωρεῖν*, philosophic or theologic knowing. The old psychology thus attains the ideas of God, freedom, and immortality, "knows that the absolute is a person," and furnishes ideals of education, religion, and life. Unfortunately for the majority of scientific people, they flounder in the quagmire of the understanding and never reach the height of "angelic knowing." Isaac Newton is called the great schoolmaster in this secondary stage of thinking, which is exemplified in later times by the doctrine of the correlation of forces. Mr. Herbert Spencer, following the lead of Mansell and Sir William Hamilton, is dragged down by his theory of the relativity of knowledge and inconceivability of the infinite into an abyss of false psychology. Dr. Harris states that the trouble is "the confusion of mental images with logical thought." Agnostics, relativists, and all others must agree with him, "if we really can know the infinity of space and time and the absoluteness implied in causality, it is a matter of great concern." In his doctrine of persistent force, Mr. Spencer attains almost to the stage of insight, "it is the highest reach of the understanding, and a logical investigation would prove that Personal Being is presupposed as its true form. It is another phase of the negative unity of Spinoza and the Eleatics, and to fully realize it is to know its own futility." Among other conclusions which are doubtless reached through the higher knowing are the affirmations that man has "two selves," "is a spiritual being existing *in opposition to Nature*," "fate rules in Nature, but man emerges out of Nature in time and space into human nature," "human society is founded on the deep mystery of vicarious atonement which is announced in the creeds of Christendom." If these and similar dogmas prove difficult for the scientific mind to assimilate, it is not without warning from Dr. Harris. He tells us that methods of science study have not a

* Psychologic Foundations of Education. By W. T. Harris, A. M., LL. D. New York: D. Appleton and Company. Pp. 400. Price, $1.50.

spiritualizing tendency, and that the analytic stage of mind holds itself back determinedly from thinking the totality. In more metaphysical language, we are content with the category of *otherness*. In somewhat fatalistic fashion he predicts for us: "Renounce teleology and you find nothing but teleology in everything. Renounce introspection, and you are to find introspection the fundamental moving principle of all Nature." It is, however, just to say that the book is a strong, consistent exposition of the *a priori* philosophy and its applications, and has the saving grace of compelling its opponents to examine the ground whereon they stand.

The author of the *Story of Photography* * has high hopes for the future of photography and its capacity for continued development and production, and writes with the enthusiasm which they inspire within him. He specially seeks to present the subject in the light of a fine art and as a source of æsthetic and refined enjoyment—"not so much with the object of producing a manual to teach photography as an art, but, while giving due weight to that side of the subject, to present it in its most scientific aspects." The order of arrangement of the topics is largely historical. In the detail of "the first steps toward photography," the earliest hints perceived by experimenters of the power of the sun to produce pictures are recorded. Then the steps are followed by which the art became real, and its development, with accounts of modern processes and inventions—printing presses, color photography, the Telegraph and Photography, and Photography and Art, of which the author says in conclusion that the one who takes up the combined science and art with the motto "All that there is in it or nothing," "will find but little cause to complain of the limitations, in view of the almost boundless possibilities of photography."

In *La Culture des Mers en Europe* † (The Cultivation of the Seas in Europe), by *Georges Roché*, inspector general of maritime fisheries, the several branches of the propagation of fishes and oysters and the development of fisheries are treated, under the heads of piscifacture, or propagation, pisciculture, and ostreiculture. While not assuming to write a work on aquiculture, as he calls it, the author endeavors to instruct his readers concerning the working of maritime industries and the technics of the methods of fish and oyster culture. He first explains the modern methods of fishing and their results as applied to the European seas; then the methods of propagation and cultivation practiced in different countries and experiments in the reproduction of lobsters and crabs; the development of oyster culture in France since the natural supply became insufficient; and, in the last chapter, the cultivation of sponges.

The third volume of the *Illustrated Flora of the Northern United States, Canada, and the British Possessions* * completes a work of the very highest value to American students. The number of species figured in the whole work is 4,162, comprising 177 families and 1,103 genera. Eighty-one of these species, being new determinations or new discoveries made while the book was going through the press, and too late for insertion in their proper places, are figured in the appendix. A conservative course has been pursued as to the admission of new species, and only those are inserted that have passed the test of continuous observation. It has nevertheless been thought better to err in the direction of illustrating too many forms rather than in giving too few. A general key of the orders and families is placed at the beginning of the volume, preceded by a table of abbreviations of the names of the botanical authors cited. A glossary of the botanical terms used is added. The orders are not described in the work itself, but their principal distinguishing characters are given in the key. The authors are sturdy advocates of the

* The Story of Photography. By Alfred T. Story. New York: D. Appleton and Company (Library of Useful Stories). Pp. 165. Price, 40 cents.

† La Culture des Mers en Europe. Piscifacture, Pisciculture, Ostreiculture. By Georges Roché. Paris: Félix Alcan.

* An Illustrated Flora of the United States, Canada, and the British Possessions; from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the One Hundred and Second Meridian. By Nathaniel Lord Britton and the Hon. Addison Brown. In three volumes. Vol. III, Apocynaceæ to Compositæ—Dogbane to Thistle. New York: Charles Scribner's Sons. Pp. 588. Price, $3 net.

recognition and the use, in ordinary talk and work, of the English names, and a list of all the popular names of plants belonging to our area, so far as they could be obtained, compiled by Judge Brown, is given in the general English index. A considerable number of the popular names occur in the text, in connection with the leading English names, or in the notes; and several thousand others, which could not appear in the text, are given in the index in Italics. The authors believe that no similar compilation of American plant names has ever been published.

The American Agriculturist Yearbook and Almanac for 1898 is the third number of that publication, the plan of which is to make each annual volume valuable of itself, and properly supplementary of its predecessors. It proposes to be a cyclopædia of events, a market guide, a treasury of statistics, and a reference work on subjects of timely interest. The present number contains, first, almanac matter, general notes, and agricultural miscellany; an article on Our own Country and Government, with notices of all the States and portraits of their governors; Our Neighbors North and South of Us (Canada, Mexico, and North and South America); The Great Problems of 1898 (a summary of the present condition of important questions and interests); For the Whole Family (in which a variety of useful or curious things are considered); The Agriculturist's Guide, Commercial Agriculture, Irrigation, Lumber and Forestry, and a number of miscellaneous paragraphs. (Orange Judd Company, New York. Price, 50 cents.)

Part XII, March 7, 1898, of *Minnesota Botanical Studies*, *Conway MacMillan*, State Botanist, embraces the title-page and tables of contents and the index of a series of original, most competent, and highly valuable and interesting studies of plant phenomena published as Bulletin No. 9 of the Geology and Natural History of the State, and forming a volume of 1081 pages.

Much interesting information is well packed in a small space in Prof. *Sydney J. Hickson's Story of Life in the Seas* (D. Appleton and Company's Library of Useful Stories; price, 40 cents). Without presuming to treat in full any of the aspects in which marine life may be regarded, the author's purpose has been only to give a sketch of some of the most important lines of scientific researches pursued by zoölogists in many parts of the world; to compress into small compass and describe in language intelligible to the laity discoveries of the deepest interest which are in many cases described in books and periodicals that do not come within reach of the general public. The first chapter relates the progress and describes the more prominent facts of oceanography. The succeeding chapters are given to accounts of shallow-water fauna, the shallow-water fauna of the tropics, invertebrate and vertebrate surface-swimming fauna, deep-sea fauna (in which many new and remarkable discoveries are recorded), commensalism and parasitism; and in the final chapter the origin of the marine fauna is considered and the reasons are mentioned for supposing that life originated in the sea.

Prof. *Dean C. Worcester*, of the University of Michigan, and *Frank A. Bourns* publish in the Proceedings of the United States National Museum lists of the birds that inhabit the Philippine and Palawan Islands, which show their distribution within the limits of the two groups.

The investigations and explorations connected with the Hopkins Seaside Laboratory, adjunct to the Biological Laboratory of Leland Stanford Junior University, have been carried on by means of assistance given by Mr. Timothy Hopkins, of Menlo Park, Cal. The tenth memoir of this series is a paper on *Scientific Names of Greek and Latin Derivation*, prepared by Prof. *Walter Miller*, and furnishing rules and hints to aid in giving such names an etymologically correct shaping. The memoirs are published as a part of the proceedings of the California Academy of Sciences.

The *Centralization of Administration in New York State* is a valuable political study contributed by *John Archibald Fairlie* to series of Studies in History, Economics, and Public Law of Columbia University. It shows how power, all centralized in the hands of the Governor in the early history of the country, was gradually taken away from him during the seventeenth and eighteenth centuries, when the towns gained a practical independence in local affairs, recognized under

English rule by the Duke of York's laws; the cities of New York and Albany received a large degree of autonomy; the creation of an elected county authority immediately followed the establishment of a legislature in 1691; and the powers of the legislature and the county supervisors were both increased at the expense of the central executive during the next one hundred years. This power seems to have reached its culmination in the Constitution of 1821, after which an isolated movement or two in the reverse direction may be perceived, the beginning of a tendency that became more evident about the middle of the century. Since then the return toward centralization has become more and more marked and rapid, and has now gained great force, the tendency toward State control and direct State administration being accompanied by a marked development of what may be called local centralization. Mr. Fairlie's paper is a careful study of the causes and influences that have contributed to this later movement.

The fifteenth volume of the *Transactions of the Kansas Academy of Science* contains the minutes of the twenty-eighth and twenty-ninth annual meetings, 1895, 1896, with eight of the papers read at the former meeting, and a considerably larger number of those read at the latter. In all, forty-two papers were read at the twenty-eighth annual meeting, and forty at the twenty-ninth. Measures have been taken by the academy for the publication of scientific monographs on the resources of the State.

The *Bibliography of the Metals of the Platinum Group* (platinum, palladium, iridium, rhodium, osmium, and ruthenium), 1748–1896, prepared by Prof. *J. Lewis Howe*, was recommended to the Smithsonian Institution for publication by the American Association's committee for indexing chemical literature. The compiler has tried to make the record of the chemistry of the metals in question as complete as possible, and it is believed that few references of importance are omitted.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Colorado State Agricultural College: No. 47. Colorado's Worst Insect Pests and their Remedies. By C. P. Gillette. Pp. 64, with plates.—Cornell University: No. 148. The Quince Curculio. By M. V. Slingerland. Pp. 24.—Delaware College: No. 40. Soil Bacteria in their Relation to Agriculture. Part I. By F. D. Chester. Pp. 16.—Michigan State Agricultural College: No. 159. A Study of Normal Temperatures and the Tuberculin Test. By C. E. Marshall. Pp. 52; No. 160. Some Insects of the Year 1897. By R. R. Pettit. Pp. 40; No. 161. Fertilizer Analyses. By R. C. Kedzie. Pp. 20.—Michigan Bureau of Vital Statistics: June and July, 1898. Pp. 20 each.—Ohio: No. 93. The Home Mixing of Fertilizers. By C. E. Thorne. Pp 20.—Purdue University: No. 70. The Relation of Water Supply to Animal Diseases. By A. W. Bilting. Pp. 12; No. 71. Corn Meal and Shorts and Skim Milk as Food (for Pigs and Young Growing Chickens). By E. S. Flume and W. B. Anderson. Pp. 10; Commercial Fertilizers. Special Bulletin. By H. A. Huston. Pp. 8.—United States Department of Agriculture: Flax Culture for Seed and Fiber in Europe and America. By C. R. Dodge. Pp. 80.

Andrews, Charles M. The Historical Development of Modern Europe. From the Congress of Vienna to the Present Time. New York: G. P. Putnam's Sons. Pp. 467. $2.50.

Binet, Alfred; Ribot, Th.; and others, Editors. L'Année Psychologique (The Psychological Annual). Fourth year. Paris: Schleicher Frères. Pp. 849. 15 francs ($3).

Bulletins, Proceedings, Reports, etc. American Chemical Society: Journal, August, 1898. Pp. about 100. $5 a year.—Association of American Anatomists: Proceedings of the Tenth Annual Session, December, 1897. Pp. 142.—Iowa, State University of: Laboratories of Natural History. Three papers. Pp. 84, with plates.—New York State College of Forestry, Cornell University: Announcement, 1898–'99. Pp 40.—Ohio State University: College of Agriculture and Domestic Sciences, 1898–'99. Pp. 16.—United States Civil Service Commission: Fourteenth Annual Report, 1896–'97. Pp. 562.—University of Upsala, Sweden: Bulletin of the Geological Institution. Edited by Hj. Sjögnen. Vol. III. Part II. Pp. 144.—Wisconsin Geological and Agricultural Survey: On the Forestry Conditions of Northern Wisconsin. By Filibert Roth. Pp. 84, with map.

Collins, G. S., Editor. Selections from Jean Paul Friedrich Richter, with Notes. American Book Company. Pp. 163. 60 cents.

Davis, H. M. The Rutherfurd Photographic Measures of Sixty-five Stars near 61 Cygni; Parallaxes of 61[1] and 62[2] Cygni; Thirty-four Stars near "Bradley 3077." Pp. 132. Women Astronomers, Pp. 32.

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Hoffman, F. S. The Sphere of Science. A Study of the Nature and Method of Scientific Investigation. New York: G. P. Putnam's Sons. Pp. 168. $1.

Lyte, E. O. Elementary English. Pp. 160. 35 cents. Elements of Grammar and Composition. Pp. 224. 50 cents.

Peckham, G. W., and Elizabeth C. On the Instincts and Habits of the Solitary Wasps. Wisconsin Geological and Natural History Survey. Pp. 245, with plates.

Quinn, Rev. D. A. Stenotypy; or, Shorthand for the Typewriter. Providence, R. I.: American Book Exchange.

Reprints. Calvert, P. F.: The Adonate Genus Macrothemis and its Allies. (Boston Society of Natural History.) Pp. 32, with plates.—Herman, Nathan, M. D.: Hypnotism in General Practice. (Maryland Medical Journal.) Pp. 5.—Hyatt, Alpheus: Report as Curator of the Boston Society of Natural History. Pp 26.—Minot, C. S.: On the Veins of the Wolffian Bodies in the Pig. (Boston Society of Natural History.) Pp. 12, with plates.—Storer, F. H.: Bussey Institution. Laboratory Notes and On the Systematic Destruction of Woodchucks. Pp. 16—Wadsworth, M. E., Houghton, Mich.: The Mechanical Action of the Divining Rod. P. 1.

Sheerin, Robert, M. D., Editor. The Suggester and Thinker. Monthly. Vol. I, No. 1. July, 1898. Cleveland, Ohio. Suggester and Thinker Company. Pp. 30. 10 cents; $1 a year.

Smithsonian Miscellaneous Collections. No. 1076. A Catalogue of Scientific and Technical Periodicals. 1665 to 1895. Together with Chronological Tables and a Library Check List By H. C. Bolton. Second edition. Pp. 1247.—An Investigation of the Influence of Impure Atmosphere on the Resistance of Animals to the Organisms of Disease. By D. H. Bergey, M. D. Pp. 10. —Contributions to Knowledge. Ratio of Specific Heats at Constant Pressure and Constant Volume for Air, Oxygen, Carbon Dioxide, and Hydrogen. By O. Lummer and E. Pringsheim. Pp. 29.

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Vocke, William. The Relations of the People of the United States to the English and the Germans. Pp. 20.

Von Nägelli, Carl. A Mechanico-Physiological Theory of Organic Evolution. Summary. Chicago: The Open Court Publishing Company. (Religion of Science Library.) Pp. 53.

Wilson, Woodrow. The State. Elements of Historical and Practical Politics. Revised edition. Boston: D. C. Heath & Co. Pp. 656. $2.

Fragments of Science.

Growth of Astronomical Photography.—Reviewing the history of astronomical photography in his address as vice president before the Astronomical and Mathematical Section of the American Association, Prof. E. E. Barnard credited the inception of the idea to the Rev. Thomas Dick, author of a series of astronomical works formerly much read, who, shortly after Daguerre's discovery was announced, speculated upon the practicability of applying it to the moon; thought the planets would prove easy subjects to the new process, and that something might perhaps be discovered about the nebulæ; and suggested that objects not visible to the eye might be found depicted on the plates. While much excellent photographic work has been done on the nebulæ, the photography of the planets seems to-day no nearer realization than in Dr. Dick's time. In 1839, Arago addressed the French Academy on the subject of photographing the skies, and within a year from that time Dr. Draper, in New York, had succeeded in getting a picture of the moon. Five years later Harvard College began its photographic work, and pictures of the moon were secured with the fifteen-inch equatorial. Since then this work has made great advances, to which American investigators have contributed materially. The completion of the Lick Observatory marked a decided advance in study. In photographic work on the sun, detail on the surface was first sought; the prominences next became objects of examination, and the corona was then taken up. With the application of the dry plate, students have gone back to detail on the surface and within the sun spots. A most important branch of investigation is that of stellar photography, which dates from 1882, when the astonishing number of stars shown on Dr. Gill's photograph of a comet at the Cape of Good Hope attracted attention. The work has been taken up with energy by many observatories, and most excellent results have been accomplished.

Officers of the American Association.—The Council of the American Association for the Advancement of Science chose Prof. Edward Orton, State Geologist of Ohio, and President of Ohio State University, to be president of the association for 1899, and Columbus, Ohio, as the place of the meeting. The following other officers, and sectional vice-presidents and secretaries, were chosen: General Secretary, F. Bedell. Secretary of the Council, Charles Baskerville. Treasurer, R. S. Woodward. Vice-Presidents: Section A, Alexander MacFarlane; Section B, Elihu Thomson; Section C, F. P. Venable; Section D, Storm Bull; Section E, J. F. Whiteaves; Section F, Simon H. Gage; Section G, Charles R. Barnes; Section H, Thomas Wilson; Section I, Marcus Benjamin. Secretaries: Section A, John F. Hayford; Section B, William Hallock; Section C, H. A. Weber; Section D, James M. Porter; Section E, Arthur Hollick; Section

F, Frederick W. True; Section G, W. A. Hellerman; Section H, George A. Dorsey; Section I, Calvin M. Woodward.

New Elements.—Prof. Charles F. Brush, in a preliminary paper read to the American Association, described a new atmospheric gas which he discovered while examining glass for occluded hydrogen, and has found absorbed in many substances. It has been partially separated from air by diffusion. The chief characteristic of this gas thus far experimentally determined is enormous heat conductivity at low pressure. Even when mixed with a large excess of other gases, its heat conductivity is about a hundred times that of hydrogen, and this will probably be increased many times when it is obtained pure. Taking the heat conductivity at this figure—a very moderate estimate—the mean molecular velocity of the new gas is calculated to be more than a hundred miles a second, and its density only a thousandth part that of hydrogen, while the specific heat is found to be six thousand times greater than that of hydrogen. A gas having attributes anything like these could not possibly be confined to the earth's atmosphere; hence the new gas probably extends indefinitely into space, and constitutes an interstellar atmosphere. In recognition of this probability, Professor Brush has named it etherion. Professor Nasini, of Padua, and two associates report that in studying the gases emanating from the earth in various parts of Italy, with the object of detecting the presence of argon, helium, etc., they have discovered in the spectrum of the gases of the Solfatara di Pozzuoli, along with other lines deserving investigation, a fairly bright line corresponding with that of (solar) corona 1474 K, attributed to coronium, an element not previously discovered on the earth, and which should be lighter than hydrogen.

A Paradise for Wild Animals.—During the last four years, the London Spectator tells us, the Duke of Bedford has carried out a scheme of animal acclimatization in the park at Woburn Abbey never before attempted in England. "Birds as well as quadrupeds are the subjects of this experiment. . . . But the greater number of the animals are various kinds of deer, of which no fewer than thirty-one species are in the open park or paddocks, bisons, zebras, antelopes, wild sheep and goats, and yaks. The novelty and freshness of this experiment consist not only in the accumulation of such a number of species, interesting as this is to the naturalist, but in their way of life, free and unmolested in an English park. That is the lot of the greater number of the animals at Woburn, some being entirely free and roaming at large, like the native red deer and fallow deer, while the others, though for the present in separate inclosures, are kept in 'reserves' so spacious and so lightly though effectively separated that they have the appearance of enjoying the same degree of liberty." The general effect on the view of this gathering of animals from all quarters of the earth on the green pastures and under the elms and oaks round the home of a great English family is described as being magnificent. "During the journey back by train through Bedfordshire and Buckinghamshire, the valleys and meadows stocked with our ordinary domestic animals seem solitary and deserted after the eye has rested for hours on the varied and impressive forms that crowd the slopes, groves, and glades of this glorious park. This effect is due in part to the largeness of the scale on which the stocking of Woburn with wild animals has been carried out. In the phrase of the farmer, the park 'carries a larger head' of animals than is commonly seen on a similar area, even in the richest pastures. The scene recalls the descriptions of the early travelers in southern Africa, when the large fauna roamed there in unbroken numbers and with little fear of man. . . . From one position, looking up a long green slope toward the abbey, there could be seen at the time of the writer's last visit between two and three hundred animals, both birds and beasts, feeding or sleeping within sight of the immediate front of the spectators. These varied in species from cranes, storks, and almost every known species of swan, to wapiti stags, antelopes, and zebras, walking, sitting, galloping, feeding, or sleeping. For quite half a mile up the slope the white swan and other wild fowl were dotted among the deer and other ruminants, presenting a strange and most attractive example of the real 'paradise' which animals will make for themselves when only the 'good beasts' are selected to lie together."

Play and Development.—In a paper on play as a factor in development, published in the American Physical Review for December, 1897, George A. Fitz, of Harvard University, places himself upon the theory now generally accepted by those who have given the most careful study of the subject, that play is simply the most important means Nature has of preparing her children for their life work. "We can readily see how this has come about. The animals which played were able to make a better fight for existence, hence survived, and fixed in their progeny the desire to play as an instinct. Play is not merely the result of the accidental desires of the individual; it is a result of that natural selection which demands everything serviceable to the preservation of the species. Thus youth becomes more completely an apprenticeship to life, with play as the master workman. All of Nature's children play and are thereby prepared to live; not playing, they die. Granting, then, that play is one of the most powerful instincts in animal life, let us study its more intimate relations to human life. How does the child who plays vigorously and spontaneously differ from the child who plays under close restriction or not at all? . . . He is born with an inherited tendency to grow into the adult form, but this inherited force toward development is not sufficiently strong to produce unassisted more than a mimicry of the best adult form, mental or physical. The great law of development is the law of use. No organ or tissue, no power of muscle or brain, can be fully developed except through use, through effort. In the play of young animals we find all the conditions of use necessary for their highest development. In the spontaneous play of the child with unrestricted opportunities, we find again the conditions of use for all the tissues fully satisfied." Further than this, the child is habituated to make rapid judgments in the presence of ever-changing relations; there is probably no factor so potent in the balance of the nervous system; in its psychic effects it gives a complete psycho-physiological picture of pleasure. "In play, the child is the unit of force; he initiates his own conditions. His limitations are self-imposed. His self-control lies in execution rather than inhibition. He is concerned with self expression rather than with self-repression. Play thus relates itself to the truest conception of education, the development of power, the power of the individual to act as a self-directed unit in civilization. The self-control gained by play acts immediately, strongly, and honestly in response to conditions as they are presented in life."

The Place of Plant Physiology.—Plant physiology, as briefly defined by Prof. D. T. MacDougal, is concerned with the fundamental properties of the protoplasm of plants, and the functions of the organisms into which it is formed. It therefore includes the consideration of all reactions of growth, movement, metabolism, changes in form, instability, and other phenomena resulting from the activity of forces internal to the plant. It merges into morphology on one side, and partly underlies oölogy on the other, and with bacteriology and mycology forms the basis of the study of pathology. Physiology and chemistry join in the consideration of the chemical activities and products of the organism, and the principles of physics are involved in the investigation of the plant machine. It is too often slighted in schools by being made a text-book and routine study. "A systematic survey reveals the fact that, instead of a complete and thorough plotting of the great field of physiology, we have made here and there a few simple trails through the dense jungle of ungrouped and vaguely defined principles, and the greater part of the work is yet to be accomplished. The fundamental problem of the constitution of living matter still confronts us." We have not yet succeeded in interpreting clearly even the cruder visible phenomena of the cell. The interprotoplastic threads have so far received no conclusive interpretation. Numerous problems relating to nutrition wait for solution—the relations of chlorophyll, of the nitro-bacteria, the acquisition of nitrogen, the balance and combined action of the mineral elements in the soil, the formation and work of the alkaloids, glucosides, pigments, and other compounds in the plant, and the ascent of sap, are only a part of the subjects concerning which we are still in the dark. It is becoming more and more evident that molecular features of growth, and the relation of this process to correlative forces and those of the environment, are hardly at all determined.

United States Railway Statistics.—Advance sheets of the Tenth Statistical Report of the Interstate Commerce Commission are authority for the following statistics: The total railway mileage in the United States on June 30, 1897, was 184,428.47 miles, there being an increase of 1,651.84 miles, or 0 90 per cent, during the year. The total number of locomotives in service on June 30, 1897, was 35,986, the increase in number as compared with the preceding year being 36. The gross earnings of the railways of the United States for the year ending June 30, 1897, as reported for an operated mileage of 183,284.25, were $1,122,089,773. In comparison with the preceding year this amount shows a decrease in gross earnings of $28,079,603. The number of men employed by the railways of the United States on June 30, 1897, as reported, was 823,476. A comparative summary is presented in the report of the average daily compensation of the different classes of employees for the years 1892 to 1897. Another summary is given in the report which shows the total amount of compensation reported as paid to railway employees during the fiscal years 1895 to 1897. It covers the compensation of over 99 per cent of railway employees for the several years. Regarding the year ending June 30, 1897, it appears that the aggregate amount of wages and salaries paid was $465,601,581. This amount represents 61.87 per cent of the total operating expenses of railways, or $2,540 per mile of line. The total compensation for 1896 was $3,222,950 greater. The total number of casualties to persons on account of railway accidents for the year ending June 30, 1897, was 43,168. Of these casualties 6,437 resulted in death, and 36,731 in injuries of varying character. Of railway employees, 1,693 were killed and 27,667 were injured during the year. The total number of passengers killed during the year under review was 222; injured, 2,795. Ninety-three passengers were killed and 1,011 injured in consequence of collisions and derailments. Other than employees and passengers the total number of persons killed was 4,522; injured, 6,269. Included in these figures are casualties to persons classed as trespassers, of whom 3,919 were killed and 4,732 were injured. From summaries showing the ratio of casualties, it appears that 1 out of every 486 employees was killed and 1 out of every 30 employees was injured during the year. With respect to train men, including engine men, firemen, conductors, and other train men, it appears that 1 was killed for every 165 employed, and 1 injured for every 12 employed. One passenger was killed for every 2,204,708 carried, and 1 injured for every 175,115 carried. Basing ratios upon the number of miles traveled, it appears that 55,211,440 passenger miles were accomplished for each passenger killed, and 4,385,309 passenger miles for each passenger injured.

Remains at Carnac, Brittany.—The name of Carnac in Brittany, the site of one of the most famous megalithic monuments in the world, is Breton for "the place of the cairn." As it is described by Mr. T. Cato Worsfold, just outside the town is a tumulus twenty-five feet high, evidently artificial, and surmounted with a grove of trees. This mound was excavated a few years ago; the first remains come to were Roman; then, deeper down, Celtic pottery, etc, were found, and finally flint and granite arrowheads and celts, the finds reminding one of the hill of Hissarlik, with its layers of deposits. Close alongside the mound have been found the remains of a Roman villa, with hypocaust, etc., as usual, the owner of which, living about eighteen hundred years ago, must have been an archæologist, as some flint arrowheads, celts, and prehistoric pottery were found carefully placed on shelves in one of the rooms excavated. The megalithic monuments consist of numbers of great monoliths, from twelve feet to twenty-five feet in height, dolmens, or "table stones," great flat stones laid on a number of small menhirs and forming a chamber; and the alignments or rows—eleven in number and about two miles in length—of monoliths running from west to east, and terminating in a quaint chamber at the east end. The alignments—in three divisions, meaning severally the place of incineration, the place of mourning, and the place of the dead—consist of menhirs from two feet to twenty feet high, are sepulchral, and are evidently the work of the same race that built Avebury and Stonehenge, though data as to the time are wanting. Stonehenge is obviously the latest of the three, for the stones there are hewn out and fashioned with mortise blocks, etc., while Avebury and Carnac are rough and unhewn.

Coal-Mine Acids in the Schuylkill River.—It is shown in a paper by Prof. O. C. S. Carter that the Schuylkill River, above the city of Reading, is so strongly charged with sulphuric acid and sulphate of iron that it can not be used as a water supply, or, on account of its corroding boilers, for the generation of steam, and is very detrimental to fish, so that there are practically none in the river between Reading and Tamaqua. The acidity of the river is due to impurities found in coal. Before coal was mined in Pennsylvania the river, it is said, was free from acidity from its mouth to its source, and fish were found along its entire course. It is also said that the amount of acid in the Big Schuylkill from Pottsville and beyond has been decreasing since 1868, owing to the transfer of mining operations to the other side of the mountains, where the streams drain into the Susquehanna, and that the amount of sulphuric acid in the Big Schuylkill in 1885 was only one half of what it had formerly been. These statements can not be strictly verified for want of means of making comparative analyses, but are taken as true. Thanks to the decrease of acid, a few hardy catfish have found their way up to the region between Port Clinton and Pottsville, but no other fish; but even the catfish are not found in the river lower down, between Port Clinton and Reading, because of the discharge of acid waters by the Little Schuylkill at Port Clinton. The water loses its acid character in the vicinity of Reading, and neutralization is complete a short distance below. This is brought about by the pouring in of the hard, limestone waters of Maiden and Tulpehocken Creeks near Reading. At the mouths of these streams the sulphate of lime is precipitated by their action, rendering the water almost milky in appearance. In 1882, when a number of abandoned coal mines were opened and the excess of acid water was pumped into the river, there was more of it than the limestone streams could neutralize in the dry season; it passed far below the city of Reading, and hundreds of dead fish were observed floating in the river.

An Endless Source of Carbonic Acid.—Prof. E. W. Claypole's president's address at the last meeting of the American Microscopical Society—Microscopical Light in Geological Darkness—concerns the aid furnished by the microscope in geological study. Among the revelations afforded by means of this instrument is that which it has yielded, in the hands of Mr. H. C. Sorby, of Sheffield, England, of the existence of innumerable inclusions of liquid carbonic acid in the rocks. As investigation has gone on, the abundance of these bubbles has been more and more realized, and they are now found to be present "by myriads and by millions, and not in gems only, but in other crystalline minerals. In size they range between the one-thousandth and the fifty-thousandth of an inch, but they are so multitudinous as often to impart a white tint to the crystal, and many specimens of milky quartz owe their whiteness solely to the presence of these innumerable bubbles. In some of the Cornish granites the cavities make five per cent of the volume, and yield four pounds of the liquid to every ton of the rock." Mr. J. C. Ward is quoted as saying that more than a thousand millions of them might be contained easily within a cubic inch of quartz. The fact is used to cast light on the problem of the origin of the coal. Coal is derived from plants, which have extracted carbon from the carbonic acid of the atmosphere. Whence was that carbonic acid derived? It has been said that it was one of the original constituents of the atmosphere. But Professor Claypole adduces many reasons to show that all the carbonic acid represented in the coal beds could never have been in the atmosphere at one time. How, then, and whence, were the successive supplies introduced? Besides Mr. Sorby's experiments, those of Professor Tilden and others show that rocks of various kinds and in various localities yield gases, of which hydrogen and carbonic acid are the most abundant, in proportions ranging from 1.3 to 17.8 of the bulk of the rock, whence it may be inferred that these gases are occluded in most rocks. Now, immense volumes of the primary rocks have been worn away by the action of water, and have furnished the material from which the sedimentary rocks are derived. This washing away has involved the breaking open of the minute reservoirs of carbonic acid, and it has gone into the atmosphere, not all at once, but gradually, so as to furnish a continuous, not excessive supply. A brief calculation presented by Professor Claypole makes it evident that the rocks would thus furnish an abundant supply, and to spare, for all the coal that is known to exist.

The Houses of Saga Times.—The construction of the dwelling houses of Saga time —A. D. 875 to 1025—has been studied in Iceland by Dr. Valtyr Gudmundsson and Thorstein Erlingsson in co-operation with Miss Cornelia Horsford, by Lieutenant Daniel Brunn, and by the Icelandic Antiquarian Society; and in Greenland by the Danish Government. The ruins of the house believed to have been built by Erik the Red, in Hawk River Valley, Iceland, and in which Leif Eriksen was probably born, as well as the ruins of other similar houses, when undisturbed, are low, grass-grown ridges and hollows, often difficult to detect, except when stones protrude through the turf. A dwelling usually consisted of three apartments—a hall or principal room, in which there was always a fireplace; a sitting room for the women, and a storeroom or pantry. These apartments were like small houses, each with a separate roof, but attached to each other with passages through the thick walls. Near by were usually one or more outhouses. The dwellings were built on the surface of the ground; the floor was of finely beaten earth. The walls were about five feet thick, and somewhat higher. The inner side was built of unhewn stones, and the interstices were filled with earth. The outer side was of alternate layers of turf and stone, and the space between the two sides was filled in with earth kneaded hard. Often, however, the walls were built entirely of layers of turf or with only disconnected rows of stones at the base. A long, narrow fireplace usually extended through the middle of the room, and was either paved or surrounded with stones standing on edge. Besides the long fire, which served to warm and light the hall, there was a small cooking fire made in the same way. The Greenland houses resembled those of Iceland, but the walls were narrower, straighter, and stronger. The dwellings were usually long and narrow, consisting of from three to eight rooms, and were surrounded by outhouses and stables for cattle, sheep, and goats; and close to them are found enormous midden heaps. A ruin is described by Miss Horsford as existing near Cambridge, Mass., bearing marks of similar construction, and is attributed by her probably to Thorfinn Karlsefin's men; and another one, ten miles or more from the settlement at Cambridge, is supposed to be of later date. Very few relics were found in the Iceland houses, but more in those of Greenland—iron nails and knives, pieces of stone vessels, spinning stones, bone combs, and stone pendants bored with holes and incised with runelike but illegible characters.

Mr. Bandelier's Explorations. — The archæological researches of Mr. Adolphe F. Bandelier in Peru and Bolivia for about six years were prosecuted at first through the liberality of Mr. Henry Villard, but since 1894 under the auspices of the American Museum of Natural History. From a very cursory summary of his work given in the American Archæologist by F. W. Hodge, it appears that from almost the moment of his arrival at Lima he observed, even in the immediate vicinity of the city, a wealth of archæological material. It was found, however, that the number of ruins was indicative of successive rather than contemporaneous occupancy. The detailed survey of the ruins proves that the cities they represent did not by any means harbor the numbers of inhabitants they have been usually believed to have contained. They were not compactly built cities, but included cultivated lots and fields occupying the greater proportion of the space. The buildings were of adobe and stone, with very thick walls. Artificial platforms and mounds are common, and tall mounds were found within the area of nearly every building examined. The aboriginal idioms have not entirely disappeared from among the natives of the Peruvian coast. Of ancient creeds and beliefs the practice of witchcraft seems to be the only vestige. Mr. Bandelier next reconnoitered the upper course of the Marañon River on the eastern slope of the Cordillera in the Peruvian north, whence the reports about the ruins of Kue-lap had created great interest. He passed the historically celebrated town of Cajamarca; traversed in the department of Amazonas an exceedingly broken and uneven country; and secured a complete plan of Kue-lap, with a number of details, furnishing data to correct previous accounts and surveys. He also gathered a number of traditions relative to occurrences anterior even to the time when the Incas began to make raids across the Marañon. After exploring many other ruins, the political conditions in Peru becoming unpleasant, Mr. Bandelier went into Bolivia, where he spent some time on the island of Titicaca, established the height of about 14,500 feet as the uppermost limit of sedentary occupancy in ancient times on the southern side of Illimani, and examined the slopes, up to 15,400 feet, of the great peak of Ka-ka-a-ka, or Huayna Potosi. At last accounts he was preparing for a journey to Pelechuco, in the northwestern corner of Bolivia.

Temperature Levels in Lake Mendota.—Prof. E. A. Birge, of the University of Wisconsin, has been pursuing studies of the "Plankton" of Lake Mendota in that State, with a prime view to making a contribution to the natural history of an inland lake as "a unit of environment." He finds that during the summer the difference in temperature between the surface and the bottom may amount to 10°, 12°, or even 15° C., but the decline in temperature from surface to bottom is not uniform as the depth decreases. If a series of temperatures is taken about the 1st of August it will be found that there is a layer of surface water from about twenty-five to forty feet in thickness, the temperature of which is nearly uniform. Immediately below this mass of warm water lies a stratum in which the decline of temperature is extremely rapid. This stratum may be from about six to ten feet thick, with a decline of nearly as many degrees centigrade per yard; or it may be only about a yard thick. This layer in which the temperature decreases rapidly may be known as the thermocline—the *Sprunsgchiet* of German authors. Below the thermocline the temperature decreases toward the bottom at first more rapidly and then more slowly as the depth of water increases, but never showing the sudden transitions which are characteristic for the thermocline. The thermocline was first noticed by Richter in 1891 in a study of the Alpine lakes. Its origin was attributed by him to the alternate action of the sun warming the surface in the day, followed by a cooling at night. The alternation of the conditions resulted in the formation of a layer of water of nearly uniform temperature above the colder bottom water. In Lake Mendota the concurrence of gentle winds and hot weather is essential to the formation of the thermocline. The warmth of the surface water, received from the sun, is distributed through a certain depth of the lake, a depth which is proportional to the violence of the wind and the area of the lake. In a lake of the size of Mendota the water would be of uniform temperature from top to bottom if it were always agitated by violent winds. On the other hand, if the weather were perfectly calm, the lake would be warmed only to the depth to which the rays of the sun could directly penetrate.

Curious Photographic Effects.—Since the rise into prominence in 1895 of the X-ray phenomena, there has been a greatly increased interest among physicists in the even more curious but apparently closely allied phenomena of normal physical emanations from certain surfaces which have the property of influencing the sensitive plate, and in some cases even impressing an image on such insensitive substances as glass, copper, etc. These phenomena have been variously labeled scotography, vapography, etc., but there has not as yet been sufficient insight gained into their causes to allow of a truly descriptive title. Dr. W. J. Russell, who has made this phenomenon the subject of his last two Bakerian lectures before the Royal Society, is authority for the following statements. He had previously found that zinc, other metals, wood, strawboard, and printed papers, when placed in contact with a dry plate, had a certain action on it, which enabled it to be developed as if it had been exposed to light. In his later lecture he recounts a number of additional experiments. Zinc and other materials, when left in contact with the plate for a week, formed an image so exact that minute scratches were reproduced; the structure and rings of growth from the section of a pine tree, and even the grain of a piece of mahogany which had been in practical darkness for a couple of centuries, were transferred to the plate, with perfect fidelity. It was also found that actual contact was not necessary, the plate being affected through a considerable intervening air space, and through gelatin, gutta-percha tissue, collodion, and celluloid. Glass was found to be quite impervious. The emanations from certain uranium salts were found, however, to pass through the glass to some extent. Among the most active metals are zinc, magnesium, aluminum, nickel, lead, and bismuth. Copper and iron are practically inert. Strawboard and fresh charcoal and copal varnish act very strongly upon the plate. Pure mercury is inactive. For efficient and rapid action, a fairly high temperature (55° C.) and a perfectly clean metallic surface are necessary. Dr. Russell's views regarding the cause of this action are not definitely stated, but he seems to incline toward the theory that the effects are due to vapors given off by the objects.

MINOR PARAGRAPHS.

Dr. James Hall, the veteran geologist, one of the last survivors of the pioneers of the science in the United States, and one of the founders of the American Association, died at Echo Hill, Bethlehem, N. H., August 7th, at the ripe old age of eighty-seven years. Notwithstanding his advanced age, he was able last year to make the long journey to Russia to attend the International Geological Congress. After his return thence his health began to fail, but until a very short time before his death he intended to be present at the meeting of the American Association just held in Boston. His fame was world-wide, and his eminence as one of the leading geologists of his time was very generally recognized in Europe as well as in America. Two years ago the American Association, in Buffalo, devoted a special session to his honor. An account of his life and his work in geology was published, with a portrait, in the Popular Science Monthly for November, 1884. An account, contributed by him, of the New York State Geological Survey, his chief scientific achievement, will also be found in the Monthly for April, 1883.

Among the results of a study of the negroes of Farmville, Va., contributed by Mr. W. E. B. Dubois to the Bulletin of the Department of Labor, is the conviction of a growing differentiation of classes among these people. The study brings to light facts favorable and unfavorable, and conditions good, bad, and indifferent. One visitor might find these people idle, unreliable, careless with their money, and lewd; while another would say that they were industrious, owners of property, and slowly but steadily advancing in education and morals —according to the particular group to which his attention was most directed. The question is not whether the negro is lazy and criminal, or industrious and ambitious, but, rather, "What, in a given community, is the proportion of lazy to industrious negroes, and what is the tendency to development in these classes?" Bearing this in mind, it seems fair to conclude, after an impartial study of the Farmville conditions, that the industrious and property-accumulating class of the negro citizens "best represents, on the whole, the general tendencies of the group. At the same time, the mass of sloth and immorality is still large and threatening." One of the most encouraging signs is that "the whole group life of the Farmville negroes is pervaded by a peculiar hopefulness on the part of the people themselves. No one of them doubts in the least but that one day black people will have all rights they are now struggling for, and that the negro will be recognized among the earth's great peoples."

The recognition by Mayor Quincy, of Boston, in his welcoming address to the American Association, of the value of science in civic administration was only just, but of a kind that is rarely offered from the official side. "Your work," the mayor said, "has a very direct relation to the work in which the people of the city of Boston are engaged in their corporate capacity and the work which their municipal government is trying to prepare for them. As I regard it, the work of good municipal government is the task of securing the practical application of the principles of science to the great fund of knowledge which has been won for us by science. I am continually impressed in my practical relation to the work of this great city with the vital relation which science bears to that work. More efficient government is to be sought along the lines of affairs which lie within the scope of our municipal government, and this is to be won for us by the investigators who have increased our knowledge of science within the last fifty years. . . . I am proud to say that we give a high place in everyday work to men of science who are giving technical application to the principles which have come to light through the investigations of abstract science. Work in the future will demand a fuller employment of men of science."

The situation as to antarctic exploration is described by the President of the Royal Geographical Society as including a German expedition in course of organization on a liberal scale; the hope that the Norwegian Government may send out an expedition, perhaps under the leadership of Dr. Nansen; the Belgian expedition under M. de Gerlache; and the expedition under Mr. Borchgrevink, which is in an advanced state of preparation, and will shortly leave for Australia and South Victoria Land. The ship of this expedition, the Southern Cross, has been designed by the builder of the Fram, and has ten feet of solid oak at her bows, while she is thirty-two inches in thickness at her weakest point. Provision of sledges and dogs is made for the inland journey on the South Victorian continent, and the expedition will make it an object to explore that land and investigate the seas between there and Australia. Mr. Borchgrevink will take with him stores for three years and a supply of carrier pigeons.

The vice-presidential address of Prof. Frank P. Whitman to the Physical Section of the American Association embodied a review of the present theories of color vision. The speaker regarded it as clearly proved that the number of color sensations is small, and that all hypotheses of a large number are untenable. The vision of white light is not a compound sensation, no matter how complex the light may be physically, but it is at the same time not a purely independent one, for there are some evident relations between it and vision by faint light, in which all the colors fade and tend to become white. A definite and highly probable function has been assigned to the visual purple, that of adaptation, and of causing or aiding vision in faint light. The number and variety of known human phenomena are very great and constantly increasing. Their interrelations grow every day more complex, and the actual mechanism governing those relations still remains almost entirely unknown. The various theories have at length arrived at such a stage of flexibility that, thanks to subsidiary hypotheses, almost any kind of visual result might be explainable. Perhaps the most hopeful line of research is that which, like the study of the visual purple, seeks to find a relation between color sensations and physical properties.

The address of Prof. A. S. Packard, as chairman of the Zoölogical Section of the American Association, was devoted to a review of a Half Century of Evolution and the bearings of the theory on the problems of the nature and origin of life. The immediate effect of the acceptance of evolution on scientific study was, the speaker said, a happy one. Collectors, instead of narrowly gathering a specimen or two for their cabinets and being content therewith, are led to look at other things during their field excursions; protective mimicry, for example, or the relation of form to environment. The race of "species makers" is diminishing, while students of geographical distribution are taking their place, and the relation of form to past geographical changes is now discussed in a more philosophical way than heretofore. Speaking of the relations of new forms and new classes to geological changes, Professor Packard was careful to indicate that their probable origin lay rather in the results of the gradual extension of the land masses and the opening of new areas.

Weighing the merits of the various plans that have been proposed for preventing or tempering the floods of the Mississippi, Mr. William Starling finds that storage reservoirs have but little effect in reducing the height the water will reach in the stream below.

Cut-offs increase the gradient and speed of the flow, destroying the balance, and the stream rapidly excavates a new bend, restoring the former condition. Artificial outlets have as little effect on the height of the stream above as storage reservoirs on that below. The author intimates that the most effective remedy lies in levees properly constructed. The old levees, the unsoundness of which has cast a prejudice against the system, were hastily and improperly made. Stumps were left in the ground, and logs, rails, etc., were thrown into the bank, which, rotting, left holes, weak spots, that the water was sure to find. Now, all decaying material is carefully kept out, and sound earth is used—"which is a good-enough material, . . . but the bank must be carefully built of sufficient dimensions, and, especially in the case of a light or treacherous underground, must have its base extended by a banquette. As to cost, it may be briefly said that levees are the least expensive means of reclaiming overflowed lands that have ever been proposed."

The agency of bacteria in promoting the fermentation or ripening of cheese has been recognized for some time, and has been taken practical advantage of by manufacturers. Messrs. S. M. Babcock and H. L. Russell, of the Wisconsin Agricultural Experiment Station, have, however, become satisfied that profound changes of a physical and chemical nature also occur in milk from which bacterial fermentatives have been excluded. In these experiments the casein of the milk underwent practically the same series of decomposition changes—the conversion of the insoluble casein into soluble proteids—as are to be found in a ripening cheese. From continued experiments the authors concluded that these changes were of a non-vital character, and were produced by enzymes; and by the usual physiological methods, proteid-converting (proteolytic) enzymes were separated, which, applied to milk, exercised a curdling as well as a digestive function.

A Cambodian people called the Pnongs are described by M. Adhémard Leclère, French resident at Kratie, as of the type of the North American Indians, well formed, and of good appearance, but with badly shaped mouths. The women are not so handsome, strong, or intelligent as the men. The Pnongs readily learn to read and write. Their costume consists of a long shawl, which folds elegantly round the body. The children are never left alone for an instant, but are constantly attended by their father or mother. They recognize a god, whom they call Brah, but their faith seems to resolve itself into a doctrine of ghosts. They eat everything, including grasshoppers, snakes, frogs, and the placenta of cows and buffaloes. For a choice drink they make a kind of spirit of rice. They smoke in wooden pipes a mild tobacco, which they dry and cut very fine, and chew various substances. They have a highly developed sense of smell, and profess to be able to distinguish different individuals and animals, metals, and other substances, with their eyes shut. They have no dances or music, but on certain solemn occasions beat gongs; and they have no funeral ceremonies. They have an art of carving small statues. They keep their promises, and have no patience with a man who breaks his word.

NOTES

The United States Life-Saving Service at the close of the fiscal year covered by its latest report, June 30, 1897, embraced 259 stations—189 on the Atlantic and Gulf coasts, 55 on the coasts of the Great Lakes, 14 on the Pacific coast, and one at the Falls of the Ohio. Three hundred and ninety-four disasters were reported as having occurred during the year to documented vessels, in which 3,737 persons were exposed, 42 lives were lost, and $1,998,930 of property out of $7,107,825 was lost. There were also 305 casualties to undocumented craft—sail boats, rowboats, etc.—carrying 706 persons, 11 of whom perished, and in which $39,465 of property was lost. Five hundred and eighty-seven shipwrecked persons received 1,082 days' relief at the stations. The number of disasters is the largest reported in the history of the service, yet the number of vessels totally lost is the smallest since 1879, when the scope of the service was much less extended.

The feat was accomplished on the first day of June, and has now become a part of the daily routine of the shops, of shipping molten iron by the ton on the railway from the blast furnaces at Duquesne to the Homestead Steel Works, near Pittsburg. The molten iron, as it is tapped from the furnaces, runs into an immense mixing ladle having a capacity of two hundred and fifty tons, and from this is poured into the twenty-ton ladle cars; and the cars are then hauled by a locomotive to the steel works, where the direct conversion of the fluid iron into open-hearth steel is made. Between seven hundred and eight hundred tons of iron are thus dealt with every day.

The Laboratory Fresenius at Wiesbaden, Germany, has recently passed the fiftieth year of its existence and its hundredth term, it having been founded on the first day of May, 1848. Since the death of its founder, Prof. C. Remigius Fresenius, June 11, 1898, it has been carried on by his sons, Dr. Heinrich Fresenius and Dr. Wilhelm Fresenius, and his son-in-law, Dr. Ernst Hintz, and is to be continued as before. The attendance at the winter session, 1897–'98, was equal to that of former years.

Several theories have been proposed in the attempt to explain the apparent enlargement of the sun and moon when near the horizon. M. D. Eginites, having compared the principal of them, finds none satisfactory, and that the phenomenon is not produced by any of the causes they assign. Any or all of these causes may contribute more or less to it, but not in any great degree, and the real cause is still to be sought.

Prof. O. C. Marsh, of Yale University, has recently been elected a foreign member of the London Geological Society.

Mr. A. Lawrence Rotch, of the Blue Hill Meteorological Observatory, Massachusetts, has been elected a foreign corresponding member of the German Meteorological Society.

Dead Man's Island—*Isla de los Muertos*—at San Pedro, in southern California, a place of historical and scientific interest, is described by Mrs. M. Burton Williamson as "a vanishing island," the whole facies of which has been changed within a few years by the erosive power of waves and tides and winter rains. A few years ago the west side of it could not be reached except by way of the inner harbor or by climbing to the top of the island and descending a precipitous trail. Now the sea has cut an arch through the solid rock, and one can go all round the island at low tide. Within the recollection of persons now living it has diminished in area one half or more. In science it is famous for its fossil shells (Pliocene and Quaternary), of which three hundred species have been found. Some of these have been identified with species still living in the coast waters farther north.

The tender shoots of ferns may be sporadically eaten among us, but nowhere that we know of do they form a regular article of diet in Europe or America. In Japan it is different, according to the Bulletin of the French *Jardin d'Acclimatation*, and some of the mountain people derive a large proportion of their food in some seasons from ferns. In the spring they eat the young leaves; later in the season, the starch which they extract from the roots. For this extraction they beat the washed roots with a mallet, stir the fragments in water, and precipitate the starch, using for reservoirs in the operation hollowed tree trunks. The starch obtained is equivalent to fifteen per cent of the root stuff used.

The buffalo tree hopper is a little grass-green insect of triangular shape which is frequently found upon vegetation, and displays considerable agility in leaping when discovered. It gets its peculiar name from a supposed similarity in shape to the male buffalo. Its thorax is very wide in front, projecting in two strong horns at the sides, and is triangular, leaving the insect relatively very narrow in the rear. The hopper does great damage in orchards and gardens, through the cutting up of the limbs by the female in depositing her eggs. C. L. Marlatt, of the Department of Agriculture, has published a circular relating to it.

The list of recent deaths includes, among men known to science, the names of Dr. Allen P. Smith, a distinguished Baltimore surgeon, and one of the original trustees of Johns Hopkins University, July 18th; A. H. B. Beale, professor of philosophy and education in the University of Washington, killed by a fall, July 18th; Dr. William Pepper, provost of the University of Pennsylvania from 1881 till 1894, and afterward professor in it of the theory and practice of medicine, and author of many works on medical and other subjects, at San Francisco, July 28th, aged fifty-five years; Dr. E. L. Sturtevant, an eminent scientific agriculturist, at Framingham, Mass., July 30th, aged fifty-six years; Prof. John Caird, an eminent philosophical writer, at Glasgow, Scotland, July 30th, aged seventy-eight years; Prof. James Hall, the oldest of American geologists, near Bethlehem, N. H., August 7th, in his eighty-seventh year; Georg Maurice Ebers, an eminent Egyptologist and author of numerous historical novels, near Munich, Bavaria, aged sixty-one years; Adolph Sutro, constructor of the Sutro Tunnel and deviser of a tidal water power, who made many gifts to education, at San Francisco; M. Émile Roger, retired inspector of mines in France and author of studies concerning the respective distances of the planets and their satellites; Prof. J. C. Fillmore, of Pomona College, California, ethnologist, at Taftville, Conn., on his way to the meeting of the American Association, where he was to read a paper on The Harmonic Structure of Indian Music, August 14th; Dr. Axel Blytt, professor of botany at Christiania, Norway, aged fifty-four years; Dr. Carlo Giacomini, professor of anatomy at Turin, July 15th; and Dr. Ernest Candez, student of coleoptera, near Lüttich, June 20th.

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