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EDITED BY
WILLIAM JAY YOUMANS

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CHARLES H. HITCHCOCK.

THE WHEAT-GROWING CAPACITY OF THE UNITED STATES.

By EDWARD ATKINSON.

In 1880 it happened to fall to me to make a forecast of the very great reduction in the price of wheat in Great Britain, which could then be predicated on the lessening cost of transportation from Chicago to the seaboard, thence to British ports, which was then sure to be soon followed by a large reduction in the railway charges for bringing the wheat to Chicago from the other Western centers of distribution. I then alleged that the time was not far off when, even if the price of wheat in Mark Lane were reduced from the then existing rate of fifty-two shillings per quarter to thirty-four shillings, it would still yield as full a return to the Western farmer as it had yielded in previous years at fifty shillings and upward. This forecast attracted great attention, and has since been made the subject of very much bitter controversy, especially since the fall in prices was much more rapid than I then thought it could be, and was carried to a much lower point than any one could have then anticipated. It will be remarked that thirty-four shillings in Mark Lane is at the rate of one dollar and three cents per bushel of sixty pounds.

From time to time I have almost been forced to defend the position then taken, notably when asked to appear before the Royal Commission on Depression in Agriculture at one of their sessions, where I was kept upon the stand for two full days in the effort of the excellent English farmers and landowners to prove that the American farmer had been ruined by the reduction in the price of wheat, which the majority of that commission attributed to the demonetization of [146] silver. The whole tone of that investigation and of a large part of the treatment of the wheat question in Great Britain has been one of complaint and of alleged wrong to British agriculture because the United States had succeeded in supplying the masses of the people of the United Kingdom with cheap bread, with sufficient profit to themselves to keep up the supply.

Now comes what may be called a cry of alarm from a scientist of highest repute lest England may be deprived even of an adequate supply of wheat, and lest the price should be forced to an exorbitant point. This view of the case was stated at great length by Sir William Crookes when assuming the presidency of the British Association for the Advancement of Science at the recent meeting in Bristol. This address is published in full in the Times of September 8th, the portion devoted to the wheat question filling three out of six columns of closely printed text; the other three are devoted to a complete review of the existing conditions of science. I venture to give a few extracts which will convey to the reader the aspect of the wheat question from this essentially British point of view. Sir William Crookes begins with a sort of apology, which the writer can fully appreciate. He says:

"Statistics are rarely attractive to a listening audience, but they are necessary evils, and those of this evening are unusually doleful.... I am constrained to show that our wheat-producing soil is totally unequal to the strain put upon it. After wearying you with a survey of the universal dearth to be expected, I hope to point a way out of the colossal dilemma. It is the chemist who must come to the rescue of the threatened communities. It is through the laboratory that starvation may ultimately be turned into plenty."

One of the singular facts which becomes quickly apparent to any one who deals with this subject in Great Britain is the inability of the English farmer to think about agriculture except in terms of wheat. Now we have an example of our English scientist of the highest repute who seems to ignore all other grain and to predict future starvation on an expected deficiency in the supply of wheat. Sir William Crookes proceeds:

"The consumption of wheat per head of the population (unit consumption) is over six bushels per annum; and, taking the population at 40,000,000, we require no less than 240,000,000 bushels of wheat, increasing annually by 2,000,000 bushels to supply the increase of population. Of the total amount of wheat consumed in the United Kingdom we grow twenty-five and import seventy-five per cent."

He then deals with the impending scarcity, saying:

"To arrest this impending danger it has been proposed that an amount of 64,000,000 bushels of [147] wheat should be purchased by the state and stored in national granaries, not to be opened except to remedy deterioration of grain, or in view of national disaster rendering starvation imminent. This 64,000,000 bushels would add another fourteen weeks' life to the population."

After dealing with the fact that while it might be possible for the United Kingdom to supply itself with its own wheat at an average of twenty-nine and a half bushels to the acre, he goes on to say that this would require thirteen thousand square miles of British territory, increasing at the rate of one hundred square miles per annum; but he says it would be clearly impossible to assign so large a proportion of the area of the United Kingdom to a single crop without suffering in other matters, adding:

"In any case, owing to our cold, damp climate and capricious weather, the wheat crop is

hazardous, and for the present our annual deficit of 180,000,000 bushels must be imported. A permanently higher price for wheat is, I fear, a calamity that ere long must be faced."

I can imagine with what a relish the Royal Commission on the Depression of Agriculture would have received this prophecy of a permanently higher price for wheat. Sir William Crookes goes on to say:

"Wheat is the most sustaining food grain of the great Caucasian race, which includes the peoples of Europe, United States, British America, the white inhabitants of South Africa, Australasia, parts of South America, and the white population of the European colonies."

He then points out how rapidly the consumers of wheat have increased, yet failing to attribute this increase in part to the rapid reduction in the cost. He says:

"In 1871 the bread-eaters of the world numbered 371,000,000; in 1881, 416,000,000; in 1891, 472,600,000; and at the present time they number 516,500,000. The augmentation of the world's bread-eating population in a geometrical ratio is evidenced by the fact that the yearly aggregates grow progressively larger.... To supply 516,500,000 bread-eaters, if each bread-eating unit is to have his usual ration, will require a total of 2,324,000,000 bushels for seed and food. According to the best authorities, the total supplies from the 1897-'98 harvest are 1,921,000,000."

It will be observed that while the English average consumption is said to be six bushels, the average employed in this computation is four and a half bushels per head. He then remarks upon the large harvests for seven years, saying:

"Bread-eaters have almost eaten up the reserves of wheat, and the 1897 harvest being under [148]
average, the conditions become serious.... It is clear we are confronted with a colossal problem that must tax the wits of the wisest. Up to recent years the growth of wheat has kept pace with demands. As wheat-eaters increased, the acreage under wheat expanded. We forget that the wheat-growing area is of strictly limited extent, and that a few million acres regularly absorbed soon amount to a formidable number. The present position being so gloomy, let us consider future prospects."

He then deals successively with the United States, Russia, Canada, and other countries. In regard to the United States he remarks:

"Practically there remains no uncultivated prairie land in the United States suitable for wheat-growing. The virgin land has been rapidly absorbed, until at present there is no land left for wheat without reducing the area for maize, hay, and other necessary crops. It is almost certain that within a generation the ever-increasing population of the United States will consume all the wheat grown within its borders, and will be driven to import, and, like ourselves, will scramble for a lion's share of the wheat crop of the world."

It is difficult for a citizen of the United States who has given any attention to the potential of our land to conceive of such views being held by an Englishman of highest scientific intelligence. When I was in England last summer I had a long interview with the editor of one of the papers of widest influence in all Great Britain. I then remarked that there were forces in action in the United States in three or four different directions which would profoundly change all the conditions of British industry, and render the English-speaking people of the United Kingdom and the United States more and more interdependent. It is seldom that one finds more than an occasional half a column in any great English paper devoted to the subject of our economic relations and to the development either of the American iron industry, of its agriculture, or of the cotton production and manufacture. Yet, in all these branches of industry, profound changes of world-wide importance, and yet of greater importance to the people of Great Britain, are now in progress. I may venture to say that this address of Sir William Crookes marks even a more profound ignorance of the forces in action in this country than even I had ever comprehended. Sir William Crookes next submits the following computation:

"The rate of consumption for seed and food by the whole world of bread-eaters was 4.15 bushels per unit per annum for the eight years ending 1878, and at the present time is 4.5 bushels.... [149]
Should all the wheat-growing countries add to their area to the utmost capacity, on the most careful calculation the yield would give us only an addition of some 100,000,000 acres, supplying at the average world yield of 12.7 bushels to the acre, 1,270,000,000 bushels, just enough to supply the increase of population among bread-eaters till the year 1931. At the present time there exists a deficit in the wheat area of thirty-one thousand square miles.... When provision shall have been made if possible to feed 230,000,000 units likely to be added to the bread-eating populations by 1931, by the complete occupancy of the arable areas of the temperate zone now partially occupied, where can be grown the additional 330,000,000 bushels of wheat required ten years later by a hungry world? If bread fails—not only us, but all the bread-eaters of the world—what are we to do? We are born wheat-eaters. Other races, vastly superior to us in numbers, but differing widely in material and intellectual progress, are eaters of Indian corn, rice, millet, and other grains; but none of these grains have the food value, the concentrated health-sustaining power of wheat, and it is on this account that the accumulated experience of civilized mankind has set wheat apart as the fit and proper food for the development of muscle and brains."

Sir William then proceeds to deal with the salvation by chemistry. But before taking notes from that part of his address, is it not singular to remark this tendency of the scientist as well as of the English farmer to think only in terms of wheat, wholly ignoring other grains? It may be interesting to point out the exact difference in the nutrients.

Wheat flour is analyzed in the following statement:

Water		11.6
Protein	11.1	
Fats	1.1	
Carbohydrates	75.6	
Mineral matters	0.6	
Total nutrients		88.4
Potential energy in one pound:	1,660	calories.

Corn or maize meal differs only as follows:

Water		14.5
Protein	9.1	
Fats	3.8	
Carbohydrates	71.0	
Mineral matters	1.6	
Total nutrients		85.5
Potential energy in one pound:	1,650	calories.

Oatmeal: [150]

Water		7.7
Protein	15.1	
Fats	7.1	
Carbohydrates	68.1	
Mineral matters	2.0	
Total nutrients		92.3
Potential energy in one pound:	1,845	calories.

Rye flour:

Water		13.1
Protein	6.7	
Fats	0.8	
Carbohydrates	78.7	
Mineral matters	0.7	
Total nutrients		86.9
Potential energy in one pound:	1,620	calories.

It will be remarked that the difference between maize meal and wheat flour consists only in a slightly larger proportion of fats and a slightly less proportion of protein, a matter very easily balanced by giving consideration to the other kinds of food which may be used by the bread-eater. Again, it is hardly to be supposed that the Scotchmen who listened to Sir William Crookes admitted in their minds that wheat flour possessed any greater potential energy in the development either of muscle or of mind than the oatmeal to which they have been habituated for so many generations. I doubt if any New England Yankee who had been brought up on the diet of corn (maize) bread and baked beans, the latter supplying the protein element in abundance, would admit any greater development of the muscle or brain by exclusive dependence on wheat for the bread of life. It is not, however, my purpose to deal with the relative food values of wheat and other grains; it is simply to take up this extraordinary delusion of Sir William Crookes in respect to the potential of the wheat-producing area of this country. His theory is salvation by chemistry, and he rightfully calls attention to the necessity for obtaining a cheap and abundant supply of nitrogen. All the other elements for fertilizing the soil are relatively abundant at low cost, especially in this country. Our enormous supply of the phosphates of lime and potash gives assurance on this matter, and our one deficiency, or rather the one element heretofore of high cost, has been the necessary proportion of nitrogen required to maintain an even balance in the soil.

I am surprised that Sir William Crookes should attribute so little importance to the recent discovery of the influence of bacteria, which living and dying in nodules attached to the stalks of the leguminous plants dissociate the nitrogen of the atmosphere, where the supply is unlimited, [151] converting it to the nutrition of the plant, and thence to the renovation of the soil. Sir William deals only with the renovating qualities of clover, having apparently no comprehension of the existence of the cow-pea vine, the soya bean, the alfalfa, and many other types of legumes by which the partially exhausted soil, especially of the South, is now being renovated with great rapidity at a low cost. Sir William's hopes of nitrogen seem to be based on some method being found to save the sewage of cities, but mainly on the conversion of the water power of Niagara and other great falls to the generation of electricity and thence to the dissociation of the nitrogen of the atmosphere.

The point to which I wish to direct attention and inquiry is this alleged nearly complete taking up of the land of the United States capable of producing wheat in paying quantities. The question which Sir William Crookes puts is this: He says there is a deficit in the wheat area of thirty-one

thousand square miles which must be converted to wheat-growing in order to keep up with the increasing demand of the world to prevent wheat starvation in less than one generation. It will be observed that the present necessities of the world are computed by Sir William Crookes at 2,324,000,000 bushels, of which this country will supply 600,000,000 to 700,000,000 bushels from an area of land devoted to wheat of 71,000 square miles, a fraction over two per cent of the area of the United States, omitting Alaska.

The problem may then be stated in these terms: Given a demand of the wheat-consuming population of the world for this whole supply of 2,324,000,000 bushels, this country could supply it at the present average per acre by devoting two hundred and fifty thousand square miles to this crop, or less than ten per cent of the area, omitting Alaska. We could supply the world's present demand, but of course such computations are purely speculative.

I venture to say that if a contract could be entered into by the bread-eaters of the world with the farmers of the United States, giving them an assurance of a price equal to one dollar a bushel in London, or a fraction under thirty-three shillings per quarter of eight bushels of sixty pounds each, which would yield to the American farmer from sixty to eighty cents per bushel on the farm, the land now under cultivation in wheat and not required for any other crop or for pasture would be opened in the United States which would be devoted to this service year by year as fast as the consumption called for it. In fact, there are now fully one hundred thousand square miles of land, 64,000,000 acres, fully suitable to the production of wheat at fifteen bushels to the acre, practically unoccupied in any branch of agriculture, which would be devoted to wheat on an [152] assured price of one dollar a bushel in Mark Lane, yielding 960,000,000 bushels. Or, to limit the question yet more: Sir William Crookes states the needs of the people of the United Kingdom at the present time to be 240,000,000 bushels, increasing at a rate of less than two per cent per annum, of which twenty-five per cent is derived from her own soil. If John Bull, in place of building granaries, could offer thirty-three shillings a quarter, or one dollar a bushel, in London as a permanent price for the next thirty years, would not Uncle Sam accept the offer? and if Uncle Sam should then ask for bids among the States, are there not several single States or Territories that would take the contract each for itself?

Having put that question, I now propose to submit an inquiry in due form in order to sustain my own belief that we can supply the whole present and the increasing demand of Great Britain for the next thirty years with six bushels of wheat per head at a dollar a bushel from land situated wholly in the Indian Territory, not yet open to private entry, but which may soon be open when the Indian titles have all been purchased. Or, again, I undertake to say that the State of Texas can meet this whole demand without impairing in the slightest degree its present products of grain, cotton, wool, and meats, and without appropriating the use of more than a small fraction of the area of that single State which has not yet been fenced in or subjected to the plow to the production of wheat.

Perhaps it would be better to put a more simple proposition in order to bring out what would be perfectly feasible. Let it be assumed that the British public should really become so alarmed as to be willing to put up the granaries which have been suggested for storing fourteen weeks' consumption, or 64,000,000 bushels. That would require a very large capital which would yield no income on which there would be a heavy loss of interest and a considerable risk of damage to the wheat during the period of storage. In place of this a feasible plan would be to put up the capital which would be required for building these granaries, invest it in consols, and pledge it as collateral security for the fulfillment of a contract running for thirty years for the annual purchase of 10,000,000 bushels of wheat per month, or say 128,000,000 bushels a year, or twice the quantity proposed to be stored.

There are several large dealers in grain and provisions in the United States who would be ready to take this contract and to put up a sufficient sum of capital invested in United States bonds to serve as security for prompt delivery.

An assured supply of 128,000,000 bushels in addition to the ordinary supply might allay the fear [153] of scarcity and high price of bread. It may here be observed that the low average crop per acre of the United States has been due to the inclusion of wheat grown on land partially exhausted by cropping or not well adapted to this grain. The all-wheat as well as the all-cotton and all-tobacco methods of ignorant farming or cropping year after year are now very rapidly giving place to varied crops coupled with an increase of product per acre. No agency has been of such service in this matter as the Agricultural Experiment Stations, now established in almost every State under the supervision of men of the highest capacity. Under this system wheat, which requires a few days of machine work in the spring and autumn, occupying very little time of the farmer himself, is rapidly becoming the surplus or money crop of farms otherwise maintained on the alternate products. Under such cultivation an average crop of twenty bushels to the acre would be assured, in many sections much more. One hundred and twenty-eight million bushels at twenty bushels per acre would require 6,400,000 acres, or ten thousand square miles. As an alternate with other crops in a rotation of four, this would call for only forty thousand square miles in varied farming. In order to satisfy the anxieties of Sir William Crookes lest land should be taken from other necessary work, this area might be divided among several States and Territories, say five thousand square miles among eight. Oklahoma (38,719 square miles) was opened to settlement only seven years since, and has yet a great deal of unoccupied land. It will this year raise 13,000,000 bushels of wheat from 850 square miles devoted to the crop. Give Oklahoma five thousand square miles, the unoccupied Indian Territory (30,272 square miles) would take all the rest as soon as open; but we may only assign five thousand square miles to that area. Five

thousand more might be assigned to the limestone section of Virginia, in the valley of the Shenandoah and its tributaries; five thousand each to Kentucky (40,400 square miles) and Tennessee (42,050 square miles), while the great wheat-growing States—Kansas (82,080 square miles), Nebraska (77,510 square miles), Minnesota (83,365 square miles), and the two Dakotas (148,445 square miles)—would compete for the contract each to open a little patch of five thousand square miles, not yet adjacent to railways. We should thus have exhausted the area called for without regard to the instant competition which would come from California (158,360 square miles), Oregon (96,030 square miles), and Washington (69,180 square miles), and probably from Pennsylvania (45,215 square miles) and other Eastern or Southern States. At a dollar per bushel in London no difficulty would be found in placing this contract even without resort to Texas (265,780 square miles), which could take the whole on but a small portion of its area not yet under the plow. [154]

The only additional measure which would then be required would be one which must come in any event—namely, the neutralization of the ports of export and import of food in the United States and Great Britain and in such other countries as may choose to join, together with the neutralization of a ferry or sea way for the transportation of the food, wherein no hostile shot should be fired and no seizure of private property permitted on the part of any nation, the condition of this understanding being that if any other nation ventured to question or contest this dedication of a neutral way for the conveyance of food to the purposes of peace, the navies of Great Britain and of the United States would be united to force its acceptance, and to sweep from the ocean the fleet of every state or nation which ventured to contest this measure. That would be a suitable measure for beginning to make a right use of navies—for the protection of commerce and for the destruction of every fleet or vessel which did not accept the principle that private property not contraband of war should be exempt from seizure upon the high seas, coupled with a declaration limiting contraband of war so that it may never be made to include customary articles of commerce, especially food, not now contraband.

The foregoing text was set in type and one hundred advance proof sheets were supplied, which have been sent by the writer to the Secretaries of Agriculture and the chiefs of the Agricultural Experiment Stations in all the States to which we look for any considerable product of wheat. The replies are so complete and so numerous as to make it impossible to incorporate a full digest of the whole case within the limits of the present article. A supplement will be prepared for a later number of this journal, in which this information will be tabulated. For the present purpose I may avail myself only of a part of the data which have been sent to me.

1. The evidence suffices to prove that there is not a State named above which could not set apart five thousand square miles for the cultivation of wheat in a rotation of four without trenching in the slightest degree upon any other crop. 2. In previous essays, in which I have dealt with the potential of the agriculture of this country, I have very guardedly computed but one half our total area of three million square miles (omitting Alaska) as being arable land, suitable for the plow. The returns now in my hands would render it suitable to increase that area to two thirds, or two million square miles subject to cultivation. 3. The area now under the plow for the production of [155] our principal crops for the year 1897 is given in the table below. If miscellaneous crops be added to these principal crops, the cultivated land of this country does not now exceed, and in fact does not reach, twenty per cent of the arable land, while from the cultivated portion a progressive increase in product may be expected under the impetus of improved methods of farming on lessening areas in each farm.

	Acreage.	Yield.	Product.	Price.	Value.
		Per acre.	Bushels.	Cents.	
Maize	80,095,051	23.8	1,902,967,933	26.3	$501,072,952
Wheat	39,465,066	13.4	530,149,168	80.8	428,547,121
Oats	25,730,375	27.2	698,767,809	21.2	147,974,719
Barley	2,719,116	24.5	66,685,127	37.7	25,142,139
Rye	1,703,561	16.1	27,363,324	44.7	12,239,647
Buckwheat	717,836	20.9	14,997,451	42.1	6,319,188
All grain	150,431,005		3,240,930,812		$1,121,295,766
Hay	42,426,770	1.43	60,664,876	6.62	401,390,728
Cotton	23,273,209		8,532,705	6.78	291,811,564
	216,130,984				$1,814,498,058

Maize	125,150	square	miles;
Wheat	61,660	"	"
Oats	40,200	"	"
Barley	4,250	"	"
Rye	2,660	"	"
Buckwheat	1,120	"	"
	235,040	"	"
Hay	66,290	"	"

Cotton	36,520	"	"
	337,850	"	"

The area under wheat in 1897 was a fraction under forty million acres, or a little less than sixty-two thousand square miles. The high price secured for that crop has led to an increase in land under wheat in 1898 to a fraction under seventy-one thousand square miles (nine thousand square miles added), on which the largest crop ever known has doubtless been raised, variously computed at the present time from 620,000,000 to 700,000,000 bushels. The area now under wheat is therefore less than four per cent of our arable land.

In order to develop our potential in wheat it will be best to limit our present consideration to three States only—namely, Minnesota, North and South Dakota—from which we derive the greater part of our spring wheat. The area of these three States is two hundred and thirty-two thousand square miles, disregarding fractions. The land which is deemed to be suitable for wheat growing is estimated by the officials from whom I have derived reports at one hundred and sixty [156] thousand square miles. The crop of 1898 is computed at 190,000,000 bushels, a quantity sufficient to supply Great Britain with all that she needs in addition to her domestic production. It has been grown on an area of less than twenty thousand square miles, or upon one eighth part of the land of these three States only; the rest of the wheat land can be as surely and profitably devoted to the production of wheat as that part already under that crop. The fact may be recalled that the territory which now constitutes the two States of North and South Dakota began to be computed separately from other States only in 1880, when a little under 3,000,000 bushels were credited to that territory. The minimum product of these two States this year will be 100,000,000 bushels.

One of the authorities upon whom I rested for absolute information is Mr. L. G. Powers, chief of the Bureau of Labor of the State of Minnesota, in whose Annual Report for 1896 is the most exhaustive study of the grain production of the Mississippi Valley that has ever been made. I therefore do not hesitate to incorporate in this article his comments upon the proof sheets sent to him:

"The probable product of wheat in a State like Minnesota, at a fixed price, such as Mr. Atkinson mentions, can be estimated, even approximately, only by taking account of a number of such factors as the present actual and relative profit of the wheat farmer, and the probable changes that will be made in the next few years in the cost of cultivating wheat and of transporting it to London. A few of the leading well-known facts relating to these subjects may with profit be noted in this connection, and first a few words with reference to the profits of wheat raising in Minnesota.

"Whatever may be true of wheat raising in Europe, or in the Atlantic coast States of America, it can be positively asserted that the average profit of the Minnesota wheat grower has been steadily though irregularly increasing since the admission of this State to the Union in 1858. This is evidenced by the relative number and amount of farm-mortgage foreclosures in the State, as a whole, and in its several sections at the present time and in the past. Properly to use those foreclosures as a measure of the increasing prosperity of the Minnesota wheat farmer, two facts should be kept in mind. In 1880, and prior to that time, the industry of wheat growing was most fully developed in those counties which now constitute the First Congressional District. The farmers of those counties at that time depended for their income largely upon their wheat crops. Later they have adopted a highly diversified system of agriculture in which wheat is only an incidental cash crop. The exclusive cultivation of wheat now finds its seat in the counties composing the Seventh Congressional District. The lands of this district are situated about two [157] hundred miles on an average farther from the markets of Europe than those of the First District. Notwithstanding this fact and all changes in the selling price of wheat, and all allied changes affecting the wheat industry of the State, the farm-mortgage foreclosures in the Seventh District in the five years ending with December, 1897, were relatively twenty per cent less than they were in the First District in the five years 1880 to 1884, and were forty per cent less than in the five years 1869 to 1873. To the extent represented by these figures has the average cultivation of wheat as an exclusive crop become more profitable in Minnesota than it was twenty, thirty, or forty years ago. A much greater increase of farm prosperity has taken place in those counties which have adopted a diversified system of agriculture, and made wheat an incidental cash crop.

"The growing farm prosperity in Minnesota above noted finds its highest development in the past five years, during which the selling price of wheat in London has averaged approximately one dollar per bushel, or the amount called for by the conditions stated by Mr. Atkinson. This increasing farm prosperity in Minnesota, which lessens the mortgage foreclosures of the exclusive wheat growers forty per cent in thirty years, has been the main factor in the settlement of Minnesota and the two Dakotas. It has caused the wheat grown in the territory of these three States to increase from 10,000,000 bushels in 1867 to 190,000,000 bushels in 1898. With no added profit in the business, the settlement of the vacant lands of these States and those of Montana and of the British Northwest will move on, and twenty-five years from now will find in the territory tributary to Minneapolis and Duluth not less than 400,000,000 bushels of wheat raised annually. Even then but a fraction of the possible wheat lands of the great Northwest will be under the plow. If a material increase should take place in the present average profits of the Northwestern wheat grower, the imagination of man could hardly picture the stimulus to wheat culture that would result.

"With a fixed price of one dollar per bushel in London, called for by Mr. Atkinson's conditions, the American farmers can find increased profit in two possible sources: decreased cost of transportation to London, and lessening cost of wheat production in Minnesota. A detailed analysis of the various charges that constitute the present cost of transporting wheat from the Red River Valley of Minnesota, the Dakotas, and of Manitoba to London gives reasonable assurance of a reduction in the next few years of at least five and possibly seven cents per bushel in such cost. Here is an almost certain addition, in the next few years, of from five to seven cents a bushel to the profit of American-grown wheat, providing only its average selling price in London remains practically unchanged.

"A careful study of farm methods among Minnesota farmers discloses this fact: Some wheat [158] growers, with the best farm machinery, and employing the best methods of agriculture, make a profit in wheat raising of from ten to fifteen cents a bushel more than do their less intelligent and less progressive neighbors. Now, the tendency in the State and throughout the Northwest is to bring, by education and a general exchange of methods, the poorer farmers up to the level of the best. This change is rapidly taking place. It will not require fifteen years to realize its consummation. When the methods and facilities of the average farmer are brought up to the level of the best of the present time, this change, with the change above noted in transportation charges, will add to the average profit of Minnesota farmers in growing wheat a total of not less than fifteen and possibly of over twenty cents a bushel. Such a change would more than double the existing net profit of the wheat grower in the Northwest. Could it be maintained for a series of years, as is presupposed under Mr. Atkinson's supposition of London prices, it would furnish such an incentive to wheat growing in Minnesota and the surrounding territory as has as yet never been experienced. A million families of immigrants would pour into the great Northwest within the next twenty to twenty-five years. They would take up all the existing vacant lands of Minnesota and the Dakotas. The lands suitable for irrigation in these States and in Montana would be set to growing wheat. The wave of humanity anxious to raise wheat for a dollar a bushel in London would sweep past the boundaries of the four States mentioned, and carry the cultivation of that cereal all over Manitoba, Assiniboia, Alberta, and Saskatchewan. In these four British provinces and in the four American States, dollar wheat in London would in twenty years open more acres of good land to wheat than are now subject to the plow within their borders. Even then the beginning only would have been made to the possibilities of wheat culture in the British Northwest. Settlements would not have extended as far north as St. Petersburg in Russia; neither would settlers have trenched upon the lands with a climate as severe as that of the Russian metropolis.

"The foregoing is a brief statement of what dollar wheat in London would do for one section of North America in stimulating wheat cultivation. If that statement is based upon a true conception, as the writer believes it is, of the possibilities of the American Northwest, it demonstrates how impossible it will be to maintain dollar wheat in London for any great length of time in the future. It also shows that Mr. Atkinson is wrong in not asserting a sure continuation of that decline in wheat prices which he so fully predicted in 1880."

Cost of Shipping Wheat per Bushel from Moorhead, an Interior Point in Minnesota, to Liverpool. [159]

	On May 27, 1898.	On July 9, 1898.	On August 20, 1898.	On September 17, 1898.
	Cts. per bu.	Cts. per bu.	Cts. per bu.	Cts. per bu.
Rate, Moorhead to Duluth	9.30	9.30	8.70	8.70
Duluth elevator and inspection charges	0.80	0.80	0.80	0.80
Lake freight, Duluth to Buffalo	1.40	1.25	1.25	1.75
Elevator charges and commission at Buffalo	1.00	1.00	1.00	1.00
Canal freight, Buffalo to New York	3.00	3.00	2.75	2.50
Elevator charges, etc., in New York	2.00	2.00	2.00	2.00
Ocean freight, New York to Liverpool	8.00	3.50	4.50	6.00
Totals	25.50	20.85	21.00	22.75

General average, 22.525 cents per bushel.

It will be remarked that Mr. Powers says I am wrong in not asserting a sure continuation of the decline in the price of wheat which I predicted in 1880. In setting up one dollar a bushel in London as the standard of this inquiry, I had no thought that our farmers could be made happy for the next thirty years by any hope of securing so high a price. In my predictions in 1880 I said that the time was not then far off when the farmers of the Mississippi Valley would secure as large a remuneration from their wheat at thirty-four shillings per quarter in London as they had been gaining from a previous average of fifty-two shillings. I might then have fixed the lessened price at twenty-eight shillings, and at the present time I have a greater expectation of a reduction in the price of wheat in Mark Lane to less than twenty-eight shillings a quarter, or eighty-five cents a bushel, than I had in 1880 that it would so soon reach thirty-four shillings. I merely adopted a dollar a bushel as an arbitrary standard on which an abundant supply of bread at low cost would be absolutely assured to the people of England.

In fact, as I stated before the Royal Commission on Depression of Agriculture, it is not probable that a reduction in the price of wheat to forty cents a bushel on Western farms or sixty-five to

seventy cents a bushel in England would stop the growth of this grain, although it might check an increase. When the price went down to a very low point on the last excessive crop it is probable that 100,000,000 bushels of wheat were fed to swine and to cattle. It proved to make better pork and beef than maize or Indian corn, and, as the price of meat did not decline in anything like the proportion to the price of wheat, the farmers who thus fed their excess secured a profit which the sale of the crude grain might not have given.

In this comment Mr. Powers deals with the reduction in the number of foreclosures in Minnesota. Attention should be called to the fact that the United States census investigation for which a [160] million dollars was appropriated, for the purpose of recording farm mortgages in 1890, disclosed the fact that in the ten great grain-growing States of the middle West two thirds of the farms were then free of any mortgage of any kind, and were well stocked; the incumbrance on the remaining third being less than forty per cent of the computed value of the mortgaged farms. Since that date several State investigations have been made, leading to the conclusion that not exceeding twenty per cent of the farms in these States are now under any incumbrance of any kind. In the more prosperous parts of Minnesota and other wheat sections since the substitution of intelligent and varied agriculture for the single wheat crop, foreclosures have almost ceased, such as do occur being attributed to special causes; while such is the abundance of capital accumulated in this section that the rates of interest on safe investments, which but a few years since were nearly double those prevailing in the seaboard commercial cities, are now about even. When certain causes lately produced a short stringency in the money markets of the East, remittances were made from these Western cities for investment in Eastern commercial paper.

In regard to wheat production at a fixed price in London, the Commissioner of Agriculture and Labor of North Dakota remarks: "Wheat at one dollar per bushel in London would net the North Dakota farmer on the average about seventy-five cents per bushel on the railroad track. At that price as a standard, every farmer in the State would utilize all the land he has, and buy up more of the land now lying idle and in the hands of speculators. It would increase immigration so that nearly all the vacant Government land would be taken up. We also have over one million acres of school and State land, of which at least eighty per cent is suitable for raising wheat. Such a price would give North Dakota a boom that never had its equal."

A few words may be given to the report from Texas. The Secretary of the Board of Agriculture states that "the area of arable land of fair quality, including pasture that might be put under the plow in this State, is two hundred thousand square miles; about one hundred thousand square miles suitable for wheat and other grains lying north of parallel 31°; about one hundred thousand square miles lying south of that line adapted to cotton, sugar, fruits, and vegetables of all kinds."

An unexpected reply comes from Idaho, as yet insignificant in wheat production, stating that the potential of that State under the conditions named might reach 400,000,000 bushels.

Again, from Arkansas, to which State we have looked more for excellent cotton than for grain, "there are fifteen million acres of good wheat land; wheat is fast becoming a cash crop, [161] displacing cotton—the capacity of a considerable part of the land at the beginning being forty bushels to the acre, which, being much better than five-cent cotton, is leading the farmers to take advantage of existing prices."

Time has not sufficed since my questions were sent out for replies to reach me from Oregon, Washington, and Montana, where the potential in wheat production is probably equal to that of Minnesota, North and South Dakota combined.

Sir William Crookes makes reference to the future necessity of providing fertilizers, a matter to which the closest attention is now being given by the cultivation of renovating crops. But regard must be given to the fact that we have the most complete and adequate supply of phosphate of lime and phosphate of potash in the vast deposits of bone or mineral phosphates of Tennessee, Kentucky, and Florida, while again we may look to nitrate of soda as a very inexpensive source of nitrogen, of which the most adequate supply can be assured at very low cost. Known methods are also being applied to saving the enormous waste of nitrogen from our coke ovens and iron furnaces.

I almost feel it right to apologize to Sir William Crookes for the presentation of these facts. My function is that of the practical business man who deals with these economic problems wholly from that point of view, and not from the high standard of a complete mastery of the physical sciences.

As I have stated, I happen to have dealt with this question several times at meetings of the British Association for the Advancement of Science, and in other ways in Great Britain as well as in this country. I deem it of the utmost importance at the present time that the interdependence of the English-speaking people should be brought into view in the most conspicuous manner. In their relative production and conditions the United Kingdom of Great Britain and Ireland and the United States are the complement of each other. Their mutual relation or interdependence is now being recognized, and it can not be long before many of the legal obstructions to mutual service will be removed. The people of this country are now passing through a stage in their economic education closely corresponding to that through which Great Britain passed between 1840 and 1856 under the wise leadership of Sir Robert Peel, Richard Cobden, and William E. Gladstone. We move more quickly, not only in acts but in ideas, than we did fifty years ago. The revolution of ideas which has followed the revolution of institutions in the Southern States has made the people of this country into one homogeneous nation. A revolution of ideas in regard to the

conditions of international commerce will presently bring the English-speaking people of the world into one homogeneous body governed by the same common law, the same common principles of action, and the same policy in the collection of revenue. When thus united, there can be no competition in the commerce of the world on the part of the continental states of Europe under their present burdens—the blood tax of standing armies and navies and the money tax of debts that can never be paid. There have been within a few months two witnesses to the growing influence and power of the English-speaking people when united for the maintenance of commerce and for the conduct of the works of peace, order, and industry: one is the warning of the Chancellor of the Austrian Empire, calling upon the states of middle Europe to unite their forces in order to remain capable of maintaining government by privilege and taxation by force of arms; the other, the recent manifesto of the enlightened ruler of Russia, calling upon the states of continental Europe to disarm, lest they should hereafter be incapable of competition with the English-speaking people of the world when they become bound together by a union of mutual service and by community of interest which without any formal alliance will give to them the chief control in rendering service by the exchange of product for product to all other states and nations, to the mutual benefit of all who are thus joined in the bonds of peace. [162]

On my visit to Russia last year, to meet the leading economists and statisticians of Europe, it was stated to me by well-informed men that a plan had been considered by several continental states in the event of war to change the present international custom by making food products contraband of war, the purpose being to cripple England. To such desperate conditions have some of the European states been brought under the burden of the policy of blood and iron. My comment upon this insane proposal was that I hoped it might become a matter of public discussion, since nothing could so surely and quickly bring about a commercial union of the English-speaking people, to the end that, even if no other alliance were made, their navies might at any moment be combined for the protection of their commerce, and for the total cessation of any interference by war vessels or privateers with their traffic.

The prime motive of this article is to remove from the minds of our English friends many false impressions which I have constantly met in my intercourse even among men who hold important positions, of which the address of Sir William Crookes is but an extreme expression, and to bring into common view a comprehension of the resources of this country and of the mutual dependence of the United Kingdom and the United States in the supply and consumption not only of wheat, but of all the other necessaries of life.

THE RACIAL GEOGRAPHY OF EUROPE. [163]

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

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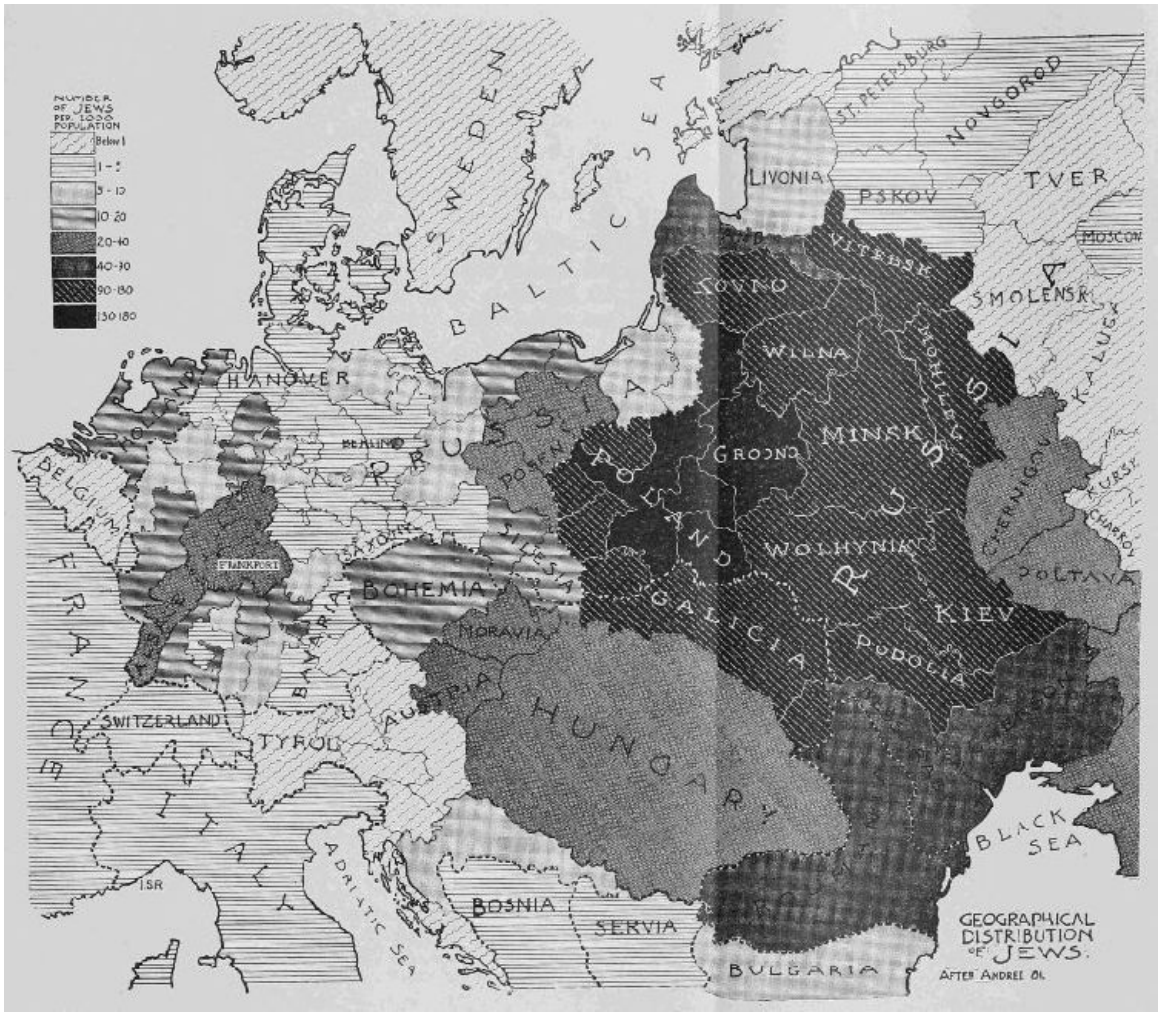
SUPPLEMENT.—THE JEWS.[1]

Social solidarity, the clearest expression of which to-day is nationality, is the resultant of a multitude of factors. Foremost among these stand unity of language, a common heritage of tradition and belief, and the permanent occupation of a definite territory. The first two are largely psychological in essence. The third, a material circumstance, is necessary rather to insure the stability of the others than for its own sake; although, as we know, attachment to the soil may in itself become a positive factor in patriotism. Two European peoples alone are there which, although landless, have succeeded, notwithstanding, in a maintenance of their social consciousness, almost at the level of nationality. Both Gypsies and Jews are men without a country. Of these, the latter offer perhaps the most remarkable example, for the Gypsies have never disbanded tribally. They still wander about eastern Europe and Asia Minor in organized bands, after the fashion of the nomad peoples of the East. The Jews, on the other hand, have maintained their solidarity in all parts of the earth, even in individual isolation one from another. They wander not gregariously in tribes, often not even in families. Their seed is scattered like the plant spores of which the botanists tell us; which, driven by wind or sea, independently travel thousands of miles before striking root or becoming fecund. True, the Jews bunch wherever possible. This is often a necessity imposed for self-preservation; but in their enforced migrations their associations must change kaleidoscopically from place to place. Not all has been said even yet of the unique achievement of this landless people. That the Jews have preserved their individuality despite all mutations of environment goes without saying. They have done more. They have accomplished this without absolute unity of language. Forced of necessity to adopt the speech of their immediate neighbors, they have only where congregated in sufficient numbers been able either to preserve or to evolve a distinctive speech. In Spain and the Balkan states they make use of Spanish; in Russia and Poland they speak a corrupt German; and in the interior of Morocco, Arabic. Nevertheless, despite these discouragements of every kind, they still constitute a distinctive social unit wherever they chance to be. [164]

This social individuality of the Jews is of a peculiar sort. Bereft of linguistic and geographical support, it could not be political. The nineteenth century, says Anatole Leroy-Beaulieu, is the age of nationality; meaning obviously territorial nationality, the product of contiguity, not birth. To this, he says, the Jew is indifferent, typifying still the Oriental tribal idea. As a result he is out of harmony with his environment. An element of dislike of a political nature on the part of the Christian is added to the irreconcilability of religious belief. It has ever been the Aryan versus the Semite in religion throughout all history, as Renan has observed; and to-day it has also become the people *versus* the nation, as well as the Jew *versus* the Christian. Granted that this political dissonance is largely the fault of the Gentile, its existence must be acknowledged, nevertheless.



GEOGRAPHICAL DISTRIBUTION of JEWS.

How has this remarkable result been achieved? How, bereft of two out of three of the essentials of nationality, has the Jew been enabled to perpetuate his social consciousness? Is the superior force of religion, perhaps abnormally developed, alone able to account for it all? Is it a case of compensatory development, analogous in the body to a loss of eyesight remedied through greater delicacy of finger touch? Or is there some hidden, some unsuspected factor, which has contributed to this result? We have elsewhere shown that a fourth element of social solidarity is sometimes, though rarely, found, in a community of physical descent. That, in other words, to the cementing bonds of speech, tradition, belief, and contiguity, is added the element of physical brotherhood—that is to say, of race. Can it be that herein is a partial explanation of the social individuality of the Jewish people? It is a question for the scientist alone. Race, as we constantly maintain, despite the abuses of the word, really is to be measured only by physical characteristics. The task before us is to apply the criteria of anthropological science, therefore, to the problems of Jewish derivation and descent. Only incidentally and as matters of contributory interest shall we consider the views of the linguists, the archæologists, and the students of [165] religious traditions. Our testimony is derived from facts of shape of head, color of hair and eye, of stature, and the like. These alone are the data indicative of racial descent. To these the geographer may add the probabilities derived from present distribution in Europe. No more do we need to settle the primary racial facts. Further speculations concerning matters rather than men belong to the historian and the philologist.

The number and geographical distribution of the chosen people of Israel is of great significance in its bearing upon the question of their origin.[2] While, owing to their fluid ubiquitousness, it is exceedingly difficult to enumerate them exactly, probability indicates that there are to-day, the world over, between eight and nine million Jews. Of these, six or seven million are inhabitants of Europe, the remainder being sparsely scattered over the whole earth, from one end to the other.

Their distribution in Europe, as our map opposite shows, is exceedingly uneven. Fully one half of these descendants of Jacob reside in Russia, there being four or five million Jews in that country

alone. Austria-Hungary stands next in order, with two million odd souls. After these two there is a wide gap. No other European country is comparable with them except it be Germany and Roumania with their six or seven hundred thousand each. The British Isles contain relatively few, possibly one hundred thousand, these being principally in London. They are very rare in Scotland and Ireland—only a thousand or fifteen hundred apiece. Holland contains also about a hundred thousand, half of them in the celebrated Ghetto at Amsterdam. Then follow France with eighty thousand more or less, and Italy with perhaps two thirds as many. From Scandinavia they have always been rigidly excluded, from Sweden till the beginning and from Norway until nearly the middle of this century. Spain, although we hear much of the Spanish Jew, contains practically no indigenous Israelites. It is estimated that there were once about a million there settled, but the persecutions of the fifteenth century drove them forth all over Europe, largely to the Balkan states and Africa. There are a good many along these Mediterranean shores of Africa, principally in Morocco and Tripoli. The number decreases as we approach Egypt and Palestine, the ancient [166] center of Jewish dispersion. As to America, it is estimated, although we know nothing certainly, that there are about a half million Jews scattered through our cities in the United States. New York city, according to the last census, contained about eighty thousand Poles and Russians, most of whom, it may be assumed, were Jews. But they have come since in ever-increasing numbers, with the great exodus from Russia, at the rate of scores of thousands annually. A recent writer places their present number in New York city at a quarter of a million. The British provinces, on the other hand, do not seem to offer great attractions; as late as 1870, for example, the census in Nova Scotia could not discover a solitary Jew.

A more suggestive index of the problems of Jewish distribution, however, is offered in the ratio of the number of Jews to the entire population. This is directly illustrated by our map. To be sure, this represents the situation twenty years ago, but no great change in relativity is to be suspected since that time. Even the wholesale exodus from Russia of recent years has not yet drawn off any large proportion of its vast body of population. Inspection of our map shows that the relative frequency of Jews increases in proportion to the progressive darkening of the tints. This brings out with startling clearness the reason for the recent anti-Semitic uprisings in both Russia, Austria, and the German Empire. A specific "center of gravity" of the Jewish people, as Leroy-Beaulieu puts it, is at once indicated in western Russia. The highest proportion, fifteen per cent, more or less, appears, moreover, to be entirely restricted to the Polish provinces, with the sole exception of the government of Grodno. About this core lies a second zone, including the other west Russian governments, as well as the province of Galicia in the Austro-Hungarian Empire. Germany, as it appears, is sharply divided from its eastern neighbors, all along the political frontier. Not even its former Polish territory, Posen, is to-day relatively thickly settled with Jews. Hostile legislation it is, beyond a doubt, which so rigidly holds back the Jew from immigration along this line. *Anti-Semitismus* is not, therefore, to-day to any great extent an uprising against an existing evil; rather does it appear to be a protest against a future possibility. Germany shudders at the dark and threatening cloud of population of the most ignorant and wretched description which overhangs her eastern frontier. Berlin must not, they say, be allowed to become a new Jerusalem for the horde of Russian exiles. That also is our American problem. This great Polish swamp of miserable human beings, terrific in its proportions, threatens to drain itself off into our country as well, unless we restrict its ingress. As along the German frontier, so also toward the east, it is curious to note how rapidly the percentage of Jews decreases as we [167] pass over into Great Russia. The governments of St. Petersburg, Novgorod, and Moscow have no greater Jewish contingent of population than has France or Italy; their Jewish problem is far less difficult than that of our own country is bound to be in the future. This clearly defined eastern boundary of *Judenthum* is also the product of prohibitive legislation. The Jews are by law confined within certain provinces. A rigid law of settlement, intended to circumscribe their area of density closely, yields only to the persuasion of bribery. Not Russia, then, but southwestern Russia alone, is deeply concerned over the actual presence of this alien population. And it is the Jewish element in this small section of the country which constitutes such an industrial and social menace to the neighboring empires of Germany and Austria. In the latter country the Jews seem to be increasing in numbers almost four times as rapidly as the native population. The more elastic boundaries of Jewish density on the southeast, on the other hand, are indicative of the legislative tolerance which the Israelites there enjoy. Wherever the bars are lowered, there does this migratory human element at once expand.

The peculiar problems of Jewish distribution are only half realized until it is understood that, always and everywhere, the Israelites constitute pre-eminently the town populations.[3] They are not widely disseminated among the agricultural districts, but congregate in the commercial centers. It is an unalterable characteristic of this peculiar people. The Jew betrays an inherent dislike for hard manual or outdoor labor, as for physical exercise or exertion in any form. He prefers to live by brain, not brawn. Leroy-Beaulieu seems to consider this as an acquired characteristic due to mediæval prohibition of land ownership or to confinement within the Ghetto. To us it appears to be too constant a trait the world over to justify such a hypothesis. Fully to appreciate, therefore, what the Jewish question is in Polish Russia, we must always bear this fact in mind. The result is that in many parts of Poland the Jews form an actual majority of the population in the towns. This is the danger for Germany also. Thus it is Berlin, not Prussia at large, which is threatened with an overload of Jews from the country on the east. This aggregation in urban centers becomes the more marked as the relative frequency for the whole country lessens. Thus in Saxony, which, being industrial, is not a favorite Jewish center, four fifths of all the Jewish residents are found in Dresden and Leipsic alone.[4] This is probably also the reason for the lessened frequency of Jews all through the Alpine highlands, especially in the [168]

Tyrol. These districts are so essentially agricultural that few footholds for the Jew are to be found.

A small secondary center of Jewish aggregation appears upon our map to be manifested about Frankfort. It has a peculiar significance. The Hebrew settlers in the Rhenish cities date from the third century at least, having come there over the early trade routes from the Mediterranean. Germany being divided politically, and Russia interdicting them from 1110, a specific center was established, especially in Franconia, Frankfort being the focus of attraction. Then came the fearful persecutions all over Europe, attendant upon the religious fervor of the Crusades. The Polish kings, desiring to encourage the growth of their city populations, offered the rights of citizenship to all who would come, and an exodus in mass took place. They seem to have been welcomed, till the proportions of the movement became so great as to excite alarm. Its results appear upon our map. Thus we know that many of the Jews of Poland came to Russia as a troublesome legacy on the division of that kingdom. At the end of the sixteenth century but three German cities remained open to them—namely, Frankfort, Worms, and Furth.[5] Yet it was obviously impossible to uproot them entirely. To their persistence in this part of Germany is probably due the small secondary center of Jewish distribution, which we have mentioned, indicated by the darker tint about Frankfort, and including Alsace-Lorraine. Here is a relative frequency, not even exceeded by Posen, although we generally conceive of this former Polish province as especially saturated with Jews. It is the only vestige remaining to indicate what was at one time the main focus of Jewish population in Europe. It affords us a striking example of what legislation may accomplish ethnically, when supplemented, or rather aggravated, by religious and economic motives.

Does it accord with geographical probability to derive our large dark area of present Jewish aggregation entirely from the small secondary one about Frankfort, which, as we have just said, is the relic of a mediæval center of gravity? The question is a crucial one for the alleged purity of the Russian Jew; for the longer his migrations over the face of the map, the greater his chance of ethnic intermixture. A moot point among Jewish scholars is, as to the extent of this exodus from Germany into Poland. Bershadski has done much to show its real proportions in history. Talko-Hryncewicz[6] and Weissenberg,[7] among anthropologists, seem to be inclined to derive this great body of Polish Jews from Palestine by way of the Rhone-Rhine-Frankfort route. They are, no [169] doubt, partially in the right; but the mere geographer would rather be inclined to side with Jacques.[8] He doubts whether entirely artificial causes, even mediæval persecutions, would be quite competent for so large a contract. There is certainly some truth in Harkavy's theory, so ably championed by Ikof (1884), that a goodly proportion of these Jews came into Poland by a direct route from the East. Most Jewish scholars had placed their first appearance in southern and eastern Russia, coming around the Black Sea, as early as the eighth century. Ikof, however, finds them in the Caucasus and Armenia one or two centuries before Christ. Then he follows them around, reaching Ruthenia in the tenth and eleventh centuries, arriving in Poland from the twelfth to the fourteenth. The only difficulty with this theory is, of course, that it leaves the language of the Polish Jews out of consideration. This is, in both Poland and Galicia, a corrupted form of German, which in itself would seem to indicate a western origin. On the other hand, the probabilities, judging from our graphic representation, would certainly emphasize the theory of a more general eastern immigration directly from Palestine north of the Black and Caspian Seas. The only remaining mode of accounting for the large center of gravity in Russia is to trace it to widespread conversions, as the historic one of the Khozars. Whichever one of these theories be correct—and there is probability of an equal division of truth among them all—enough has been said to lead us geographically to suspect the alleged purity of descent of the Ashkenazim Jew. Let us apply the tests of physical anthropology.

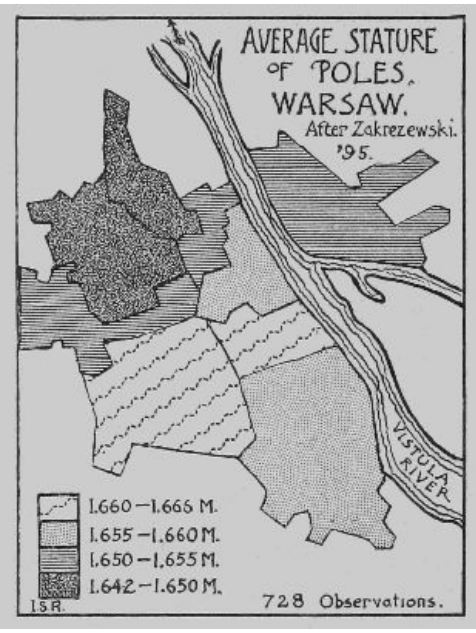
Stature.—A noted writer, speaking of the sons of Judah, observes: "It is the Ghetto which has produced the Jew and the Jewish race; the Jew is a creation of the European middle ages; he is the artificial product of hostile legislation." This statement is fully authenticated by a peculiarity of the Israelites which is everywhere noticeable. The European Jews are all undersized; not only this, they are more often absolutely stunted. In London they are about three inches shorter than the average for the city. Whether they were always so, as in the days when the Book of Numbers (xiii, 33) described them "as grasshoppers in their own sight," as compared with the Amorites, sons of Anak, we leave an open question. We are certain, however, as to the modern Jew. He betrays a marked constancy in Europe at the bodily height of about five feet four inches (1.63 metre) for adult men. This, according to the data afforded by measurements of our recruits during the civil war, is about the average of American youth between the ages of fifteen and sixteen, who have still three, almost four, inches more to grow. In Bosnia, for example, where the [170] natives range at about the American level—that is to say, among the very tallest in the world (1.72 metre)—the Jews are nearly three inches and a half shorter on the average.[9] If we turn to northern Italy, where Lombroso has recently investigated the matter, we apparently find the Jew somewhat better favored by comparison. He is in Turin less than an inch inferior to his Italian neighbors. But why? Not because taller than in the case of Bosnia, for his stature in both places is the same. The difference decreases, not because the Jew in Piedmont is taller, but solely because the north Italians are only of moderate height. So it goes all over Austria and Russia: the diminutiveness is plainly apparent.[10] There is in all Europe only a single exception to the rule we have cited. Anutchin finds them in Odessa and Riga slightly to exceed the Christians. In order to emphasize this point it will repay us to consider the adopted fatherland of the Jews a bit more in detail.

STATURE POLAND.

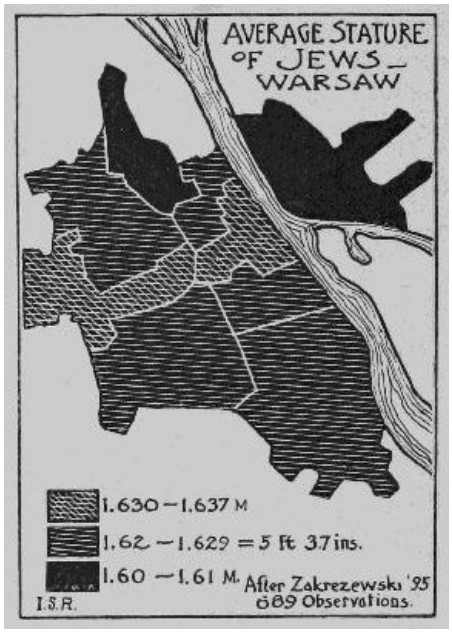
Our map herewith shows a general average of stature for Poland by districts. This unhappy country appears to be populated by the shortest human beings north of the Alps; it is almost the most stunted in all Europe. The great majority of the districts, as our map shows, are characterized by a population whose adult men scarcely average five feet four inches (1.62 metre) in height. This is more than half a head shorter than the type of the British Isles or northern Germany. What is the meaning of this? Is it entirely the fault of the native Poles? We know that the northern Slavs are all merely mediocre in stature. But this depression is too serious to be accounted for in this way; and further analysis shows that the defect is largely due to the presence of the vast horde of Jews, whose physical peculiarity drags down the average for the entire population.[11] This has been proved directly. Perhaps the deepest pit in this great "misery spot," as we have termed such areas of dwarfed population elsewhere, is in the capital city of Warsaw, where Elkind found the average stature of two hundred male Jews to be less than five feet three inches and a half (1.61 metre).[12] The women were only four feet eleven inches tall on the average. Compare the little series of maps given on pages 172 and 173 if further proof of this national peculiarity be needed. Two of these, it will be observed, give the average height [171] of Jews and Poles respectively, dividing the city into districts. The social status of these districts is shown upon our third map. Comparison of these three brings out a very interesting sociological fact, to which we have already called attention in our earlier papers.[13] The stature of men depends in a goodly measure upon their environment. In the wards of the city where prosperity resides, the material well-being tends to produce a stature distinctly above that of the slums. In both cases, Poles and Jews are shortest in the poorer sections of the city, dark tinted on the maps. The correspondence is not exact, for the number of observations is relatively small; but it indicates beyond a doubt a tendency commonly noticeable in great cities. But to return to our direct comparison of Poles and Jews; the deficiency of the latter, as a people, is perfectly apparent. The most highly favored Jewish population socially, in the whole city of Warsaw in fact, [172] can not produce an average stature equal to that of the very poorest Poles; and this, too, in the most miserable section of the capital city of one of the most stunted countries in Europe.

We may assume it as proved, therefore, that the Jew is to-day a very defective type in stature. He seems to be susceptible to favorable influences, however; for in London, the West End prosperous Jews almost equal the English in height, while they at the same time surpass their East End brethren by more than three inches.[14] In Russia also they become taller as a class wherever the life conditions become less rigorously oppressive. They are taller in the fertile Ukraine than in sterile Lithuania; they sometimes boast of a few relatively tall men.[15] These facts all go to show that the Jew is short, not by heredity, but by force of circumstances; and that where he is given an even chance, he speedily recovers a part at least of the ground lost during many ages of social persecution. Jacobs mentions an interesting fact in this connection about his upper-class English Jews. Close analysis of the data seems to show that, for the present at least, their physical development has been stretched nearly to the upper limit; for even in individual cases the West End Jews of London manifest an inability to surpass the height of five feet nine inches. So many have been blessed by prosperity that the average has nearly reached that of the English; but it is a mean stature of which the very tall form no component part. Thus perhaps [173] does the influence of heredity obstruct the temporary action of environment.

Whether this short stature of the Jew is a case of an acquired characteristic which has become



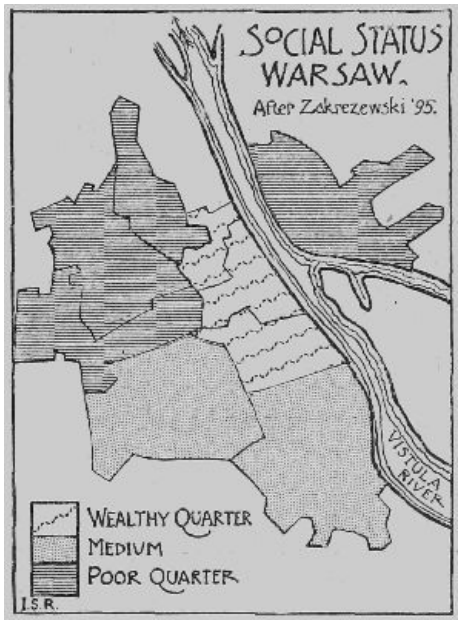
AVERAGE STATURE of POLES, WARSAW.



AVERAGE STATURE of JEWS, WARSAW.

hereditary, we are content to leave an open question. All we can say is, that the modern Semites in Arabia and Africa are all of goodly size, far above the Jewish average.[16] This would tend to make us think that the harsh experiences of the past have subtracted several cubits from the stature of the people of Israel. In self-defense it must be said that the Christian is not entirely to blame for the physical disability. It is largely to be ascribed to the custom of early marriages among them. This has probably been an efficient cause of their present degeneracy in Russia, where Tschubinsky describes its alarming prevalence. Leroy-Beaulieu says that it is not at all uncommon to find the combined age of husband and wife, or even of father and mother, to be under thirty years. The Shadchan, or marriage broker, has undoubtedly been an enemy to the Jewish people within their own lines. In the United States, where they are, on the other hand, on the up grade socially, there are indications that this age of marriage is being postponed, perhaps even unduly.[17]

A second indication in the case of the Jew of uncommonly hard usage in the past remains to be mentioned. These people are, anthropologically as well as proverbially, narrow-chested and deficient in lung capacity. Normally the chest girth of a well-developed man ought to equal or exceed one half his stature, yet in the case of the Jews as a class this is almost never the case. Majer and Kopernicki[18] first established this in the case of the Galician Jews. Stieda[19] gives additional testimony to the same effect. Jacobs[20] shows the English Jews distinctly inferior to Christians in lung capacity, which is generally an indication of vitality. In Bosnia, Glück[21] again refers to it as characteristic. Granted, with Weissenberg,[22] that it is an acquired characteristic, the effect of long-continued subjection to unfavorable sanitary and social environment, it has none the less become a hereditary trait; for not even the perhaps relatively recent prosperity of Jacobs's West End Jews has sufficed to bring them up to the level of their English brethren in capacity of the lungs.



SOCIAL STATUS WARSAW.

At this point a surprising fact confronts us. Despite the appearances of physical degeneracy which we have noted, the Jew betrays an absolutely unprecedented tenacity of life. It far exceeds, especially in the United States, that of any other known people.[23] This we may illustrate by the following example: Suppose two groups of one hundred infants each, one Jewish, one of average American parentage (Massachusetts), to be born on the same day. In spite of all the disparity of social conditions in favor of the latter, the chances, determined by statistical means, are that one half of the Americans will die within forty-seven years; while the first half of the Jews will not succumb to disease or accident before the expiration of seventy-one years. The death rate is really but little over half that of the average American population. This holds good in infancy as in middle age. Lombroso has put it in another way. Of one thousand Jews born, two hundred and seventeen die before the age of seven years; while four hundred and fifty-three Christians—more than twice as many—are likely to die within the same period. This remarkable tenacity of life is well illustrated by the following table from a most suggestive article by Hoffmann.[24] We can not forbear from reproducing it in this place.

Death Rates per 1,000 Population in the Seventh, Tenth, and Thirteenth Wards of New York City, 1890, by Place of Birth.

Ages.	Total.	United States (includes colored).	Ireland.	Germany.	Russia and Poland (mostly Jews).
Total	26.25	45.18	36.04	22.14	16.71
Under 15 years	41.28	62.25	40.71	30.38	32.31
15 to 25 years	7.55	9.43	15.15	7.14	2.53
25 to 65 years	21.64	25.92	39.51	21.20	7.99
65 and under	104.72	105.96	120.92	88.51	84.51

From this table it appears, despite the extreme poverty of the Russian and Polish Jews in the most densely crowded portions of New York; despite the unsanitary tenements, the [175] overcrowding, the long hours in sweat shops; that nevertheless, a viability is manifested which is simply unprecedented. Tailoring is one of the most deadly occupations known; the Jews of New York are principally engaged in this employment; and yet they contrive to live nearly twice as long on the average as their neighbors, even those engaged in the outdoor occupations.

Is this tenacity of life despite every possible antagonistic influence, an ethnic trait; or is it a result of peculiar customs and habits of life? There is much which points to the latter conclusion as the correct one. For example, analysis of the causes of mortality shows an abnormally small proportion of deaths from consumption and pneumonia, the dread diseases which, as we know, are responsible for the largest proportion of deaths in our American population. This immunity can best be ascribed to the excellent system of meat inspection prescribed by the Mosaic laws. It is certainly not a result of physical development, as we have just seen. Hoffmann cites authority showing that in London often as much as a third of the meats offered for sale are rejected as unfit for consumption by Jews. Is not this a cogent argument in favor of a more rigid enforcement of our laws providing for the food inspection of the poor?

A second cause conducive to longevity is the sobriety of the Jew, and his disinclination toward excessive indulgence in alcoholic liquors. Drunkenness among Jews is very rare. Temperate habits, a frugal diet, with a very moderate use of spirits, render the proportion of Bright's disease and affections of the liver comparatively very small. In the infectious diseases, on the other hand, diphtheria and the fevers, no such immunity is betrayed. The long-current opinion that the Jews were immune from cholera and the other pestilences of the middle ages is not to-day accepted. A third notable reason for this low death rate is also, as Hoffmann observes, the nature of the employment customary among Jews, which renders the proportion of deaths from accidental causes exceedingly small. In conclusion, it may be said that these people are prone to nervous and mental disorders; insanity, in fact, is fearfully prevalent among them. Lombroso asserts it to be four times as frequent among Italian Jews as among Christians. This may possibly be a result of close inbreeding in a country like Italy, where the Jewish communities are small. It does not, however, seem to lead to suicide, for this is extraordinarily rare among Jews, either from cowardice, as Lombroso suggests; or more probably for the reason cited by Morselli—namely, the greater force of religion and other steadying moral factors.

[*To be continued.*]

THE PLAYGROUNDS OF RURAL AND SUBURBAN SCHOOLS.

[176]

By ISABELLA G. OAKLEY.

While the officers and friends of education in large cities are exerting themselves to provide open-air playgrounds for the schools, the villages and smaller towns all over the East are reversing the case. Except in the small district schools, the children's playground has almost ceased to exist.

This is an evil which has crept in with the tendency to centralize the schools. When in any place the schools begin to overflow, a movement to put up a larger building takes place, accompanied by an effort to create a high-school department; not so much the need of the community as the ambitious dream of some principal who would be superintendent, or some sort of central sun to a group of satellites. This dream is too easily realized, because it flatters the people. Then there rises a preposterous structure of stone and brick; a house of many gables, out of keeping with everything, either public or private, in the place; a temple of vanity. Now is rung the knell of the school playground, for the new "high school," although it will house all the children from five to fifteen, must needs be surrounded by a fine lawn, studded with shrubbery, and threaded by bluestone roads. The janitor has to employ an assistant to keep the grounds in order. A shut-in, penitentiarylike place has been evolved by the architect and school committee, gratifying to their pride and a deep wrong to the children. There are many wrongs about it; the one insisted upon here is the abolishing of the recess, that time-honored joy of the American schoolboy and schoolgirl.

The cheerful sounds of play no more re-echo; the little ones march in "lock step" from the doors to the very curb of this immaculate ornate inclosure. If, on this beautiful lawn, any impulsive youngster is caught running, or performing an instinctive hopscotch or leapfrog, he is sure to be

seen by a watching and powerful janitor and reported. Leapfrog and profanity, in the true Draconian spirit, are alike visited with the extreme penalty of a visit to the principal's office. However, in default of a playground, the new schoolhouse provides a gymnasium for physical culture. I speak now of a particular school, the pride of a simple village, and a type of many. This gymnasium is a costly room filled with elaborate apparatus, most of which is suited only to the high-school pupils, and never touched by the majority, who leave school at twelve or thirteen; their physical exercises have been chiefly provided for by a box of dumb-bells and wands. In many schools the "gymnasium" is a cavernous and ugly basement, a place full of shadows cast by [177] the gloomy arches on which the building rests, with walls of brick and floors of asphalt. Little troops of silent, pale children arrive and depart all day for their *physical culture*, a dreary repetition of silent dumb-bell exercises. There is no speech nor language among them, no sound is heard but the jingle of the piano and the sharp tones of the monitor's counting. I have never heard the children count aloud or accompany the calisthenics by singing except in a private school. What an alternative for a free recess! No penitentiary drill could be more perfunctory, spiritless, dead. It must be said of the public schools that the thing they most seem to dread is the sound of a child's voice. The rude, untrained intonations, the slovenly speech, the slouching attitude remain rude, slovenly, and slouching, for all the school attempts to do for their improvement is infinitely little. Even the blessed relief of shaking the arm and hand to attract the teacher's attention has been reduced in some schools to lifting two fingers.

The pupils generally hate their calisthenics, or, in the new phrase, physical culture exercises. And they would hate just as sincerely regulated games superintended by some impossible master of sports. What they want is spontaneity in play. Public money is wasted in providing these abhorrent alternatives. Poor little Carthusians as young as six and seven years are kept in their rooms, and principally in their seats, above two hours at each session, and often after that to atone for some delinquency, most likely for speaking. In many schools they do not leave the room for any kind of exercise. If they were capable of demanding their rights they would call for both the abolition of the school lawn and calisthenic basement, and the restoration of their playground and recess.

From the cruelty of this repression nature finds a little way out; the children require of the neighbors what they have been deprived of by the school committee. All around the precincts of the temple of learning the trodden borders of the sidewalk, churned to mire in winter and trampled to rock in summer, speak of the victory of the boys. There are towns, perhaps, where they all go straight home, but in our town, they gather four times a day in knots of twenties and fifties for some kind of fun. The patient neighbors go on removing coats and dinner pails from the pickets, clearing away papers and missiles from their inclosures, yet I discover that even they would vote to keep the school lawn; it improves the town. Very true. But ingenuity could well contrive some way of uniting the playground and the school park. Spaces of grass to rest the eye and decorate the square could be interspersed with inclosures of asphalt, furnished with a few parallel bars and swings, without sacrifice of appearances. Often the school property is so large [178] that it could include half a dozen such special playgrounds. We have but to begin it to find some feasible plan.

If the palatial school and its park is reaction against the "ragged beggar" of Whittier's lovely poem, sunning in the midst of the blackberry vines of Hardscrabble Hill, it is a reaction that has gone too far to suit a generation which loves to read Hosea Bigelow:

> "So the old school'us is a place I choose
> Afore all others, ef I want to muse;
> I set down where I used to set, an' git
> My boyhood back, an' better things with it—
> Faith, Hope, an' sunthin', ef it isn't Cherrity,
> It's want o' guile, an' thet's ez gret a rarity."

If it may be replied, that is not the generation for whom schoolhouses are now built, it is one which may interpret the wants of its children by just such recollections.

Another evil has grown out of the centralization of the schools. The smaller schoolhouses formerly stood within convenient reach, and by abandoning them we have forced many little children to walk farther than they are able to walk. In the absence of street cars and sidewalks this becomes a great hardship in extreme weather. In one village in New York, out of an enrollment of fourteen hundred, there was one month last year an average attendance of four hundred. The new school building, which had cost seventy-five thousand dollars, was more than two miles from some part of the district, and there were no sidewalks; neither were there paved streets or street lamps. In such circumstances a number of children are unable to get home to the noon meal, usually dinner, and most important. Where do they eat their luncheon? In their seats, watched by teachers, who are compelled unwillingly to take turns at this duty, and who have also to eat a cold, unpalatable lunch in bad air for a week at a time. After lunch there is an hour to be disposed of by the children, but there is no place to play in except the basement or the streets of the neighborhood. The teachers frequently read them a story, that they may stretch their minds a little if not their bodies. It is a painful sight—few more painful to me—to see a crowd of young children having their recreation in one of these basements. Running and loud

talking are forbidden; a police of teachers armed with symbols of authority and punishment keep the restless little prisoners within bounds.

Another objection to the central school is the rainy-day half-session. Though the daily instruction may be managed so that the pupils do not miss anything, it is still a fact that the majority of [179] parents expect the school to take charge of their children, and are often much dissatisfied to have them thrown back upon their own hands on rainy days.

How has it come about that the playground and school recess have been so generally given up? Is it altogether on account of appearances? Teachers plead that the children ought to be preserved from association with objectionable playmates. This may do for the touch-me-not, only child, but in American society it is never a strong plea. That small fraction which seeks to educate its children as a class can do so in a few schools limited to church, plutocracy, Quakerism, or some such narrow basis. But the schools of a free State are, above everything, founded on the essential equality of individuals in the State, and the possibility of every one to rise to a successful and honorable manhood. If there is one conviction above another strengthened by experience, it is that, in their choice of companions and susceptibility to influence, children are governed by their innate qualities, and these qualities are fixed by heredity and home influences long before the school age. In so large a community as a public school there is companionship for all, for it certainly represents the town itself. Let no one be afraid of the democratic instincts of childhood.

I believe the playground is abolished because it interferes with that deadly order and craze for supervision which is sought for as the prime condition both inside and outside the schools. Order of a wholesome sort is not inconsistent with the free recess of a big school. I watched in Los Angeles a great school as it was marshaled out to play and back again at the sound of a drum. After a quarter of an hour of unrestrained sport, several hundreds were gathered in lines at the tap of the drum, facing the cheerful schoolhouse in the mild bright sun, their faces radiating contentment and good will while they straightened up at the mere hint of the teachers on duty. In San Francisco I once found a certain primary school keeping doll's day, when every girl brought her doll to school and exhibited her at recess. The school yard was a barren inclosure within a high board fence, but a joyful place to that young company. To what purpose are teachers urged to study psychology? The children in their seats are emptied of everything that pertains to their souls. Not to study, because the teacher will explain everything, and to behave just well enough to get safe out of school, is the simple code which covers the conduct of average children. To extend this code to ideas of social duty—the highest—is not possible while they do not form a society. Cultivation of friendship is just as much out of the case; awakening of ideals, an impossibility. But thrown together half an hour or more each day, the dead machinery that pulls [180] the bells and adds the marks within the school walls gives way to life; and here a man who sympathizes with childhood has all the opportunity he needs, and probably much more than he can use, in providing for that life where a code of reciprocity and honor must be established. It is not as the magistrate he will successfully rule, but as the sympathetic general in the field, whose very name is a talisman and an inspiration to every man. In the school yard, the bully, who comes to the front in about every tenth child, needs to be repressed; the foul mouth must be cleansed; against these prevailing evils the playground has a protection the street can not possess. The boy's world is a peculiar world, certainly, making laws for itself as rigorous and about as barbarous as those of a gang of pirates; but it is through his *esprit du corps* he can be uplifted and educated; the individual may be a selfish animal; as one of a body he is capable of heroism and devotion to a noble idea. He can be a friend; the playground is the field for the natural growth of friendships, and youth the generous time of their birth.

I recall another scene in a schoolroom in a Western city long ago. A gentle girl, magnetic, deep-hearted, large-eyed, sat after school at her table in tears. On a seat in front of her platform were piles of slates which she had been correcting, for she instructed all day a succession of arithmetic classes coming to her from the different grades. At the same time she was in charge, for all particular purposes of their order and conduct, of about forty boys in their early teens. Her tears were in consequence of a quarrel at recess between two of her boys. They had settled their quarrel by a fight; not unlikely it was a wholesome fight, for they were not boys of the mean sort, and were friends. It is an affair of long ago, but of a time when, in a large city, a teacher shed her influence upon the school playground, and took account of its moral standards, its friendships and breaches of friendship.

Although white men, if they take due precautions, may live and do certain kinds of work in tropical Africa, it will never be possible, Mr. J. Scott Keltie concludes from the results of past experience and study, to colonize that part of the world with people from the temperate zone. Even in such favorable situations as Blantyre, a lofty region south of Lake Nyassa, children can not be reared beyond a certain age, but must be sent home to England; otherwise they will degenerate physically and morally. A plan has been proposed of bringing Europeans down into the tropical regions by degrees, and acclimatizing them by successive generations to more and more torrid conditions till they are finally settled in the heart of the continent. But the experiment would be a very long one, if tried; and the ultimate result would probably be a race deprived of all those characteristics which have made Europe what it is.

UP THE SKEENA RIVER TO THE HOME OF THE TSIMSHIANS.[25]

[181]

By GEORGE A. DORSEY, Ph. D.,
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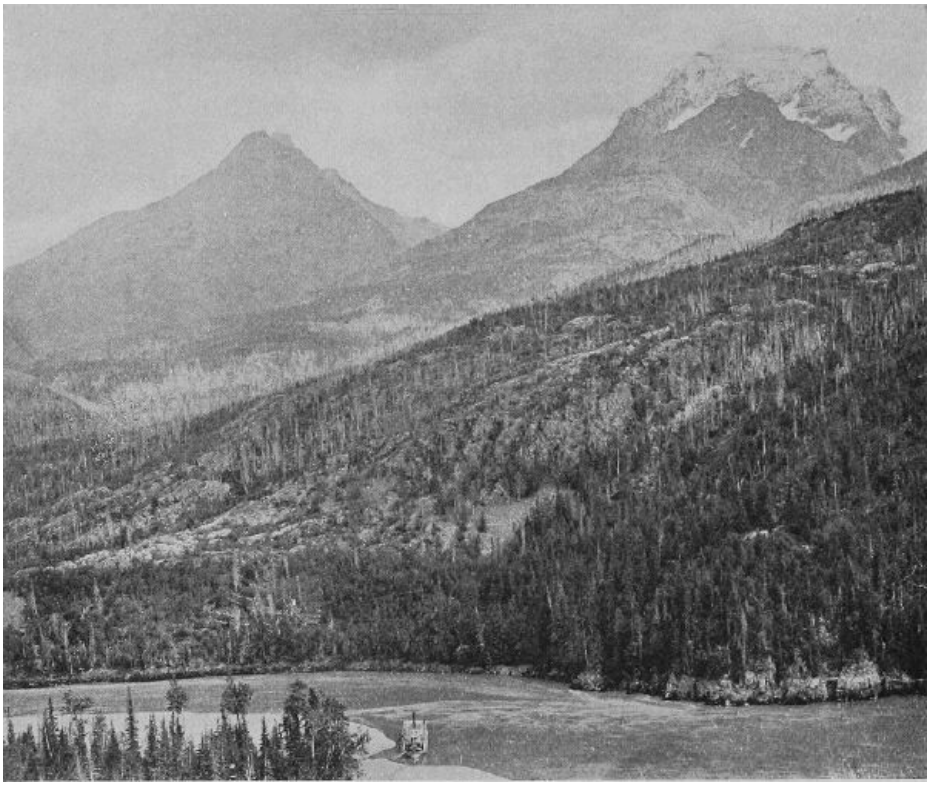
In a recent number of the Monthly I described some of the incidents of a visit to the Haida and Tlingit villages about Dixon's Entrance; now I am to speak of the Tsimshian villages on the Skeena River. The Tsimshian Indians are one of the five great stocks which make up the aboriginal population of the coast of British Columbia and southern Alaska. They are shut in by the Tlingits on the north and by the Kwakiutls on the south, while on the head waters of the Nass and Skeena Rivers they come in contact with the great Tinneh or Athabascan stock. The Tsimshians are probably the most progressive of all the coast Indians, and are one of a few stocks on the American continent which are holding their own in point of numbers.

Desiring to visit those villages which are least contaminated by modern influence, we ascended the Skeena River to the village of Kitanmaksh or Hazelton. The Skeena is the historic river of British Columbia; its name signifies the "Water of Terrors." Nearly every rock, every bend, every cañon is the scene of some mythical tale. The scene of the birth of the Tsimshian nation lies in its valley; the rock is still revered upon which rested the Tsimshian ark after the flood, and the "Dum-lak-an," "the new home and place of dispersal," is still a Mecca to which pilgrimages are made. In the modern development of the Omenica and Cariboo gold fields the Skeena has been the highway to the sea. For hundreds of years canoes have been paddled up and down its waters; it has been the highway for intertribal trade from time immemorial, and when the Hudson Bay Company's post was established at Hazelton, and merchandise began to pour into the upper country in a steady stream, the Tsimshians with their canoes enjoyed for a long time a monopoly of the carrying trade. Gradually, as they learned the ways and methods of the white man, the price per ton of freight from the coast to Hazelton began steadily to rise, until in 1891 the tariff of sixty dollars a ton was declared ruinous by the company, and they decided to build their own steamer with which to carry their freight up the river.

Port Essington is the chief port of the mouth of the Skeena, and in Essington we found ourselves on the twenty-third day of July. The Caledonia was up the river on her third trip, but was expected back any hour, but so delightfully uncertain is the river voyage that, as we were [182] informed, "there was no telling when she would be down—in fact, she might be caught above the cañon and wouldn't be down for weeks."



View on the Upper Skeena River; Peak of the "Five Virgins" Mountain.

The town of Essington dates back to 1835, when the Hudson Bay Company established a post there. Its only rival for preeminence on the coast is Port Simpson. The town in summer is completely given over to fishing, the salmon cannery of Cunningham & Son being one of the largest on the coast, and the river for twenty miles is dotted with canneries. In one day, while we were in Essington, the catch of salmon on the river was ninety-two thousand fish. In addition to the cannery the town boasts of a good hotel and a Salvation Army. An Indian Salvation Army is worth going miles to see, for the Indian is a natural-born salvationist; the army permits him to make all the noise he chooses, sing as loudly as he pleases, and, best of all, he is entitled to make a speech every time it comes his turn.

In the afternoon, about four o'clock, on the day after our arrival, a long, shrill blast of the whistle aroused the entire town, for the Caledonia was in sight. Down we went to the wharf, and the entire town followed. What a motley crowd you will find on one of these British Columbia [183] wharves! What coloring, what a Babel of tongues—Tlingits from Alaska, Haidas from the Queen Charlotte Islands, Tsimshians from the Skeena, Kwakiutls from Vancouver, Chinamen, Japanese, Greeks, Scandinavians, Englishmen, and Yankees; men, women, children, dogs, and from two to six woolly bear cubs. The Caledonia is the exclusive property of the Hudson Bay Company; she is not a common carrier, and does not encourage either passengers or freight, as the tariff rates prove. There is a feverish haste and hustle about the movements of the steamer which are fairly contagious. She makes her first trip early in the spring, as soon as the ice has left the rivers, on the Stickene; then it is a wild, eager ambition of the company to have her make four trips up the Skeena before the river closes up in the fall.

We had as passengers two prospectors from Spokane, a mining expert from Victoria, a native evangelist from Essington, and about fifty Indians, mostly women and children, each one with a varied assortment of boxes, bales, bundles, and dogs; the crew numbered twenty, and we had about one hundred tons of freight on board.

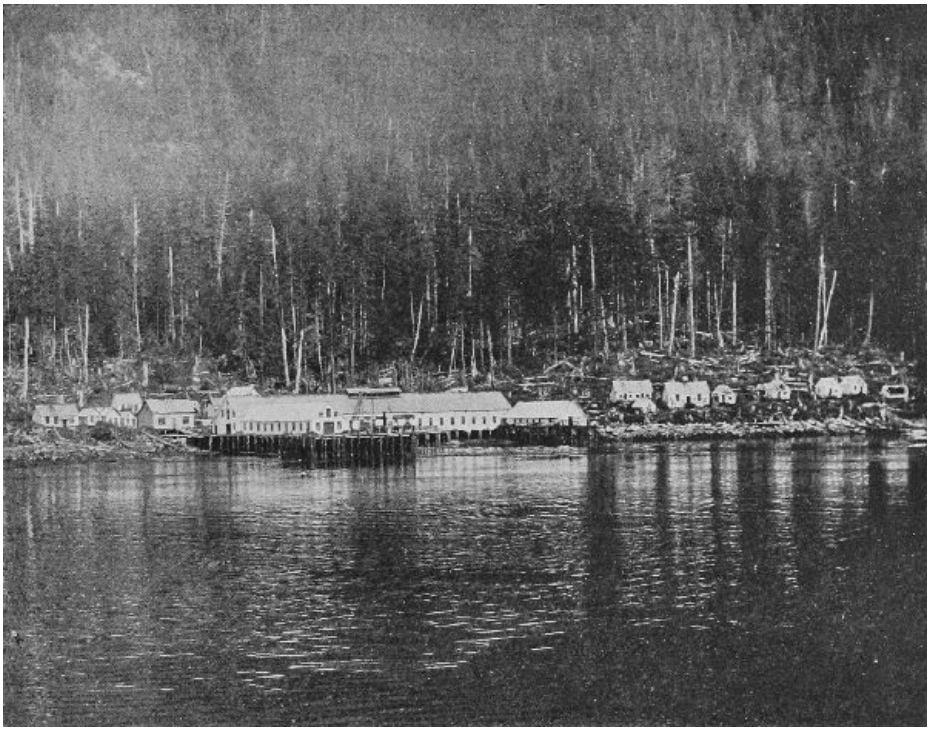
From Essington to Hazelton is one hundred and fifty-two miles, a panorama of unending and unbroken beauty; never monotonous, always interesting, it presents a river voyage which is probably not equaled, certainly not excelled, by any other river voyage of the same length on the American continent or in the world. We began the voyage on Sunday morning, we tied up in front of Hazelton on Saturday night. To recount in detail the haps and mishaps of each day's progress would take more time than I can command. In one day we made forty-eight miles, on another day we made one hundred yards, on another day we didn't make a foot. With plenty of water under her keel the Caledonia could run twenty miles an hour; she could cut her way through a sand bar at the rate of a yard or so an hour; and at either rate of progress she burned each hour from one and a half to two cords of wood.

For the first ten miles the scenery does not differ materially from that which we are accustomed to in the inland sea from Victoria to Alaska. Then we enter fresh water and for the next forty miles steam through one long mountain gorge, for here the river has cut completely through the Cascade Range. The mountains begin at the water's edge and rise almost perpendicularly to heights of from three to four thousand feet. Their lower limits are covered with dense green forests, which seem to grow out of the solid rock. The summits are smooth and glistening, and often covered with snow and ice. Here and there we can trace some tiny rivulet issuing from an ice bed high up among the clouds, and every portion of its course can be traced down the steep mountain wall until it gives one final and headlong plunge into the river. At times these streams, [184] taking their rise in some extensive glacier, are of considerable magnitude, and fairly roar as they leap and hurl themselves downward from their dizzy height. And here we learned a curious fact about the river: in summer it falls when it rains, and rises when the sun shines, so rapidly do the pent-up snows of winter disappear and rush down the mountain sides under the heat of the spring sun.

Until noon of the second day we had been making good time, but now the fun began, for we had left deep water and had arrived at the first flight of the eight-hundred-foot stairway which the Caledonia had to climb ere Hazelton could be reached. The river had been gradually widening as one island after another had been passed, until now it was nearly half a mile wide and flowed through four channels. The captain attempted one channel, but we couldn't gain an inch, and in drifting back again down the rapids the current carried the boat against the rocks and, with a crash and a lurch, but minus some woodwork, she was in the stream again. Then two other channels were tried, but without avail, although the wheel was throwing water and gravel over the pilot house. The fourth channel was next tried, but the current was too strong. Then we "lined her out," and this novel method of getting a huge steamboat up a stream soon became only too commonplace. The method of procedure is this: The boat is forced against a sand bar and allowed to rest while men go forward in a skiff with a long four-inch cable, which is made fast to a tree on the bank or to a "dead man," a long spar buried deep in the earth of a sand bar and heaped over with bowlders. When all is ready, the boat is attached to the capstan and the wheel begins to revolve. It is tedious work and often provoking, as when the cable parts, or the "dead man" gives up his hold, and the whole work must be done over again. The boat quivers from stem to stern, and the wheel, with all possible steam on, is simply one revolving ball of water. We fairly hold our breath as we listen to the dull vibration of the boat, the rumbling of the capstan, and the grating sound of the keel of the steamer as she is being dragged through the rapids over the bar; but above all can be heard the voice of Captain Bonser as he shouts to his Indian pilot, "Go 'head capstan," "Stop steamboat," "Stop capstan," "Go 'head steamboat," "Go 'head capstan!" In four hours we have made about fifty yards, but we are in open water again and the boat settles down to its regular chug, chug, chug.

Eighty miles from Essington the Skeena in its flight to the sea makes its first plunge into the Cascade Mountains, and its entrance is indescribably grand. No pen or brush can do justice to the beauties of the Kitselas Cañon. At its mouth we are in a broad, deep basin, as if the river had [185] felt depressed as it passed through the quarter-mile narrow gorge and had here spread itself out to breathe and rest before it started anew its downward journey to the sea. It was late in the afternoon, and the western sun threw long shadows of the lofty sky-crowned perpendicular walls of the left-hand side of the cañon over against the rocky islets and ragged, rock-bound eastern shore. Once we have entered, there is no faltering; "lining it out" is impossible here, and on and

on the boat labors and climbs, twisting and turning through the narrow, tortuous channel. A quick eye and a steady nerve must command the wheel now, for a turn too much or too little would be fatal. One instinctively feels that the "Water of Terrors" is the proper name for this river, and with that feeling comes the other—that it was never intended for navigation.



A Skeena River Salmon Cannery.

After four days' grinding over sand bars and pounding against rocks we tie up for repairs. One of the boilers had sprung a leak which could be neglected no longer. The delay of thirty-six hours was not without compensation, for the country about was open, and proved a relief after the long ride through the high-walled river from the sea to the cañon. The banks were low or moderately high and of gravel or sand bluffs, and we could look off over a landscape broken here and there [186] by solitary peaks or clustered mountains, their summits always covered with ice and snow. To the far east were the pure white peaks of the Five Virgins, their summits glistening under the bright sun. Even the character of the vegetation had changed, and the dense forests of somber firs, spruces, and cedars of the lower river had given way to great cottonwoods and underbrush of hazel and alder.

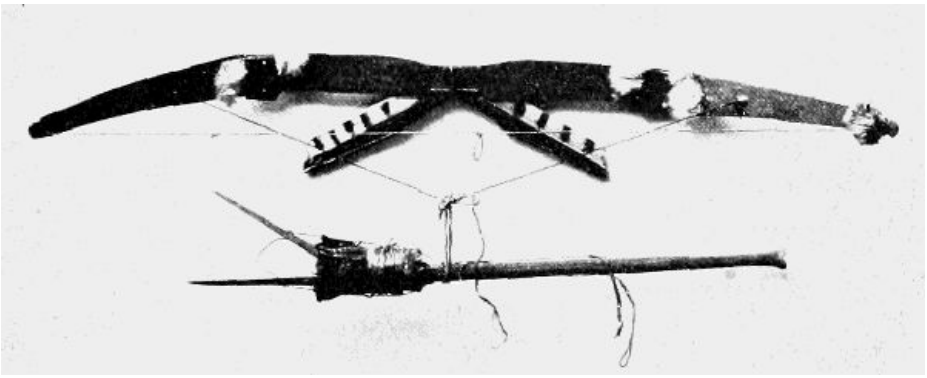
In the afternoon we climbed a bluff near the river, from which we could look off over a country that was wild and extremely picturesque. To one side of us could be seen a great mountain, its summit covered by a mighty glacier whose blue-white ice gleamed and glistened in the sun. And there was no mistaking the power of the sun that day; its warm rays being especially welcome after some weeks of the cold, depressing gloom and fog of the coast.

We were now really in the country of the Tsimshians, and every few hours we drew up in front of some quiet, peaceful village, its almost deserted cottages guarded by the totem poles of former days. In succession we pass Meamskinesht, Kitwangah, and Kitzegukla, with now and then a small salmon-fishing station. The villages proved disappointing both in their smallness and modernness, and none of them seemed worthy of any extended visit. From time to time we passed great black patches in the forest, the result of extensive fires, sure signs that the rainy coast was far away.

On Friday night we tied up to the bank within five miles of our destination, but we had yet to pass Macintosh's Bar. That was accomplished on the following day, after eleven hours' hard work, and by five o'clock we had reached "The Forks," or the junction of the Skeena and Bulkley Rivers. Our course was to the left, up the Skeena for half a mile, and in a few moments more we tied up in front of the stockaded post of the Hudson Bay Company; we had reached Hazelton. The region about us was "Dum-lak-an," "what will be a good place," the home of the Tsimshians.

Before 1870 the town was farther down the river, on the flat at the junction of the Bulkley and Skeena Rivers. It has had additions to its population from Kis-pi-yeoux, and from villages down the river. There are also to be numbered among the inhabitants the Indian agent, Mr. Loring, the Hudson Bay representative, Mr. Sargent, and his assistants, and Mr. Fields, the missionary. The Indian population numbers about two hundred and seventy-five. The town occupies a low, uneven plain, which, beginning at the water's edge, extends back for a quarter of a mile, where it is hemmed in by a high bluff on the face of the second river terrace. There are but few of the old houses left and still fewer totem poles, and they are without particular interest. Most prominent in the village is the warlike stockade of the company's post, with its two bastions at opposite [187] corners, and the blockhouse in the center of the inclosure, but now hidden by the store which stands in front of it. The stockade was put up in 1891, when an Indian uprising was feared throughout the length of the river.

Wherever you find a trading post and a missionary you can not hope to find people who retain much of their native life or who are of great value to anthropology. But still Hazelton was sufficiently primitive to be of interest in many respects. In matters of dress the Indians are almost on a footing with the whites, but they still make a curious garment for winter's use which is worn by nearly all of the interior tribes. This is a blanket made out of long, narrow strips of rabbit hide, and is warm, heavy, and extremely durable. We were fortunate enough to find a woman who was engaged in making one of these curious garments on a most rude and primitive loom. Other garments are still occasionally made of Indian hemp, which grows wild and in abundance. This is beaten and pounded and then spun into fine thread, and woven into the desired form.



Tsimshian Shaman's Ceremonial Bow and Arrow.

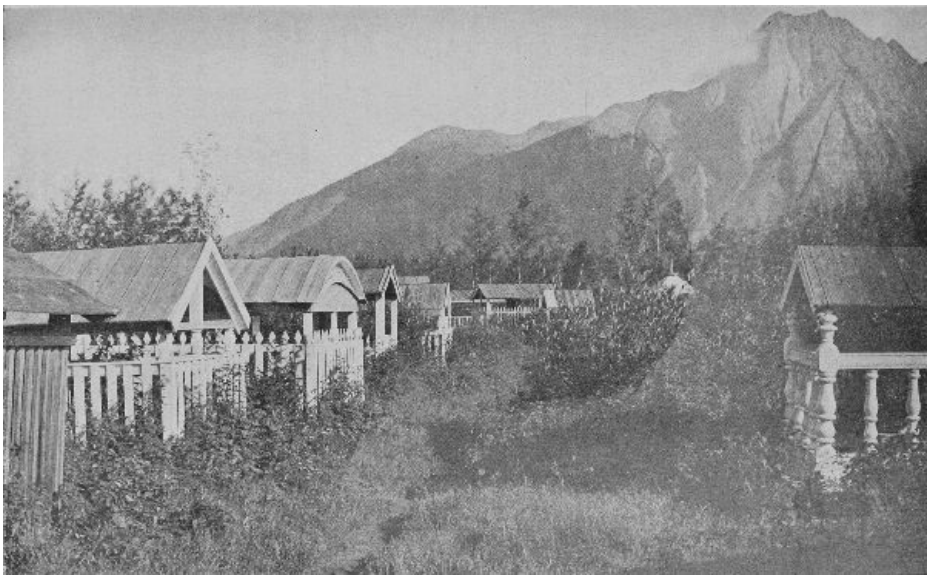
In former days the Indians used large quantities of the wool of the mountain sheep in making the beautiful *chilcat* blankets that formed an important part of the chief's costume, but now the Indians buy most of their wool. Its chief uses are for sashes and belts, which are still worn and made after the fashion of former days. Of other garments of daily use, except moccasins, there is nothing remaining. There are a few remnants of ceremonial costumes still in existence, and by a bit of good fortune we were enabled to secure the complete paraphernalia of a shaman, or Indian doctor, who had only recently renounced his native practices and joined Mr. Fields's band of Christians. In the outfit thus acquired were rattles, charms, blankets, masks, and headdresses of various kinds. From another individual we secured the complete costume of a member of the fraternity, or secret society, of Dog Eaters. The Tsimshians have four such societies, and the Dog Eaters stand third in rank, being surpassed only by the Man Eaters or Cannibal Society. The chief [188] object of this outfit, apart from the white and red cedar bark rings, was a long club, one side of which was ornamented by a fringe of red cedar tassels. Of interest also was the curious cap made of plaited bands of red cedar bark, and so ornamented as to represent the head of the owl. Another object secured from a shaman was a peculiar bow and arrow. These were purely ceremonials, and were only used in the dances of the secret societies. By an ingenious device the point of the arrow could be opened out, and in this position represented the open jaws of a serpent. On the bow were two fins, that could be lowered or raised at will by means of cords, which represented the fin-back whale. The bow itself is of light soft wood, and is bent by means of a string passing around the operator's body, the two ends of the bow being fastened to the body of the bow by leather hinges.

In all the ceremonies, both religious and civil, an important part of the costume is the mask. These are generally of wood, and portray all manner of real and fanciful personages. Some of them are wonders of ingenuity, being so constructed that the eyes, mouth, and often the ears can be moved at the will of the wearer. Some of them are even double, and so arranged that by drawing open the outer mask, an inner one of an entirely different character can be revealed. One of the rarest masks which was ever brought out of the Tsimshian country is one in the possession of the museum, which was acquired some time ago. It is of bone and finely carved, while the teeth and tusks are those of animals.

Hazelton is of much interest to the observer of the human countenance, for, while the residents of the town are Tsimshians, there is a village near by on the Bulkley River, the people of which belong to the great Tinneh or Athabascan stock, which extends from the Arctic Circle on the north to the Territories of Arizona and New Mexico on the south, where it is represented by the Apaches. In some respects the differences between the Tsimshians and Tinnehs, or Howgelgaits, as this branch is called, are quite marked, and these differences stand out in greater relief because more or less of the population of Howgelgait spend a part of their time in Hazelton, and so one sees representatives of the two stocks in close contact. The Tsimshians, like the Haidas, are great canoe people, and are rather short-legged, with great development of the chest and shoulders. Like the Haidas, also, they have strong, long arms, which bespeak familiarity with the paddle. The Howgelgaits, on the other hand, are a pure mountaineer people, and are tall, robust, and finely proportioned. Their hair is black, coarse, and abundant. The eyebrows are thick and remarkably wide at the outer side. This same peculiarity may be observed in the masks of this tribe. The beard is sparse, but it must be remembered that the hair is generally pulled out as it [189] appears, particularly on the cheeks, while the mustache and the chin tuft are allowed to grow. [190] Among the Tsimshians the face is wide and the cheek bones are prominent. The nose is narrow, with a depressed root. Neither the Tsimshians nor Tinneh practice artificial deformation of the head. With the Tinneh, or more exactly the Howgelgaits, the forehead is broad and less receding than is usual with the American aborigines. The face is full and broad and the cheek bones

prominent, but the nose, unlike that of the Tsimshians, is well formed and generally aquiline, although occasionally it is thick and flattish. Their lips are also thick and the chin is more prominent than is usual among the Tsimshians. The eyes are large and of a deep black color; the jaws are generally very heavy and massive.

Of traces of the ancient prevalent fashion in deformity we saw very little. One old woman still retained the labret, but it was only a shadow of the former labrets in size. Although the long, finely polished bone ornament which the men formerly wore in a hole through the septum of the nose has entirely disappeared, we saw a few old men in whom the pierced septum was still plainly visible. With the Howgelgaits it was formerly the custom to load down the ears with highly polished bits of abalone shells, which were suspended by means of brass rings inserted into holes one above the other on the outer margin of the ear, extending from the lobe around the entire helix.



A Street in the Tsimshian Cemetery at Hazelton, B. C.

Hazelton's "City of the Dead" stands on a high bluff overlooking the town and valley, and commands a view off over the broken forest-clad country which is as beautiful as well could be. A trail winds along the face of the bluff until the crest of the plateau is reached, where it divides into a right and left path leading through the main street of the silent city. The sight is strangely odd and picturesque. Over each grave has been erected a neat little frame house, often of considerable dimensions. All are painted with bright colors, and the effect is decidedly "mixed." In one of the houses, which was substantially built and neatly carpeted, I saw through a glass window two chairs, a washstand with full assortment of toilet articles, and an umbrella, while at the rear of the house stood a table on which was spread a neat cloth, and on the table was a lamp. On the floor was a new pair of shoes. Over the table hung a large crayon portrait of the departed occupant of the grave beneath.

In another house I saw chests of clothing, and suspended from a cord were garments of various kinds, including a complete costume of the fraternity of the Dog Eaters. These five-feet-deep graves covered by little houses are not the usual manner of burial with the Tsimshians, for until within a very few years the dead were cremated Even to-day in the neighboring village of [191] Kispiyeoux the dead are buried in shallow graves just in front of the house.

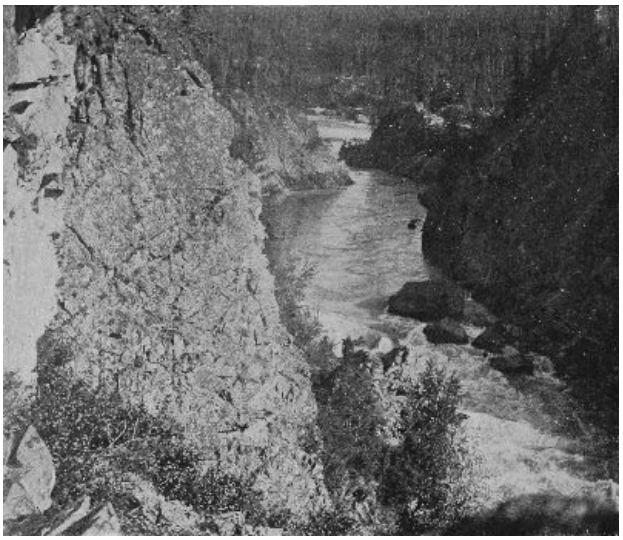
Of the many charming spots about Hazelton which are well worthy of a visit, we had time for only one—a horseback ride to the Howgelgait Cañon. The ride was most enjoyable in every respect. The road leads from the town up over the plateau through the burying ground, and then on through a partly cleared forest of cottonwoods and maples. Then we plunge into a two-mile-long lane, the trail scarcely wide enough to admit of the passing of a horse, through a dense grove of hazel bushes, laden to their tips with unripe nuts still protected by their green fuzzy envelopes; and now we knew whence came the name "Hazelton." Suddenly the grove terminates, and after dismounting and walking forward a few steps we came to the face of the cañon. What a sight! On the opposite cliff, but on a higher level, stands the old deserted village of Howgelgait, with its great empty houses and skeleton totem poles. At our feet, down a sheer precipice almost a thousand feet below, the Bulkley River, set on edge, rushes and roars and foams through the rocky gorge to join the Skeena a mile away. Just by the mouth of the cañon, at the edge of the great whirlpool, and on a gravelly beach, stands the present town of Howgelgait. Hearing shouts, we looked closer, and far down we saw men moving about, their forms dwarfed to almost spiderlike dimensions. They were building a swinging bridge over the river, and the timbers already in place looked like the meshes of a spider's web.

Looking up the cañon, we could see from the opposite wall near the water's edge, and far below us, a rude scaffolding suspended by bark ropes over the river, and from this Indians were lowering their nets and drawing up salmon. One man after another would leave for his home, his back bending under the weight of many fish, his place to be taken by another, who begins casting his nets. And so these rude scaffoldings here and all along the rivers are occupied by busy

fishermen throughout the summer, for salmon is chief of the winter's food supply of these people. In one house we saw over a thousand salmon hung up to dry for use during the winter months.

We left the cañon for the ride back to Hazelton with keen regret, for no more fascinating spot did we find on our entire journey than right here. On the way we encountered a woman of the Carrier tribe of the Tinnehs from Frazer's Lake, who was returning from Hazelton laden with provisions and cheap calicoes.

We had scarcely entered Hazelton when the tinkling of the bell of the "lead horse" announced the arrival of the pack train. Second only in importance to the arrival of the Caledonia to the people of Hazelton is the arrival of the pack train, for it brings the news of the far interior. But of much [192] greater importance and value is the cargo of furs which are brought out on every trip in exchange for supplies which are taken in. On that day there were fifty-seven mules, each laden with two bales of furs weighing two hundred and fifty pounds, and including beaver, mink, otter, sable, and bear, all destined for the Hudson Bay Company's house in London, there to be auctioned off in lots to the highest bidder, and then to be distributed to all parts of the civilized world.



Hagivilgait Cañon, with Indian Fish Weirs at Bottom.

Within less than an hour's time the precious furs were aboard, and we bade farewell to Hazelton. The Caledonia drops back, is slowly turned around by the current, and with its steady chug, chug, we began our journey down the river, the power of the boat aided by the swiftly flowing water carrying us along at a rapid rate. If the slow, labored up journey was a revelation with its worries and anxieties, what can be said of the down journey with its kaleidoscopic panorama of sand bars, Indian villages, far-away snowy mountains, dense forests of mighty cottonwoods, lofty heights which tower above us clad to their very summits with eternal green, mountain streams, and innumerable waterfalls and cascades! And what shall one say of that memorable ride through [193] the cañon, the wheel reversed and throwing water over the pilot house, the boat rocking and swaying to and fro! Before we were fairly aware of the fact we were out into that great, deep, silent basin again and off on the home stretch. Apart from taking on wood and stopping at one or two Indian villages, a delay of a few hours was made to permit some mining engineers to examine a mine. They had just come up from the coast and brought with them news of the gold excitement in the Yukon Valley, and now for the first time we heard that magic word "Klondike," which was soon to "electrify the world and put the gold fields of California, South Africa, and Australia to shame."

At nine o'clock we were in Essington once more. "Klondike, Klondike!" on every side. The whole country seemed to have gone daft. One steamer after another went racing by the mouth of the Skeena on the way to Dyea and the Skagway Trail. But our fortunes lay in the other direction, and that night we were aboard the Islander, bound for Victoria and the south.

LIGHT AND VEGETATION.

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Light is the most important of all the external agencies which influence the vegetal organism, and the sun's rays have been the most potent force in shaping the development of existent plant forms.

The sunbeam stands in a manifold relation to the plant. First and foremost, light is the universal source of energy, by the aid of which the chlorophyll apparatus in green leaves builds up complex food substances from simple compounds obtained from the soil and air, a process necessary for

the nutrition of the entire living world. Some obscure organisms, such as the "nitrosomonas," soil bacteria, are able to accomplish the construction of complex substances, by means of energy derived from other chemical compounds, which were, however, formed originally by green plants. These food-building processes are designated as photosynthesis, chemosynthesis, electrosynthesis, thermosynthesis, etc., according to the source of energy used.

By photosynthesis, carbon dioxide from the air and water from the cell are combined in the green cells of leaves, forming sugar and possibly other substances. During this process an amount of oxygen approximately equal to that of the carbon dioxide taken up is exhaled. It will be of [194] interest to note the relation of the living world to the atmosphere. Eight hundred to nine hundred grammes of carbon dioxide are produced in the respiration of a single person for a day, and the entire product of the human race for this period is twelve hundred million kilogrammes. In addition, large quantities of the gas result from the combustion of the four hundred and sixty millions of kilogrammes of coal and wood burned yearly. The lower animals, fungi, and green plants themselves contribute an amount which must bring the total to twice the immense sum named above. The atmosphere contains three or four hundredths of one per cent of carbon dioxide, or an amount of about two to three thousand billions of kilogrammes. No especial variation in this proportion has been detected since observations upon this point were first made. The fact that no increase takes place is partly due to the absorption of the gas by plants, and its replacement by oxygen, and also to certain geological processes in constant operation. Absorption takes place at the rate of about two and a half grammes for every square metre of leaf surface per hour, or about twenty-five to thirty grammes daily, since the process goes on only in daylight. It is to be seen that a single human being exhales as much carbon dioxide as may be removed from the air by thirty or forty square metres of leaf surface. According to Ebermayer, a hectare (2.47 acres) of forest would use eleven thousand kilogrammes of carbon dioxide yearly, and the amount used by plants is generally much in excess of that furnished by the activity of the inhabitants of any given area. Plants thrive and show increasing vigor as the amount of carbon dioxide in the air rises until two hundred times the present proportion is reached. An increase of the gas in the atmosphere would therefore be partly corrected by the absorption and by the stronger vegetation induced. Nothing short of a comprehensive cataclysm could work such disturbance to the composition of the air as to endanger the well-being of the animal inhabitants of the earth.

The activity of a square metre of leaf surface results in the formation of one and a half to two grammes of solid substance per hour in sunlight. A vigorous sunflower with one hundred and forty-five leaves constructed thirty-six grammes of solid matter in a day, and a squash with one hundred and sixteen leaves one hundred and sixteen grammes in the same length of time. The amounts formed by such trees as the beech, maple, oak, poplar, elm, and horse-chestnut, with leaf surfaces aggregating three hundred to one thousand square metres, must be correspondingly large.

A comparison of plants grown in strong sunlight, diffuse light, and darkness will reveal many differences in stature and internal structure. These differences are for the most part due to the *formative* and *tonic* effect of light. Otherwise expressed, the influence of variations of light upon [195] plants causes adaptive reactions, and disturbances of the nutritive processes and growth.

In consequence of these facts the reaction of any given organ to changes in the intensity of the illumination will depend upon its specific functions and relation to the remainder of the organism.

The stems formed by seedlings and awakening underground organs are usually surrounded by plants or other objects which cut off more or less sunlight. The developing shoot can not spread its leaves to the light advantageously until it has outstripped or grown beyond the objects intervening between it and the light. This necessity is one of the most important conditions in the struggle for existence. To meet it, a very great majority of seed-forming plants have acquired the power of accelerated elongation of the stems when deprived of their normal amount of light.

Very striking examples of this reaction are offered by the awakening corms of the Jack-in-the-pulpit (*Arisæma triphyllum*). The corms usually lie at a distance of five or six centimetres below the surface of the soil, and when the growth of the large bud begins in the spring the heavy sheathing scales elongate and pierce the soil, opening when the surface is reached at the distance of a few centimetres. If the corm should have been buried deeper in the substratum by floods or drifts of leaves, the growth of the bud scales will continue until the light is reached, though it may be a distance of twenty centimetres. Such growth may be seen if the corms are grown in a deep layer of sphagnum moss, or in a dark room.

After the stems emerge from the "drawn" buds they show a similar attenuation, attaining a length of twice the normal. The excessive elongation of stems is accompanied by variations in the structure and contents of the tissues. The cells are generally longer, while the walls are thinner. In consequence, organs grown in darkness are very weak and easily bent or broken. Growth in darkness is attended by the non-formation of chlorophyll. This is replaced by etiolin, giving the plant a pale, waxy, yellow appearance.

The adaptive elongation is not shown by all species, however. It has been found that stems of beet, hop, dioscorea, and a few others show no adaptations to diminished light. The adaptive modification of stems elongating in darkness is developed from the retarding influence exercised by light upon growth. Thus it is a well-known fact that the action of certain portions of the sun's rays actually impedes or checks the increase in volume known as growth, though it does not influence actual division of the cells to any great extent. When this retarding action is eliminated

excessive elongation ensues.

The behavior of leaves in illuminations below the normal depends upon the relation of these organs to the storage structures of the plant as well as upon other factors, and many types are dependent upon their own activity for plastic material necessary for growth. [196]

It is to be said in general that leaves of dicotyledonous plants are incapable of full development in darkness, though to this rule there are many exceptions. Thus the leaves of the beet develop normally, or nearly so, in darkness.

On the other hand, leaves of monocotyledonous plants attain normal size in darkness, especially those with straight or curved parallel venation. Some, as the iris, swamp marigold, and onion, attain a greater length in darkness than in light. Here, as in stems, cell division is not modified, but the growth of the individual cell is increased.

The growth of leaves in darkness may be easily observed if the underground perennial stems of common mandrake are placed in a dark chamber before the growth of the leaf buds has begun. The leaves are peltate, and in the bud are folded about the end of the petiole after the manner of an umbrella. Usually this umbrella expands as soon as it has pushed upward and become free from the soil, attaining a diameter of twenty-five to forty centimetres when outspread. In darkness, however, it refuses to unfold, the laminæ are pale yellow and retain the crumpled form of the bud, and as the petiole shows an exaggerated elongation the organ takes on the appearance of a very small parasol on a very long handle. The imperfect development of leaves and the rapid decay of aërial organs deprived of sunlight leads to the conclusion that the action of light is necessary to the health and normal activity of these organs, and the light therefore exercises a *tonic* influence upon vegetation.

Many species of plants are so plastic and capable of such ready response to variations in external conditions that they undergo distinct morphological changes in response to variations in the intensity of the light. The common potato is an example of this fact. The edible tubers are simply thickened stems, and the plant has the habit of storing starch in any stems not acted upon by the light. The branches arising from the base of the main stem are generally underneath the surface of the soil, and afford the proper conditions for tuber formation. Sugar is constructed in the leaves, carried down the length of the stem, and deposited in the underground branches as starch. Space is made for the accumulating store by the multiplication of the thin-walled cells of the pith. If any of the upper branches should become shaded, they become at once the focus of converging streams of sugar, and similar enlargement ensues, resulting in the formation of tubers. Such structures are occasionally observed in plants grown thickly together. [197]

Vöchting, by a number of most ingenious experiments, has succeeded in producing tubers on any branch of a potato plant by simply inclosing the branch in a small dark chamber. As the result of one experiment the entire main stem springing from a sprouting tuber was converted into a new tuber nearly as large as the first. The entire plant at the close of the experiment had the form of a dumb-bell, with the old tuber as one ball and the new tuber as the other.

The same writer has described important results obtained from a study of the action of light upon the stems of cactus, consisting of a number of flattened internodes. When the growing tips of such plants were allowed to develop in a dark chamber the new internodes grown were cylindrical in form. Such behavior suggests that these plants were originally furnished with cylindrical stems and foliar leaves. The leaves at some time in the history of the plant were found unsuitable, and gradually atrophied, while the stems were flattened and extended to take up their functions.

Some very striking adaptations of form of organs to the intensity of the light have been analyzed by Goebel. The common harebell (*Campanula rotundifolia*) has an upright stem twenty to sixty centimetres in height. The upper part of the stem bears sessile lanceolate leaves, decreasing in size from the base to the summit. The first leaves formed by the stem on its emergence from the soil are entirely different in construction, showing a heart-shaped lamina with a distinct petiole. These leaves are formed at the actual surface of the soil, are generally more or less shaded or covered by fallen leaves, and in fact are not known or seen by many collectors or observers of the plant. Goebel found that similar leaves might be formed on any part of the plant if it were shaded from the full glare of the sun's rays. The cordate leaves at the base of the stem were always produced, however, no matter to what intensity of illumination that part of the plant was subjected. It is therefore safe to conclude that the cordate leaves are inherited forms, and that the lanceolate organs are adaptations to light which may be shown by any individual of the species.

In general it is to be said that the leaves of sun-loving species have a thick epidermis, entirely free from chlorophyll, with stomata on the lower side only, a firm consistence due to the formation of woody tissues, and are often provided with a coating of hairs. The leaves of shade-loving plants, on the other hand, have a thin-walled epidermis often containing chlorophyll, stomata on both sides, and are not so plentifully provided with hairs as those in exposed situations.

The variations in external form described above are due to the intensity of the illumination. At the same time the structure and arrangement of the cells depend on the direction from which the light rays come. Thus, an organ receiving light from one side only will exhibit a structure different from an organ of the same kind receiving direct rays from two or more sides. Light, [198]

then, is a cause of dorsiventrality—that is, of the fact that the upper and lower sides of organs are not alike in structure. The leaf affords a splendid example of dorsiventrality as a result of the exposure of one side only to direct light. The upper side of a horizontal leaf, such as the oak, beech, or maple, contains one or two layers of cylindrical cells with their long axes perpendicular to the surface. In vertical leaves, such as the iris, these *palisade* cells, as they are termed, are not so well defined, and in all leaves grown in darkness this tissue is very much reduced. If a young leaf not yet unfolded from the bud is fastened in such a position that the under side is uppermost, palisade cells will be formed on the side exposed to the direct rays of the sun.

The influence of light upon the sporophylls, or reproductive organs of the seed-forming plants, is quite as well defined as upon the vegetative organs.

In general it is to be said that stamens and pistils may reach functional maturity in darkness or diffuse light, and if pollination is provided for, seed and fruit formation may ensue.

The diminution of light has the effect of transforming inflorescences into leafy shoots in some instances, however. The more common reaction consists of alterations in the size, form, and color of the perianth, and greater changes are induced in the petals than in the sepals. The corolla shows greater decrease in size in *Melandryum* and *Silene*, in diffuse light, though the relative form is maintained. The writer has obtained most striking results from growing flowers of *Salvia* (sage) in a dark chamber, inclosing the inflorescence only. In the normal flower the irregular scarlet corolla attains three times the length of the calyx, and two stamens extrude from under the upper lip. When grown in darkness, the corolla with the adherent stamens measure about three millimetres in length, or one twelfth the normal, and are scarcely more than half the size of the calyx, which is but two thirds the size of similar organs grown in the light. The color is entirely lacking from the corolla, and is found only along the veins of the calyx.

In other instances in which the corolla is composed of separate members, an unequal reaction is exhibited. The corolla of nasturtium (*Tropæolum majus*) consists of five approximately equal petals. Flowers of this species grown in darkness show one of nearly normal stature, two of [199] reduced size, while the remaining two take the form of club-shaped bracts.

The diminished size of the perianth of cleistogamous flowers of such types as the violet is due directly to the action of diminished light upon the hidden or inclosed flower.

The influence of light upon the structure, reproductive processes, and distribution of the lower forms brings about the most widely divergent reactions, which can not be described here.

The distribution and color of marine algæ depend upon the depth of the water and the consequent intensity of the light. This gives rise to distinct zones of aquatic vegetation. Thus in one series of surveys the *littoral* zone, the beach area covered at high water and exposed at low water, was found to furnish proper conditions for green, brown, and red algæ. The *sublittoral* zone, extending to a depth of forty metres, is furnished with red algæ, increasing in number with the depth, and the brown algæ disappear; while the *elittoral* zone, from forty to one hundred and ten metres, is inhabited by red algæ alone. The number of species of vegetal organisms below this depth is extremely small. An alga (*Halosphæria viridis*) has been brought up from depths of one thousand to two thousand metres.

A very great number of bacteria are unfavorably affected by light, and find proper conditions at some depth in the soil or water. It is on account of this fact that the water of frozen streams becomes more thickly inhabited by certain organisms than in the summer time, and exposure to sunlight is adopted as a hygienic measure in freeing clothing and household effects from infection. Bacteria occur abundantly in sea water at depths of two hundred to four hundred metres, and quite a number of species are to be found at eight hundred to eleven hundred metres.

The distribution of fungi follows the general habit of bacteria in that they thrive best in darkness.

It is to be noticed in this connection that light is also a determining factor in the distribution of the higher land plants. Thus the amount of light received in polar latitudes is quite insufficient for the needs of many species, entirely irrespective of temperature.

The retarding influence of light upon growth is even more marked in the lower forms than in the higher. Such action is the result of the disintegrating effect of the blue-violet rays upon ferments and nitrogenous plastic substances.

The greater massiveness of the bodies of the higher plants enables them to carry on the chemical activities in which these substances are concerned in the interior, where the intense rays may not [200] penetrate. The attenuated and undifferentiated fungi must seek the shade, to escape the dangers of strong light, against which they have no shield.

The reproductive processes are particularly sensitive to illumination. The formation of zoöspores by green felt (*Vaucheria*) may occur only in darkness, at night, or in diffuse light, and these examples might be multiplied indefinitely. Many features of the germination of spores and the growth of *protonemæ* or *prothallia* among the mosses, liverworts, and ferns are determined by light.

Perhaps the most striking reactions of plants to light are to be seen in locomotor and orientation movements.

Locomotor movements are chiefly confined to lower forms, and are most noticeable in the "swarm spores," or zoöspores of the algæ, though exhibited by spermatozoöids as well. Zoöspores may be seen collected against the side of the vessel receiving direct sunlight, while the opposite side of the vessel will be free from them. The chlorophyll bodies of green cells arrange themselves similarly. The latter bodies may move away from the exposed side of the cell if the light exceeds a certain intensity.

The typical plant may not move its body toward or away from the source of light, but it may secure the same end by dispositions of its surfaces to vary the angle at which the rays are received. This form of irritability is one of the most highly developed properties of the plant. Wiesner has found that a seedling of the vetch is sensitive to an amount of light represented by one ten-millionth of a unit represented by a Roscoe-Bunsen flame. The "sensitiveness" to light may take one of three forms: The organ may place its axis parallel and pointing toward the source of the rays, as in stems, when it is said to be *proheliotropic*; the axis of the organ may assume a position perpendicular to the rays, which is designated as *diaheliotropism*; or it may place its axis parallel to the rays and pointing away from the light, when it is said to be *apheliotropic*. Upright stems are proheliotropic, horizontal leaves and creeping stems are diaheliotropic, and roots and such stems as those of ivy are apheliotropic.

Sunlight varies from zero to the full blaze of the noonday sun, and assumes its greatest intensity in the equatorial regions. The intensity in latitudes 40° to 45° north would be represented by 1.5 units, and at the equator by 1.6 units. Near the equator the intensity is so great that an ordinary leaf may not receive the full force of the noonday sun without damage. The injury would not result from the luminous rays, but from the temperatures, 40° to 50° C., arising from the conversion of light into heat. As an adaptation to this condition nearly all leaves have either a pendent or a vertical position, or the power of assuming this position by motor or impassive wilting movements. [201]

Among the plants of the temperate zone the so-called compass plants are examples of similar adaptations. The compass plants include, among others, the wild lettuce (*Lactuca scariola*) and rosin weed (*Silphium laciniatum*). These plants place the leaves in a vertical position with the tips pointing north and south in such manner that the direct rays of the morning and evening sun only may strike the surfaces at right angles, while the edges are presented to the fierce rays at noonday. That this arrangement is an adaptation against the intense light is evident when it is seen that specimens growing in shaded locations or in diffuse light place the leaves in the typical horizontal position. To meet the functional conditions, both sides of the compass leaves are almost equally provided with palisade cells for food formation and stomata for transpiration. The estimation of the light striking a compass leaf shows that it receives approximately the same amount of light as a horizontal leaf during the course of a day, but the two maxima of intensity, morning and evening, are much below that of the noon of horizontal leaves.

The influence of light upon plants may be briefly summed as follows:

Light is necessary for the formation of food substances by green plants, and it is an important factor in distribution in land and marine forms.

Growth and reproduction are generally retarded by the action of the blue-violet rays.

Light is fatal to certain bacteria and other low forms of vegetable life.

Many plants have the power of accelerated growth of stems in diminished light as an adaptation for lifting the leaves above "shading" objects.

The growth of many leaves and of the perianth of flowers is hindered in diminished light.

The outward form of many organs, particularly leaves, is dependent upon the intensity of the light received.

The internal structure of bilateral or dorsiventral organs is largely determined by the direction of the rays.

Plants have the power of movement to adjust their surfaces to a proper angle with impinging light rays, as a protective adaptation.

Matches which do not contain any phosphorus and which take fire by friction on any surface—a match that has been long sought—have been prepared by Mr. S. A. Rosenthal and Dr. S. J. von Kornocki. It is represented that they can be manufactured as cheaply as ordinary matches.

THE STONE AGE IN EGYPT. [202]

By J. DE MORGAN.

The investigation of the origin of man in Egypt is a very complex problem, belonging as much to

geology as to archæology. The earliest evidences we have of human industry, in fact, go back to so remote a period that they should be regarded rather as fossils than as archæological documents. They are very coarsely worked flints, which are found near the surface of the ground among the pebbles of the Quaternary or Pleistocene epoch, and similar to those which occur abundantly in Europe, America, and Asia; but the study and collection of them have been pursued with less method than in those countries. The more recent monuments, so much more conspicuous and more easily accessible, have attracted most attention, while these have been left in the background.

No region in the world presents a clearer and more distinct individual character than Egypt. Each village is a special world, each valley a universe that has developed its own life; and man has felt the special local impressions; and even in modern times, while all the Egyptian villages present a similar aspect, and although the fellah appears to be the same sort of a man everywhere, each locality has its special individual characteristics. One who knows how to observe men and things critically will find considerable differences. These dissimilarities are as old as Egypt itself. They have always existed, and are as much more intense as the communications between district and district were formerly more difficult. They are due to physical conditions special to each village, to the prevailing winds, the form and character of the mountains, the extent of cultivable lands, and the supply of water. A study of the detail of the country is a very important preliminary to the examination of Egyptian history. Every village and every nome had formerly its special divinity and its particular usages. Are we sure that the gods and customs were not imposed by local conditions? At Ombos two hostile gods were adored in the same temple. May we not see in this fact a recollection of the hostility which has always prevailed between the inhabitants of the two banks of the river, and still continues?

Previous, however, to investigating these details which have been so influential on Egyptian civilization, we ought to dispel the darkness which hides from us the earliest traces of man in the valley of the Nile, and examine how man lived in his beginning, to study the geology of the country and its condition when it issued from the seas. As one of the results of this study we find that palæolithic man, known to us only through the rough-cut flints we find in the alluvions, made [203] his first appearance. After this period of excavation came that of filling up with silt, which still continues. New evidences of man appear in his burial places and the ruins of his villages, the kitchen middens which he has left in his habitations of unburned brick and in his camps. This time he is more civilized; he chips his flints with a skill that is not surpassed in European neolithic implements; he makes vessels of stone and clay, covers them with rude paintings, sculptures animal forms of schist, and wears necklaces of the shells and the stones of the country. Then comes a foreign people to take possession of Egypt, bringing knowledge of metals, writing, hieroglyphics, painting, sculpture, new industries and arts that have nothing in common with the arts of the people it has overcome. The ancient Pharaonic empire begins, or perhaps the reign of the divine dynasties. The men with stone implements are the aborigines; the others are the conquering civilized Egyptians. Nothing can be more interesting than a comparison of the arts of the aborigines and those of the Egyptians of the earlier dynasties. Nearly all their characteristics are different, and it is impossible to regard them as of common origin. Yet some of the native forms persisted till the last days of the empire of the Pharaohs. These aborigines belonged to a race that is now extinct, they having been absorbed into the mass of the Egyptians and Nubians among whom they lived, and from this mixture the fellah of ancient times is derived. The origin of the conquering race—of the Egyptians as we know them—has not been precisely determined. The weight of evidence, so far as it has been obtained, and the balance of opinion, are in favor of an Asiatic origin and of primary relationship with the Shemites of Chaldea.

In Egypt more than in any other country it is necessary to proceed with the most scrupulous circumspection in the examination of remote antiquities. The relics of thousands of years of human life have been piled one upon another and often intermixed. The questions they raise can not be answered in the cabinet or by the study of texts; but the inquiry must be prosecuted on the ground, by comparison of the deposits where they are found and in the deposits from which they are recovered.

From my first arrival in Egypt, in 1892, my attention has been greatly occupied with the question of the origin of the relics of the stone age that have been found from time to time in that country. I have gathered up the scattered documents, explored a large number of sites, and have bought such flint implements as I have found on sale. I have gradually been led to believe that while some of these cut stones may possibly belong to the historical epoch, we shall have to attribute a [204] much more remote antiquity to the most of them, and that evidences of a neolithic age in the valley of the Nile are more abundant than has generally been supposed.

In many minds the historical antiquity of Egypt, the almost fabulous ages to which its civilization ascends, seem to challenge the history of other countries, and the land of the Pharaohs, rejecting all chronological comparison, to have appeared in the midst of the world as a single example of a land which savage life had never trodden. Yet what are the centuries since Menes ruled over the reclaimed valleys, the few thousand years of which we can calculate the duration, by the side of the incalculable lapse of time since man, struggling with the glaciers and the prehistoric beasts, began his conquest of the earth? The antiquity of Egypt, the eight thousand years (if it be as many) since the first Pharaoh, are only as an atom in the presence of these ages. We can assert some vague knowledge of these pre-Pharaonic inhabitants, for two hatchets of the Chellean pattern were found some time ago in the desert, one at Esnet, the other near the pyramids of Gizeh; and we can now affirm in the most positive manner that Quaternary man lived in the

country which is now Egypt, and was then only preparing to be. Four palæolithic stations have been more recently discovered—at Thebes, Tukh, Abydos, and Daschur. Join these sites to the other two where isolated pieces were found, and we have the geography of what we know at present of Chellean man in the valley of the Nile. Doubtless continuous researches would result in similar discoveries at other points, for I have met these relics wherever I have been able to make a short sojourn. The Chellean implements are found in the gravels of the diluvium on the pebbly surface. They have been disturbed and probably scattered, but some places yield them more numerously than others—points possibly corresponding to the ancient workshops. I have found a considerable number of specimens at Deir-el-Medinet; M. Daressy, of the Bureau of Antiquities, found a perfectly characteristic Chellean hammer stone in the Yalley of the Queens at Gurneh, as perfectly worked as the best specimens found at Chelles, St. Acheul, and Moulin-Quignon.

The finds are not very numerous at Tukh, but one may in a few hours make a collection there of hatchets (or hammer stones), scrapers, points, simple blades, and a large number of stones bearing indisputable marks of having been worked, but not presenting precise forms. The deposit at Abydos is in the bottom of a circle behind the ruins surrounding the Pharaonic necropolis. The specimens seem sufficient to prove the existence of Quaternary man in Egypt, while the search for them has hardly yet begun. In view of them it is extremely improbable that man did not also exist there during the long period that intervened between this primitive age and that of the [205] earliest Egyptians who had metals. He did exist there then, and the evidences of it are found in neolithic remains between Cairo and Thebes, a distance of about eight hundred kilometres along the valley of the Nile, in the Fayum, and in Upper Egypt. Among these are the remarkable tombs at Abydos which have been explored by M. E. Amélineau, and of which he has published descriptions. They belong to a category which I have characterized as tombs of transition and as signalizing the passage from the use of polished stone to that of metals. Their archaic character can not be disputed, and their royal origin is probably certain. They may belong to aboriginal kings or to the earliest dynasties. They reveal a knowledge of brass and of the use of gold for ornament. At the necropolis of El-'Amrah, a few miles south of Abydos, are some archaic tombs, all of the same model, composed of an oval trench from five to six and a half feet deep. The body is laid on the left side, and the legs are doubled up till the knees are even with the sternum; the forearms are drawn out in front and the hands placed one upon the other before the face, while the head is slightly bent forward. Around the skeleton are vases, and large, rudely made urns, often filled with ashes or the bones of animals, and nearer to them are painted or red vessels with black or brown edges, vessels roughly shaped out of stone, and figurines in schist representing fishes or quadrupeds, cut flints, alabaster clubs, and necklaces and bracelets of shells. Bronze is rare, and found always in shape of small implements. Both purely neolithic tombs and burials of the transition period to metals occur at El-'Amrah. The most remarkable feature of the burials is the position of the corpse, totally unlike anything that is found of the Pharaonic ages.

The Egyptian finds of stone implements present the peculiarity as compared with those of Europe, that types are found associated together belonging to what would be regarded in other countries as very different epochs. The time may come when subdivisions can be made of the Egyptian stone age, but the study has not yet been pursued far enough to make this practicable at present. Among these articles are hatchets showing the transitions, examples of which are wanting in Europe, from the rudest stone hammer to the polished neolithic implement; knives of various shape and some of handsome workmanship; scrapers, lance heads, arrowheads, saws, pins, bodkins, maces, beads, bracelets, and combs. The large number of instruments with toothed blades found at some of the stations may be regarded as pointing to a very extensive cultivation of cereals at the time they were in use. The deposits of Tukh, Zarraïdah, Khattarah, Abydos, etc., situated in regions suitable for growing grain, yield thousands of them, while they are very rare [206] at the fishing station of Dimeh. That the use of sickles tipped with flint very probably lasted long after the introduction of metals seems to be proved by the hieroglyphics; but very few evidences of the existence of such tools are found after the middle empire.

No traces of articles related to the religion of the Pharaohs are found in the burial places of the aborigines. In place of the statuettes and funerary divinities of later times are found rude figurines of animals cut in green schists. They represent fishes, tortoises with eyes adorned with hard stone or nacre, and numerous signs the origin of which is unknown, and were apparently regarded as fetiches or divinities. Articles of pottery are very numerous, very crude, and of a great variety of forms. It is not necessary to suppose that the people who have left these relics were savages or barbarians. History and even the present age afford instances of many peoples who have obtained considerable degrees of civilization while backward in some of the arts. It is hardly possible to achieve delicacy of design and finish without the use of metals. I believe I have shown that an age of stone once existed in Egypt, and that it furthermore played an important part, even in Pharaonic civilization.—*Translated for the Popular Science Monthly from the Author's Recherches sur les Origines de l'Egypte.*

SUPERSTITION AND CRIME.

By Prof. E. P. EVANS.

In January, 1898, an elderly woman came in great anxiety to a priest of the Church of St. Ursula,

in Munich, Bavaria, and complained that the devil haunted her house at night and frightened her by making a great noise. In explanation of this unseasonable and undesirable visit from the lower world she stated that a joint-stock company had been formed in Berlin, with a branch in Munich, for the purpose of discovering hidden treasures, and that in order to attain this object a human sacrifice must be made to the devil, and that she had been selected as the victim. A woman, whose husband was a stockholder in the aforesaid company, had kindly communicated to her this information, so that she might be prepared and have time to set her house in order. Satan, however, grew impatient of the promised sacrifice, and began to look after her. The priest sent one of his younger assistants at the altar to read appropriate prayers in the haunted house, and thus exorcise the evil spirit. We can hardly suppose that his reverence believed in the reality of the reported apparition, and yet he could not assert its impossibility by calling in question the [207] existence of the devil or the actuality of diabolical agencies in human affairs without undermining the foundations of the ecclesiastical system, of which he was an acknowledged supporter. Such a declaration would "take away our hope," as the Scotchman said of the denial of a literal hell-fire and the doctrine of eternal punishment. It was for the same reason that the great body of the Catholic clergy, from Pope Leo XIII and the highest dignitaries of the church down to the humblest country vicar, so easily fell into the snares laid by Leo Taxil and accepted the signature of the devil Bitru as genuine, and his revelations concerning the pact of the freemasons with Satan as authentic. It is certainly somewhat startling to meet with such a case of gross superstition as the above-mentioned in one of the seats of modern science and centers of European civilization. In rural districts, remote from the influences of intellectual culture, however, instances of this kind are of quite frequent occurrence, and often result in the commission of crime. Human sacrifices to Satan are still by no means uncommon in many parts of Russia, and are supposed to be effective in warding off famine and in staying the ravages of pestilence. Even in Germany and other countries of western Europe the belief in their prophylactic virtue is remarkably prevalent, and would be often put into practice were it not for the stricter administration of justice and the greater terror of the law.

In October, 1889, the criminal court in the governmental province of Archangelsk, in northern Russia, sentenced a Samoyede, Jefrern Pyrerka, to fifteen years' imprisonment with hard labor for the murder of a maiden named Ssavaney. His sole defense was that an unusually severe winter with a heavy fall of snow had produced a famine followed by scurvy, of which all his children had died. He therefore made an image of the devil out of wood, smeared its lips with fat, and set it up on a hillock. He then attempted to lasso one of his companions, Andrey Tabarey, and had already thrown the noose round his neck, when the energetic wife of the intended victim intervened and rescued her husband. Shortly afterward he succeeded in strangling the girl and offering her as a sacrifice to his idol. In the province of Novgorod, known as "the darkest Russia," it is a general custom among the country people to sacrifice some animal, usually a black cat, a black cock, or a black dog, by burying it alive, in order to check the spread of cholera. In the village of Kamenka, a peasant, whose son had died of this disease, interred with the body eight live tomcats. The immolation of dumb animals, however, is deemed less efficacious than that of human beings. On one occasion, when the cholera was raging severely, a deputation of peasants waited upon their parson, stating that they had determined to bury him alive in order to appease [208] the demon of the plague. He escaped this horrible death only by apparently acceding to their wishes and craving a few days' respite in order to prepare for such a solemn ceremony; meanwhile he took the measures necessary to secure his safety and thwarted the purpose of his loving parishioners. In Okopovitchi, a village of the same province, the peasants succeeded in enticing an aged woman, Lucia Manjkov, into the cemetery, where they thrust her alive into the grave containing the bodies of those who had died of the epidemic, and quickly covered her up. When brought to trial they proved that they had acted on the advice of a military surgeon, Kosakovitch, who was therefore regarded as the chief culprit, and sentenced to be knouted by the hangman, and then to undergo twelve years' penal servitude in Siberia. We are indebted for these instances of barbarous superstition to the researches of Augustus Löwenstimm, associate jurisconsult in the department of justice at St. Petersburg, who has derived them from thoroughly authentic and mostly official sources. He reports several occurrences of a similar kind during the epidemics of cholera in 1831, 1855, and 1872. Indeed, it is very difficult to abolish such pagan practices so long as the clergy foster the notion that animal sacrifices are expiatory and propitiatory in their effects. In some parts of the province of Vologda it is still customary on the day dedicated to the prophet Elias (July 20th in the Greek calendar) to offer up bullocks, he-goats, or other quadrupeds within the precincts of the church. The animal is driven into the courtyard surrounding the sacred edifice and there slaughtered; the flesh is boiled in a large kettle, one half of it being kept by the peasants who provide the sacrifice, while the other half is distributed among the priests and sacristans.[26]

The belief that the walls of dams, bridges, aqueducts, and buildings are rendered preternaturally strong by immuring a living human being within them still prevails in many countries of Christendom, and there is hardly an old castle in Europe that has not a legend of this sort connected with it. Usually a child is supposed to be selected for this purpose, and the roving bands of gypsies are popularly accused of furnishing the infant victims. The custom of depositing gold coins or other precious objects in the foundation stones of important public edifices is doubtless a survival of the ancient superstition.[27]

Löwenstimm mentions a curious superstition of pagan origin still practiced in portions of Russia, [209] and known as "*korovya smertj*" (cow-death) and "*opachivaniye*" (plowing roundabout). If pestilence or murrain prevails in a village, an old woman of repute as a seeress or fortune-teller

enters the confines of the village at midnight and beats a pan. Thereupon all the women of the place assemble in haste, armed with divers domestic utensils—frying-pans, pokers, tongs, shovels, scythes, and cudgels. After shutting the cattle in their stalls, and warning the men not to leave their houses, a procession is formed. The seeress takes off her dress and pronounces a curse upon Death. She is then hitched to a plow, together with a bevy of virgins and a misshapen woman, if such a one can be found, and a continuous and closed furrow is drawn round the village three times. When the procession starts, the image of some saint suitable to the occasion, that of St. Blasius, for example, in the case of murrain, is borne in front of it; this is followed by the seeress, clad only in a shift, with disheveled hair and riding on a broomstick; after her come women and maidens drawing the plow, and behind them the rest of the crowd, shrieking and making a fearful din. They kill every animal they meet, and if a man is so unfortunate as to fall in with them he is mercilessly beaten, and usually put to death. In the eyes of these raging women he is not a human being, but Death himself in the form of a were-wolf, who seeks to cross their path and thus break the charm and destroy the healing virtue of the furrow. The ceremony varies in different places, and generally ends by burying alive a cat, cock, or dog. In some districts the whole population of the village, both men and women, take part in the procession, and are often attended by the clergy with sacred images and consecrated banners. During the prevalence of the pest in the province of Podolia, in 1738, the inhabitants of the village of Gummenez, while marching in procession through the fields, met Michael Matkovskij, a nobleman of a neighboring village, who was looking for his stray horses. The strange man, wandering about with an eager look and a bridle in his hand, was regarded as the incarnate pestilence, and was therefore seized and most brutally beaten and left lying half naked and half dead on the ground. At length he recovered his senses and succeeded with great difficulty in reaching his home. No sooner was it [210] known that he was still alive than the peasants rushed into his house, dragged him to their village, subjected him to terrible tortures, and finally burned him. A curious feature of these remedial rites is the mixture of paganism and Christianity which characterizes them; and it is an unquestionable though almost incredible fact that their atoning efficacy is often quite as firmly believed in by the village priests of the Russian Church as by the most ignorant members of their flock. In the autumn of 1894 some Russian peasants in the district of Kazan slew one of their own number as a sacrifice to the gods of the Votiaks, a Finnish race dwelling on the Volga, Viatka, and Kama Rivers. Even orthodox Christians of the Greek Church, although regarding these gods as devils, fear and seek to propitiate them, especially in times of public distress.

Still more widely diffused is the practice of infanticide as the sequence of superstition. The belief that dwarfs or gnomes, dwelling in the inner parts of the earth, carry off beautiful newborn babes and leave their own deformed offspring in their stead is not confined to any one people, but is current alike in Germanic, Celtic, Romanic, and Slavic countries, and causes a misshapen child to be looked upon with suspicion and subjected to cruel tortures and even killed. The supposed changeling is often severely beaten with juniper rods and the scourging attended with incantations, so as to compel the wicked fairies to reclaim their deformed bantling and restore the stolen child. If the castigation proves ineffective, more summary measures are frequently taken, and the supposititious suckling is thrown out of the window on a dunghill or immersed in boiling water. In 1877, in the city of New York, an Irish immigrant and his wife burned their child to death under the delusion that they were ridding themselves of a changeling. Cases of this kind are quite common in Ireland, where the victims are sometimes adults.[28] Not long since Magoney, an Irish peasant, had a sickly child, which the most careful nurture failed to restore to health and strength. The parents, therefore, became convinced that a changeling had been imposed upon them, and when the boy was four years old they resolved to have recourse to boiling water, in which he was kept, notwithstanding his shrieks and protestations that he was not an elf, but their own Johnny Magoney, until death released him from his torments.

Wilhelm Mannhardt, the celebrated writer on folklore, states that when, in 1850, he was in Löblau, a village of West Prussia, he saw a man brutally maltreating a boy on the street. On inquiry he found that the lad had done nothing worthy of blame, but that his only fault was an [211] exceptionally large head. This cranial peculiarity, offensively conspicuous in what seems to have been a narrow-headed family, was reason enough for the parents to disown their offspring, and to treat him as the counterfeit of a child foisted in by the fairies. At Hadersleben, a considerable market town of North Silesia, the wife of a farmer, in 1883, gave birth to a puny infant, which the parents at once assumed to be a changeling. In order to defeat the evil designs of the elves and to compel the restoration of their own child, they held the newborn over a bed of live coals on the hearth until it was covered with blisters and died in intense agony. In East Prussia, the Mazurs, a Polish race, whose only notable contribution to modern civilization and the gayety of nations is the mazurka, take precautionary measures by placing a book (usually the Bible, although any book will do) under the head of the newborn babe, so as to prevent the devil from spiriting it away and substituting for it one of his own hellish brood, thus unwittingly furnishing a marvelous illustration of the beneficent influence of the printing press and the magic power of literature. The Estonian inhabitants of the island of Oesel in Livonia refrain from kindling a fire in the house while the rite of baptism is being celebrated, lest the light of the flames should render it easier for Satan surreptitiously to exchange an imp for the infant. After the sacred ceremony has been performed there is supposed to be no danger of such a substitution.

One of the most incredible instances of this extremely silly and surprisingly persistent superstition occurred in 1871 at Biskunizy, a village of Prussian Posen, where a laborer, named Bekker, had by industry and frugality gradually acquired a competence and been able to buy a house of his own, in which he led a happy domestic life with his wife and five children, of whom

he was very fond. After fourteen years of unbroken felicity the wife's elder sister, Marianne Chernyāk, came from Poland to pay them a visit. This woman was a crackbrained devotee, who spent half her time in going to mass and the other half in backbiting her neighbors. She also claimed that she could detect at once whether a person is in league with Satan, and could cast out devils. The villagers came to look upon her as a witch, and avoided all association with her, especially as her aberrations manifested themselves in exceedingly malevolent and mischievous forms. Unfortunately, she acquired complete ascendency over her younger sister, who accepted her absurd pretensions as real. On November 19, 1871, Marianne, after returning from confession, went to bed, but at midnight Mrs. Bekker, who slept with her youngest child, a boy about a year old, was awakened by a fearful shriek and lit the lamp. Thereupon the sister rushed [212] into the room, crying: "The demons have stolen your child and put a changeling in your bed: beat him, beat him, if you wish to have your child again!" Under the influence of this suggestion, which seemed to be almost hypnotic in its character, the bewildered mother began to beat the boy. The aunt now seized him and swung him to and fro, as if she would fling him out of the window, at the same time calling out to Satan: "There! you have him; take your brat!" She then gave him back to his mother with the words: "Throw him to the ground, drub him, beat him to death; otherwise you will never recover your child." This advice was followed, and the boy severely strapped with a heavy girdle as he lay on the floor. Meanwhile Bekker, hearing the noise, got up and at first tried to intervene for the protection of his son, but was easily convinced by his wife that she was doing the right thing, and persuaded to aid her in discomfiting the devil by beating the boy with a juniper stick. The process of exorcism, thus renewed with increased vigor, soon proved fatal. At this juncture, as the son of the aunt, a lad of five years, threw himself down with loud lamentations beside the dead body of his little cousin, his mother cried out: "Beat him; he is not my child! Why should we spare him? We shall get other children!" Thereupon he, too, was maltreated in the same manner until he expired. The aunt then declared that the devil had crept into the stovepipe, and went to work to demolish the stove, but, when she was prevented from doing so, fled into the garden, where she was found the next morning by the school-teacher. By this time Bekker and his wife seem to have come to their senses, and were sitting by the corpses of the murdered children, weeping and praying, as the neighbors entered the house. The trial, which took place at Ostrov in January, 1872, led to the introduction of conflicting expert testimony concerning the mental soundness of the accused, and the matter was finally referred to a commission of psychiaters in Berlin, who decided that Bekker and his wife were not suffering from mental disease, and therefore not irresponsible, but that the aunt was subject to periodical insanity to such a degree as not to be accountable for her actions. Curiously enough, the jurors remained uninfluenced by this testimony, and pronounced her guilty of the crime laid to her charge, and in accordance with this verdict the court sentenced her to three years' imprisonment with hard labor. The jurors even went so far as to declare that she herself did not believe in the existence of elf children or satanic changelings, but made use of this popular superstition for her own selfish purposes, and that she guilefully denounced her own boy as an imp in order to get rid of him. In this verdict, or rather in the considerations urged in support of it, it is easy to perceive the effects of strong local prejudice against the accused, who [213] had the reputation of being a lazy, malicious, and crafty person, and was therefore denied the extenuation of honest self-deception. Indeed, in such cases it is always more or less difficult to determine where sincere delusion ceases and conscious swindling begins. Just at this point the annals of superstition present many puzzling problems, the solution of which is of special interest as well as of great practical importance not only to the psychologist and psychiater, but also to the legislator and jurisprudent, who have to do with the enactment and administration of criminal laws.

In the penal codes of the most civilized nations the agency of superstition as a factor in the promotion of crime is almost wholly ignored, and, as this was not the case in former times, the omission would seem to assume that the general diffusion of knowledge in our enlightened age had rendered all such specifications obsolete and superfluous. Only in the Russian penal code, especially in the sections *Ulosheniye* and *Ustav* on felonies and frauds, as cited by Löwenstimm, do we find a distinct recognition and designation of various forms of superstition as incentives to crime. Thus, in paragraph 1469 of the first of these sections, the murder of "monstrous births or misshapen sucklings" as changelings is expressly mentioned, and the penalty prescribed; and in other clauses of the code punishments are imposed for the desecration of graves and mutilation of corpses, in order to procure talismans or to prevent the dead from revisiting the earth as vampires, and for various offenses emanating from the belief in sorcery and diabolical possession. The practice of opening graves and mutilating dead bodies is quite common, and arises in general from the notion that persons who die impenitent and without extreme unction, including suicides and victims to delirium tremens, apoplexy, and other forms of sudden death, as well as schismatics, sorcerers, and witches, come forth from their graves and wander about as vampires, sucking the blood of individuals during sleep and inflicting misery upon entire communities by producing drought, famine, and pestilence. The means employed to prevent this dangerous metamorphosis, or at least to compel the vampire to remain in the grave, differ in different countries. In Russia the deceased is buried with his face downward, and an ashen stake driven through his back, while in Poland and East Prussia the corpse is wrapped up in a fish net and covered with poppies, owing, doubtless, to the soporific qualities of this plant. Preventive measures of this kind are often taken with the consent and co-operation of the clergy and local authorities. Thus, in 1849, at Mariensee, near Dantzig, in West Prussia, a peasant's wife came to the Catholic priest of the parish and complained that an old woman named Welm, recently [214] deceased, appeared in her house and beat and otherwise tormented her child. The priest seems to have accepted the truth of her statement, since he ordered the corpse to be disinterred,

decapitated, reburied at a cross-road, and covered with poppies. In 1851, during the prevalence of cholera in Ukraine, in the governmental province of Kiev, the peasants of Possady attributed the epidemic to a deceased sacristan and his wife, who were supposed to roam about at night as vampires and kill people by sucking their blood. In order to stay the ravages of the scourge the corpses of this couple were exhumed, their heads cut off and burned, and ashen stakes driven through their backs into the ground. In 1892 a peasant woman in the Russian province of Kovno hanged herself in a wood near the village of Somenishki. The priest refused her Christian burial because she had committed suicide, and was therefore given over to the devil. In order that she might rest quietly in her grave and not be changed into a vampire, her sons severed her head from her body and laid it at her feet. In thus refusing to perform religious funeral rites the priest obeyed the canons of the church and also the laws of the Russian Empire. Until quite recently a corner of unconsecrated ground next to the wall of the Russian cemetery was reserved as a sort of carrion pit for the corpses of self-murderers, and it is expressly prescribed in the *Svod Sakonov*[29] that they "shall be dragged to such place of infamy by the knacker, and there covered with earth." This treatment of a *felo-de-se* by the ecclesiastical and civil authorities directly fosters popular superstition by tending to confirm the notion that there is something uncanny, eldritch, demoniacal, and preternaturally malignant inherent in his mortal remains, a notion still further strengthened by a most unjust paragraph (1472) in the Russian code, which declares the last will and testament of a suicide to have no legal validity. Drought, too, as well as pestilence, is ascribed to the evil agency of vampires, which "milk the clouds," and hinder the falling of the dew. In 1887 the South Russian province of Cherson began to suffer from drought soon after a peasant had hanged himself in the village of Ivanovka, the inhabitants of which, assuming a causative connection between the aridity and the self-homicide, poured water on the grave while uttering the following words: "I sprinkle, I pour; may God send a shower, bring on a little rainfall, and relieve us from misery!" As this invocation failed to produce the desired effect, the body was taken up and inhumed again in a gorge outside of the village. In some districts the corpse is disinterred, beaten on the head, and drenched with water poured through a sieve; in others it is burned.

The records of the criminal courts in West Prussia during the last half century contain numerous [215]
instances of the violation of graves from superstitious motives. Thus in March, 1896, a peasant died in the village of Penkuhl; soon afterward his son was taken ill of a lingering disease, which the remedies prescribed by the country doctor failed to relieve. It did not take long for the "wise women" of the village to convince him that his father was a "nine-killer," and would soon draw after him into the grave nine of his next of kin. The sole means of depriving him of this fatal power would be to disinter him and sever his head from his body. In accordance with this advice the young man dug up the corpse by night and decapitated it with a spade. In this case the accused, if tried in court, might honestly declare that he acted in self-defense; indeed, he might plead in justification of his conduct that he thereby preserved not only his own life, but also the lives of eight of his nearest and dearest relations, and that he should be commended rather than condemned for what he had done. It is the possibility and sincerity of this plea that render it so difficult to deal with such offenses judicially and justly. Here is needed what Tennyson calls

> "The intuitive decision of a bright
> And thorough-edged intellect, to part
> Error from crime."

Quite different, however, from a moral point of view, is the opening of graves in quest of medicaments, and especially of talismans, which are supposed to bring good luck to the possessor or to enable him to practice sorcery and to commit crime with impunity. In ancient times, and even in the middle ages, physicians sometimes prescribed parts of the human body as medicine, and in Franconia, North Bavaria, a peasant now occasionally enters an apothecary's shop and asks for "*Armensünderfett*," poor sinner's fat, obtained from the bodies of executed malefactors and prized as a powerful specific. The culprit was tried first for murder and then for lard, and thus made doubly conducive to the safety and sanitation of the community. Formerly many persons went diligently to public executions for the purpose of procuring a piece of the criminal as a healing salve, but since the hangman or headsman has generally ceased to perform his fearful functions in the presence of a promiscuous crowd, such loathsome remedies for disease are sought in churchyards.

In May, 1865, a Polish peasant in Wyssokopiz, near Warsaw, discovered that the grave of his recently deceased wife had been opened and the corpse mutilated. Information was given to the police, and a shepherd's pipe, found in the churchyard, led to the detection of the culprit in the [216]
person of the communal shepherd, a man twenty-six years old, who on examination confessed that he, with the aid of two accomplices, had committed the disgustful deed. His object, he said, was to procure a tooth and the liver of a dead person. He intended to pulverize the tooth and after mixing it with snuff to give it to his brother-in-law in order to poison him. On perceiving, however, that the body was that of a woman, he did not take the tooth, because it would have no power to kill a man; but he cut out the liver for the purpose of burying it in a field where the sheep were pastured, and thus causing the death of the entire flock in case he should be superseded by another shepherd, which he feared might happen. All three were condemned to hard labor in Siberia.

It is a quite prevalent notion that if any part of a corpse is concealed in a house, the inmates will have the corresponding bodily organs affected by disease and gradually paralyzed. A drastic example of this superstition occurred in May, 1875, at Schwetz, a provincial town of West

Prussia, where a woman named Albertine Mayevski became the mother of a male child, which died soon after its birth. The father, to whom she was betrothed, refused to marry her, and to punish him for this breach of promise she disinterred the body of her babe, cut off its right hand at the wrist and the genitals, and hid them in the chimney of the house of her faithless lover, hoping thereby to cause the hand, with which he had pledged his vow, to wither away, and to render him impotent. All this she freely confessed when brought to trial, and was sentenced to two months' imprisonment. But such relics of the tomb are used, on the principle of *similia similibus*, not only for inflicting injury, but also for bringing luck. Thus members of the "light-fingered craft" carry with them the finger of a corpse in order to enhance their skill, success, and safety in thievery; if the finger belonged to an adroit thief or a condemned criminal its talismanic virtue is all the greater. It is also believed that a purse in which a finger joint is kept will contain an inexhaustible supply of money. The finger of a murdered man is greatly prized by burglars because it is supposed to possess a magic power in opening locks. The records of criminal courts prove that these absurd notions are generally entertained by common malefactors in East Prussia, Thuringia, Silesia, Bohemia, and Poland. A candle made of fat obtained from the human body is very frequently used by thieves on account of its supposed soporific power, since with such a taper, known in Germany as *Diebslicht* or *Schlummerlicht* (sloom-light in provincial English), they are confident of being able to throw all the inmates of the house into a deep sleep, and thus rummage the rooms at will and with perfect impunity. The danger of detection is also [217] forestalled by laying a dead man's hand on a window sill; and in order to make assurance doubly sure, both preservatives are usually employed. Hence the proverbial saying, "He sleeps as though a dead hand had been carried round him." The desire to procure material for such candles often leads to the commission of crime. An Austrian jurist, Dr. Gross, in his manual for inquisitorial judges (*Handbuch für Untersuchungsrichter*), and the folklorists Mannhardt and Jakushkin, give numerous instances of this kind, and there is no doubt that the many mysterious murders and ghastly mutilations, especially of women and children, so horrifying to the public and puzzling to the police, are due to the same cause. In most cases the prosecuting attorneys and judges are unable to discover the real motives of such bloody and brutal deeds because they are ignorant of the popular superstitions in which they have their origin, and, for lack of any better explanation, attribute them to mere brutishness, wantonness, homicidal mania, and other vague and unintelligible impulses, whereas in reality they spring from a supremely selfish but exceedingly definite purpose, are perpetrated deliberately, and with the normal exercise of the mental faculties, and can not be mitigated even by the extenuating plea of sudden passion. Crimes of this sort are of common occurrence not only in the semi-barbarous provinces of Russia, but also in Austria and Germany, justly reckoned among the most civilized countries of Christendom. On January 1, 1865, the house of a man named Peck, near Elbing in West Prussia, was entered during the absence of the family by a burglar, Gottfried Dallian, who killed the maid-servant, Catharina Zernickel, and ransacked the premises in search of money and other objects of value. Before carrying off his spoils he cut a large piece of flesh out of the body of the murdered girl in order to make candles for his protection on future occasions of this sort. The talismanic light, which he kept in a tin tube, did not prevent him from being caught in the act of committing another burglary about six weeks later. During the trial, which resulted in his condemnation to death, he confessed that he had eaten some of the maid-servant's flesh in order to appease his conscience. This disgusting method of alleviating the "compunctious visitings of Nature" would seem to confirm the suggestion of a writer in the *Russkiya Wjedomosti* (Russian News, 1888, No. 359) that the thieves' candle is a survival of primitive cannibalism, distinct traces of which he also discovers in a Russian folk song which runs as follows: "I bake a cake out of the hands and feet, out of the silly head I form a goblet, out of the eyes I cast drinking glasses, out of the blood I brew an intoxicating beer, and out of the fat I mold a candle." It is certainly very queer to find such stuff constituting the theme of popular song within the confines of Christian civilization at [218] the present day, a grewsome stuff more suitable as the staple of Othello's tales

"—of the cannibals that each other eat,
The anthropophagi, and men whose
heads
Do grow beneath their shoulders."

In the burglary just mentioned the murder and mutilation of the maid were incidental to the robbery, and probably an afterthought, but there are on record numerous instances of persons being waylaid and killed for the sole purpose of making candles out of their adipose tissue. No longer ago than November 15, 1896, two peasants were convicted of this crime in Korotoyak, a city on the Don in South Russia. Their victim was a boy twelve years of age, whom they strangled and eviscerated in order to make candles from the fat of the caul and entrails. It would be superfluous and tedious to cite additional examples of this outrageous offense against humanity and common sense, for, like the devils that entered into the Gadarene swine, their name is Legion.

A still more disgusting and dangerous superstition is the notion that supernatural powers are acquired by eating the heart of an unborn babe of the male sex, just as a savage imagines that by eating the heart of a brave foe he can become indued with his valor. The modern European cannibal believes that by eating nine hearts, or parts of them, he can make himself invisible and even fly through the air. He can thus commit crime without detection, and defy all efforts to arrest or imprison him, releasing himself with ease from fetters, and passing through stone walls. This horrible practice has been known for ages, and is still by no means uncommon. In the first half of the fifteenth century the notorious marshal of France, Gilles de Laval, Baron of Rayz, is

said to have murdered in his castle near Nantes one hundred and fifty women in order to get possession of unborn babes. He was then supposed to have committed these atrocities from lewd motives, and was also accused of worshiping Satan. A mixed commission of civilians and ecclesiastics, appointed to examine into the matter, found him guilty and condemned him to be strangled and burned on October 25, 1440. In 1429, when he was thirty-three years of age, he had fought the English at Orleans by the side of Joan of Arc, and it was probably the desire to acquire supernatural powers in emulation of the maid that led him to perpetrate a succession of inhuman butcheries extending over a period of fourteen years, the real object of which seems to have been imperfectly understood by the tribunal which sentenced him to death.[30] Löwenstimm cites several instances of this crime. Thus, in 1577 a man was put to the rack in Bamberg, North [219] Bavaria, for murdering and disemboweling three pregnant women. In the seventeenth century a band of robbers, whose chief was known as "King Daniel," created intense consternation among the inhabitants of Ermeland in East Prussia. For a long time these freebooters roved and spoiled with impunity, but were finally arrested and executed. They confessed that they had killed fourteen women, but, as the unborn infants proved to be female, their hearts were devoid of talismanic virtue. Indeed, they attributed their capture to this unfortunate and unforseeable circumstance, and posed as persons worthy of commiseration on account of their ill luck. One of the strangest features of this cruel and incredible superstition is its persistency in an age of superior enlightenment. Dr. Gross records two cases of comparatively recent occurrence in the very centers of modern civilization: one in 1879, near Hamburg, where a woman, great with child, was killed and cut open by a Swede named Andersen, and another of like character ten years later in Simmering, near Vienna.

An ordeal very commonly practiced in the middle ages to determine the guilt or innocence of any one accused of theft was to give him a piece of consecrated cheese, which, if he were guilty, it would be impossible for him to swallow. Hence arose the popular phrase, "It sticks in his throat." Thus Macbeth says, after he had "done the deed":

> "But wherefore could not I pronounce
> amen?
> I had most need of blessing, and amen
> Stuck in my throat."

Wuttke states that this custom still prevails in the Prussian province of Brandenburg, where a person suspected of larceny is made to swallow a piece of Dutch cheese on which certain magical letters and signs are scratched. His failure to do so is regarded as conclusive evidence of his guilt. Various other means of making inquest for the detection of crime are in vogue, some of them merely silly, and others mercilessly savage. Thus a mirror is laid for three successive nights in the grave of a dead man. It is placed there in the name of God, and taken out in the name of Satan. It is believed that by looking into such a mirror the person of the thief can be clearly seen. A bull belonging to a peasant not far from Perm, on the Kama, died suddenly. The owner declared that the death of the animal was due to witchcraft, and demanded that all the women of the village should be made to creep through a horse collar in order to discover the hag who had wrought the mischief. This plan was approved by his neighbors, and, although their wives protested against being subjected to the degrading and for corpulent women extremely difficult [220] and even dangerous test, they finally submitted to it rather than remain under the suspicion of practicing the black art. This performance, which is unquestionably a relic of Uralian-Finnish paganism, took place on March 16, 1896. The following instance may serve as an example of the ruthless barbarity to which such delusions often lead: In December, 1874, a South Russian peasant in the vicinity of Cherson missed one hundred rubles and went to a weird woman in order to learn what had become of them. She consulted her cards and declared that the money had been stolen by a certain Marfa Artynov. The man was greatly astonished at this response, because the accused was a highly respected teacher of young children, and had the reputation of being thoroughly honest. Nevertheless, his credulity got the better of his common sense, and with the aid of his neighbors he seized Marfa and carried her to the churchyard, where he bound her to a cross and began to torture her, beating her with a knout, suspending her by her hands, and twisting and tearing her neck and tongue with a pincers. To her cries and entreaties her tormentors coolly replied, "If you are really innocent, what we are doing can cause you no pain!" Many of the persons who offer their services as clairvoyants and seers to a credulous and confiding public, and whose utterances are accepted as oracles, are professional swindlers. Thus a young lady moving in the higher circles of society in Vienna had a valuable set of diamonds stolen. By the advice of a trusted lackey she consulted a woman, who was reputed to have the power of divination, and who informed her, contrary to the strong suspicions of the police, that the theft had been committed, not by any member of the household, but by a stranger. The young lady was so firmly persuaded of the truth of this statement that, although urged by the court to prosecute the lackey, she refused to do so. The evidence against him, however, was so strong that he was finally tried and condemned. The pythoness, who had endeavored to exculpate him, proved to be his aunt and accomplice.

A queer phase of superstition, which in many parts of Europe seriously interferes with the administration of justice, manifests itself in the various means of avoiding the evil consequences of perjury, at least so far as to soothe the pangs of conscience and to avert the divine anger. This immunity is secured in some provinces of Austria by carrying on one's person a bit of consecrated wafer, a piece of bone from the skeleton of a child, or the eyes of a hoopoe, holding a ducat or seven small pebbles in the mouth, pressing the left hand firmly against the side, crooking the

second finger, or pulling off a button from the trousers while in the act of swearing, or spitting immediately after taking an oath. The Russian province of Viatka is settled by a people of Finnish origin, the majority of whom have been baptized and call themselves orthodox Christians, while the remainder are still nominally as well as really heathen. When they take an oath it is administered by a pope or priest, and a Russian jurist, J. W. Mjeshtshaninov, describes the method employed by them to forswear themselves with safety. When called upon to take an oath, the witness raises the right hand with the index finger extended; he then lays the left hand in the palm of the right hand with the index finger pointing downward, and by a crisscross combination of the other fingers, which probably works as a charm, the whole body is converted into a conductor, so that the oath entering through the index finger of the right hand passes through the index finger of the left hand into the earth like an electric current. The witness thus feels himself discharged of the binding influence of the oath, and may give false testimony without laying perjury upon his soul. [221]

The superstitions which encourage ignorant people to commit crime are handed down from generation to generation, and have in most cases a purely local character. In other words, the charms and sorceries and other magical arts employed to produce the same results differ in different places, and unless the judges are familiar with these various forms of superstition they will be unable to understand the exact nature of the offenses with which they have to deal, and their efforts to detect and punish violations of the law will be greatly hampered and sometimes completely thwarted.

The subject here discussed has not only a speculative interest for ethnographers and students of folklore, but also, as already indicated, a practical importance for criminal lawyers and courts of justice in the Old World and even in the United States. The tide of immigration that has recently set in from the east and south of Europe has brought to our shores an immense number of persons strongly infected with the delusions which we have attempted to describe. Acts which would seem at first sight to have their origin in impulses of cruelty and brutality are found on closer investigation to be due to crass ignorance and credulity, and, although the ultimate motives are usually utterly selfish, there are rare instances in which the perpetrators of such deeds are thoroughly disinterested and altruistic, and do the most revolting things, not from greed of gain, but solely for the public good. In cases of this kind the most effective preventive of wrongdoing is not judicial punishment but intellectual enlightenment.

A GEOLOGICAL ROMANCE. [222]

By J. A. UDDEN.

A western naturalist once said that the geology of Kansas was monotonous. In one sense this remark is certainly justifiable, and the same may be said about the geology of some of the other States on the Western plains. The American continent is built on a comprehensive plan, and many of its formations can be followed for hundreds of miles without presenting much variation in general appearance. Occasionally, however, some feature of special interest crops out from the serene uniformity, and the very nature of its surroundings then makes it appear all the more striking. Minor accidents in the development of our extensive terranes sometimes stand out in bold relief, as it were, from the monotonous background. In their isolation from other details such features occasionally display past events with unusual clearness.

Such is the case with a deposit of volcanic ash which has been discovered in the superficial strata on the plains.[31] It lies scattered in great quantities in a number of localities in Nebraska, Kansas, South Dakota, and Colorado, having been found in no less than twenty counties in the first-mentioned State. It measures from two to fourteen feet in thickness in different localities, and is mostly found imbedded in yellow marl and clay, and has a somewhat striking appearance in the field, due to its snowy whiteness and to the sharpness of the plane which separates it from the underlying darker materials. Many years before its real nature was known it had been noticed and described by Western geologists. Prof. O. T. St. John saw it many years ago in Kansas, where it appeared as "an exceedingly fine, pure white siliceous material," forming a separate layer of several feet, and set off by a sharp line from the buff clay-marl below. His words describe its usual appearance in other places (see Fig. 1).

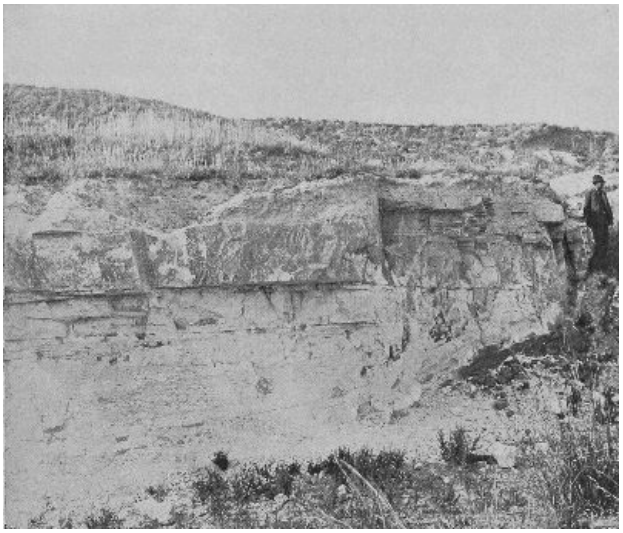


Fig. 1.—Stratified Volcanic Ash near Meade, Kansas.
(From the University Geological Survey of Kansas, vol. ii.)

This ash occurs in several outcrops in McPherson County in the central part of Kansas, where the writer had an opportunity to study it somewhat in detail a few years ago. Some of the features of the dust at this place reveal the conditions under which it was formed with considerable distinctness, and the volcanic episode which produced it appears strikingly different from the dull monotony of the ordinary geological work recorded in the terranes of the plains. It may be said to [223] consist of angular flakes of pumice, averaging one sixteenth of a millimetre in diameter, and having a thickness of about one three-hundredth of a millimetre. The most common shape of the flakes is that of a triangle, or rather of a spherical triangle, since the flakes are apt to be concave on one side and convex on the other. In the microscope they sometimes appear like splinters of tiny bubbles of glass, and this is really what they are (Fig. 2).

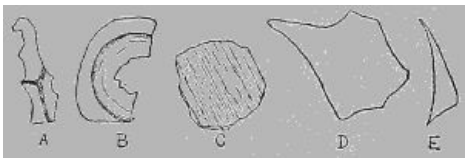
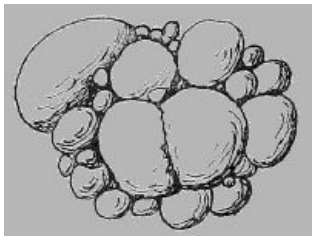


Fig. 2.—Flakes of Volcanic Ash. Magnified about 100 diameters. A, flake with a branching rib; B, fragment of a broken hollow sphere of glass; C, fragment with drawn-out tubular vesicles; D and E, plain fragments of broken pumice bubbles. (From American Geologist, April, 1893.)

The explosive eruptions which give rise to showers of this kind of ash, or dust, are due to fusion and superheating of subterranean masses of rocks charged with more or less moisture. A part of this moisture escapes in the form of steam at the time of an eruption. But the viscidity of the ejected material prevents much of the steam from passing off, and such of the lava as cools most rapidly retains a certain quantity in solution, as it were. Obsidian is a rock which has been made in this way. It often contains much of the original water, which will cause it to swell up into a stony froth when fused.

This volcanic dust has the same property. If one small particle of it be heated on a piece of platinum foil it is seen to swell up into a compound bubble of glass (Fig. 3). It is [224] evident that this is due to the expansive force of the heated included moisture, to which the viscid half-molten glass readily yields. At the time of the eruption which produced this dust, subterranean heat was applied to the moisture-bearing rock until this was superheated to such an extent that the weight of the overlying material was insufficient to hold the water from expanding into steam. Then there was a tremendous explosion, and the molten magma was thrown up with such a force that it was shattered into minute droplets, in the same way as water does when it is thrown forcibly into the air. Being thus released from pressure, the steam inside of each little particle of the heated glass caused it to swell out into a tiny bubble. As this kept on expanding it was cooled, the thin glass wall of the bubble congealed, and finally burst from the pressure of the steam within. This is the reason why the little dust particles are thin, mostly triangular, and often slightly concave flakes with sharp angles. Sometimes the angles appear rounded, as if the fragments had been viscid enough to creep a little after the bubble burst. The study of one single little grain of dust, barely visible to the naked eye, thus makes clear the nature of a catastrophe which must have shaken a whole mountain, and which left its traces over a quarter of a continent.

That the dust was produced in this way is quite evident from other circumstances. If a handful from the dust of this place be thrown into water and gently stirred, it nearly all will settle after a while. But some rather large particles remain floating on the surface. If these are removed and examined under the microscope, they are seen to be hollow spheres (Fig. 2, *b*). These are some of the original bubbles that never burst, either because they contained too little steam or else because the steam was cooled before it had time to break the walls open. It is evident that not every droplet of the molten magma would



form a single sphere, but that many also would swell up into a compound frothlike mass of pumice. A few such pieces may sometimes be observed in the deposit at this place, and that many more were made and broken is evident from the great number of glass fragments which have riblike edges on their flat sides (Fig. 3, *a*).

Fig. 3.—A Particle of Volcanic Ash swelled up by Fusion. Magnified 100 diameters.

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The nature of the force which caused the eruption may thus be understood from the study of one little grain of the dust, but much more extended observations are needed in order to make out the place where the great convulsion took place. It will, perhaps, never be known what particular volcanic vent was the source of this ash. Different deposits may have come from different places. But it seems possible that it all came from the same eruption. There can be no doubt that the volcanic disturbances occurred to the west of the Great Plains. No recent extinct volcanoes are found in any other direction. This conclusion is corroborated by the fact that the dust is finer in eastern localities and coarser nearer the Rocky Mountains. In a bed near Golden, in Colorado, seventy-three per cent, by weight, of the dust consists of particles measuring from one fourth to one thirty-second of a millimetre, while some from Orleans, in Nebraska, contains seventy-four per cent of particles measuring from one sixteenth to one sixty-fourth of a millimetre in diameter. Still finer material comes from the bluffs of the Missouri River near Omaha. Evidently the coarser particles would settle first, and if the dust is finer toward the east, it must be because the wind which brought it blew from the west. Most likely the eruption occurred somewhere in Colorado or in New Mexico.

It may be asked how it can be known that the dust was carried this long distance by the wind. May it not as well have been transported by water? The answer must be, in the first place, that showers of the same kind of material have been observed in connection with volcanic outbursts in other parts of the world. One such shower is known to have strewn the same kind of dust on the snow in Norway after a volcanic eruption in Iceland, and after the great explosion on Krakatoa, in 1883, such dust was carried by the wind several hundred miles, and scattered over the ocean. If this ash had been transported by water, it would not be found in such a pure state, but it would be mixed with other sediments. There would, no doubt, also be found coarser fragments of the volcanic products. On the contrary, it appears uniformly fine. No particles have been found which measure more than one millimetre in diameter, and less than one per cent of its weight consists of particles exceeding one eighth of a millimetre in diameter. In seven samples taken from different places the proportions of the different sizes of the grains were about as follows:

Diameter of grains in millimetres	$\frac{1}{2}$-$\frac{1}{4}$	$\frac{1}{4}$-$\frac{1}{8}$	$\frac{1}{8}$-$\frac{1}{16}$	$\frac{1}{16}$-$\frac{1}{32}$	$\frac{1}{32}$-$\frac{1}{64}$	$\frac{1}{64}$-$\frac{1}{128}$	$\frac{1}{128}$-$\frac{1}{256}$
Percentage of weight of each size	0.1	0.1	19	37	32	9	1

Flaky particles of this size are easily carried along by a moderate wind. In some places it appears as if the dust were resting on an old land surface where no water could have been standing when it fell. There is really no room for doubt that it was carried several hundred miles by the wind. It must have darkened the sky at the time, and it must have settled slowly and quietly over the wide plains, covering extensive tracts with a white, snowlike mantle several feet in thickness. What a desolate landscape after such a shower! What a calamity for the brute inhabitants of the land!

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Fig. 4.—Tracks in the Volcanic Dust, probably made by a Crawfish. Reduced to $\frac{2}{8}$

Right here in McPherson County there was either a river or a lake at the time of the catastrophe. This is plainly indicated in several ways. In one place the dust rests on sand and clay, with imbedded shells of fresh-water clams. It is assorted in coarse and fine layers like a water sediment. Lowermost is a seam of very coarse grains. These must have settled promptly through the water, while the finer material was delayed. In another place it lies on higher ground, and here marks of sedges and other vegetation are seen extending up about a foot into the base of the deposit, from an underlying mucky clay. Bog manganese impregnates a thin layer just above the clay, indicating a marshy condition. Here also the material is somewhat sorted, but in a different way. It is ripple-bedded. The water was evidently shallow, if there was any water at all. A burrow like that of a crawfish extended down into the old clay bottom. On a slab of the volcanic ash itself some tracks appeared (Fig. 4). These were probably made by an individual of the same race in an effort to escape from the awful fate of being buried alive like the inhabitants of Herculaneum and Pompeii.

The shower must have lasted for a time of two or three days. I infer this from the nature of the wind changes, which are indicated by the ripples in the dust. These still lie in perfect preservation (Fig. 5), and may be studied by removing, inch by inch, the successive layers from above downward, for it is evident that as the direction of the wind changed, the ripples were also turned. The deciphering of this record must be made backward. The bottom layers were deposited first, and the excavation must begin on top. Otherwise the record is as perfect as if it had been taken down by an instrument when the shower occurred. It may be only local in its significance, for it shows the direction of the wind at this particular

Fig. 5.—Ripple Marks in the Volcanic Dust.

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diameter.

Reduced to ¼ diameter.

place alone. The wind may have been somewhat deflected from the general direction by local topographic peculiarities, though these appear to have been of small importance. In any case, the old legend is quite interesting to read, being, I believe, the only geological record ever found of the passing of a cyclone over the United States.

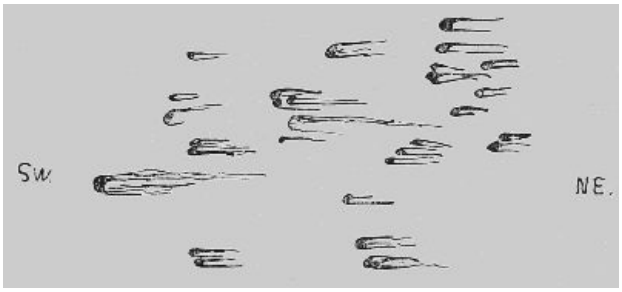

Fig. 6.—Peculiar Elevations caused by a Current from the Southwest to the Northeast.
Reduced to ½ diameter.

In the lowermost foot of the deposit no ripple marks can be seen. But there appear some marks of sedges and other vegetation, and these are inclined to the west, as if the plants had been bent by an east wind. Just above the height to which the imprints of the vegetation extend, ripple marks begin to appear, running on a northeast-southwest course. They were made by a southeast wind, for their northwest slopes are the steeper. A little above this height some peculiar small elevations appear on one of the bedding planes, and slightly raised ridges run for a short distance to the northeast from each elevation, vanishing in the same direction (Fig. 6). A southwesterly current was unmistakably obstructed by the little elevations, and left the small trails of dust in their lee. Six inches higher up the wind comes more from the south, and for the next foot the ripples continue to gradually turn still more in the same direction so as to at last record a due south wind. At this point it suddenly changed and set in squarely from the west, for the ripples [228] are turned north and south, with the steeper slopes to the east. This direction seems to have prevailed as long as the dust kept on falling. It appears to me that these successive changes are best explained as attendant upon the passage of a cyclone, or of what our daily weather maps call a "low area." Going by from west to east, on the north, it would at first cause an east wind. This would then gradually be turned to the south and then to the west. One such rotation of the wind generally lasts a day or two. The shower must then have kept on at least for the same length of time, if not longer (Fig. 7).

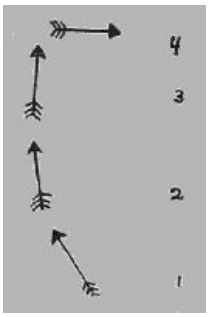

Fig. 7. —Changes in the Wind as recorded by the Ripple Marks.

There is reason to believe that this catastrophe occurred in summer. No crayfish would be out making tracks during the cold months, and the fossil vegetation could hardly have left such plain marks if it had been buried by the dust during the winter. The most conspicuous of these marks are some triangular and Y-shaped molds of the stems and leaves of sedges. Siliceous skeletons of *chara* and filamentous algæ were also found upon a close examination in some of these molds.

It is really difficult to appreciate the change such a shower must have produced in the appearance of the landscape, and the effect it must have had on animal and plant life. So far away from the volcanic source, the wind can not have laid down a layer of this dust several feet in thickness without scattering it far and wide all around. It must have covered tens of thousands of square miles. Just imagine, if you can, a whole State, clad in the verdure of summer, suddenly, in two or three days, covered over by a blanket of white volcanic ash! Many species of plants must have found it impossible to grow in such a soil. And what disaster it must have caused in the animal world! Grazing herds had their sustenance buried from their sight, and could save their lives only by traveling long distances in this loose dust. Many a creature must have had its lungs or its gills clogged with the glassy flakes floating in the water and in the air. The sudden disappearance of several mammal species near the beginning of the Quaternary age has been noted by paleontologists. Does it seem unlikely that an event like this, especially if repeated, may have hastened the extermination of some species of land animals? That many individuals must have perished there can be no doubt. Not very far away from that outcrop of the dust which I have described, one of the early settlers in this part of the State once made a deep well that penetrated the ash. Above the deposit, and some sixty feet below the surface of the prairie, he found what he described as "an old bone yard." In digging other wells in this vicinity [229] mammal bones have been taken up by the settlers from about the same horizon. It is to be regretted that, with one exception, none of these fossils have been preserved for study, for it is likely that they were the remains of animals which were killed in the dust shower.

In the absence of fossils definitely known to be connected with the ash, its exact age seems yet uncertain. In McPherson County it is underlaid by clay, gravel, and sand, which contain remains of the horse, of a megalonyx, and of bivalve mollusks of modern aspect. In the bluffs of the Missouri River near Omaha pockets of a similar ash rest on glacial clay under the loess. At the latter place it must belong to the Pleistocene age, and at the former it can not be older than the late Pleiocene. These two deposits may not belong to the same shower, but it appears, at any

rate, that the volcanic disturbances which produced them occurred near the beginning of the Pleistocene age.

In comparison with the slow and even tenor of the routine of geological history, the event here sketched appears so unique and so striking that it may well be called a geological romance. Modern science has taught us that the geological forces are slow and largely uniform in their work, and that most of the earth's features must be explained without taking recourse to theories involving any violent revolutions or general terrestrial cataclysms. While the making of this dust is not any real exception to the law of uniformity, we are here reminded that Nature is quite independent in her ways, and that even in her sameness there is room for considerable diversity.

Mr. William Ogilvie, of the Topographical Survey of Canada, estimates that there are more than 3,200 miles of fair navigation in the system of the Yukon River, of which Canada owns nearly forty-two per cent. A remarkable feature of the river, with its Lewes branch, is that it drains the Peninsula of Alaska and nearly cuts it in two, starting as it does less than fourteen miles, "as the crow flies," from the waters of the Pacific Ocean, at the extreme head of the Lewes branch, whence it flows 2,100 miles into the same ocean, or Bering Sea, which is a part of it. The drainage basin of the river occupies about 388,000 square miles, of which Canada owns 149,000 square miles, or nearly half, but that half is claimed to be the most important. As for the origin of the name Yukon, the Indians along the middle stretches of the river all speak the same language, and call the river the Yukonah; in English, "the great river" or "the river." The Canadian Indians in the vicinity of Forty Mile call it "Thetuh," a name of which Mr. Ogilvie could not learn the meaning. The correct Indian name of the Klondike is *Troandik*, meaning Hammer Creek, and refers to the barriers the Indians used to erect across the mouth of the stream to catch salmon, by hammering sticks into the ground.

THE SEASON OF THE YEAR.

[230]

By GRANT ALLEN.

A year is, roughly speaking, the period which it takes the earth to perform one complete revolution round the sun. I say "roughly speaking" with due humility, having the fear of the expert ever before my eyes, because I know that if I do not sing small, that inconvenient person, the astronomical critic, will come down upon me at once like a wolf on the fold, with minute distinctions about the mean, the tropical, and the sidereal year; matters of immense importance at Greenwich Observatory, no doubt, but elsewhere of very little interest indeed, seeing that they differ from one another by so many minutes only. Let us leave the astronomers their own problems. The year with which I am going to deal humbly here is a much more commonplace, ordinary, and comprehensible year—the visible year of vegetation, of plant and animal life, of the four seasons; the year as roughly known to children and savages, and to the weeds, the flowers, the bees, and the squirrels.

It has often struck me as curious that people took this complex concept of the year so much for granted—inquired so little into its origin and discovery. Yet it is by no means everywhere obvious. How did men first come to notice, in the tropics especially, that there was such a thing as the year at all? How did they first observe, save in our frozen north, any fixed sequence or order in the succession of Nature? How did they learn, even here, that spring would infallibly follow winter, and summer be succeeded in due course by autumn? And, to go a step farther back, how did the plants and animals, in all parts of the world alike, come originally to discover and adapt themselves to all these things? How did the bee know that she must "gather honey all the day from every opening flower," the summer through, in order to use it up as bodily fuel in winter? How did the plants learn when to blossom and produce seed? In one word, how did the seasons come to be automatically recognized?

That they *are* automatically recognized, even by plants, quite apart from the stimulus of heat or cold, drought or rain, a single fact (out of many like it) will sufficiently prove. Trees brought from Australia to England, where the seasons are reversed, try for two or three years to put forth leaves and flowers in October or November—the southern spring. It takes them several autumns before they learn that the year has been turned upside down—that June is now summer and December winter. This shows that life moves in regular cycles, adapted to the seasons, but not directly dependent upon them. The rhythm of the world has set up an organic rhythm which now [231] spontaneously and automatically follows it.

At first sight, to the dweller in the temperate zone at the present day, the questions I have put above may seem needless, not to say childish. But that is perhaps because we have all too much the habit of taking it for granted that what is true here and now has also been true everywhere and always. A first visit to the tropics often enough rudely disturbs this uninquiring attitude of mind. For in the tropics, and especially in the equatorial region, there is no winter and no summer, no spring and no autumn. The world wags wearily through an unending display of monotonous greenery. As far as temperature goes, the year is pretty much alike in all its months.

Yet not only do equatorial men recognize the existence of the year as a natural epoch quite as much as other men—not only do equatorial savages celebrate annual feasts, count ages by years, and perform certain rites in certain months only—but also animal and vegetable nature recognizes the year; trees have their month for blossoming and fruiting, birds their month for assuming the plumage of courtship, for nesting and hatching, almost as markedly as elsewhere. The recognition of the year both by man and by Nature is not therefore entirely dependent upon the difference of summer and winter, as such. We must go deeper, and I think, when we come to consider geological time, much deeper, if we wish to understand the true character of yearliness —a word which I venture here to coin to express this meaning.

Have you ever quite realized what the tropical year is like? Suppose you are living on or near the equator, then in December the sun is south of you and at its greatest distance away; you have, so to speak, a relative winter. But in March the sun is overhead; it is now full midsummer. By the end of June the sun has gone north, and is once more on a tropic; you have a second winter; not much of a winter, I admit, but still, a relative winter. By September he has returned overhead again, and you are enduring a second summer. In December he has once more retreated to the southern tropic (Capricorn), and it is comparative winter. Thus the equatorial year consists of four distinct seasons, in two of which the sun stands directly overhead, while in two he is at his northern or southern limit. I may add that the effect is always curious when, as you face the sun, you see that he is moving in his diurnal path, not from left to right ("the way of the sun," as we say), but from right to left (or "widdershins"). You are never till then aware how natural and inevitable has seemed the opposite direction: when you find it reversed the effect is surprising.

Now, the distance to which the sun travels north or south of you, if you live on the equator—I use [232]
ordinary terms instead of astronomical ones for simplicity's sake—is so comparatively small that within the tropics themselves you never notice much difference as to the amount of heat between one period of the year and another. In equatorial countries the day and night temperature is much the same all the year round: if the country be plain, it is always hot; if mountainous, like the district about Bogotá, it is "a perpetual spring"; one day is always much the same as the one that went before and the one that comes after it. Even on the actual tropics, again, the difference is too slight to make any marked change in the temperature; people living on the northern tropic (Cancer), for example, have the sun vertical to them on June 21st, and some forty-three degrees south of them on December 21st. Nevertheless, the sun is still as near them and as powerful as he is at Milan or Venice in the height of summer; and the consequence is that, as a matter of fact, the thermometer within the tropics and at sea level seldom descends below 75° or 80°, even at midnight in the relative winters. For the heating power of the sun depends, of course, upon the directness of his rays, and lessens with their obliquity; in Venice and Milan they are strong enough to make the ground very hot in July and August, though it has been cooled before by a northern winter; much more than in Jamaica or Madagascar, which have never been cooled, does the accumulated heat keep everything warm even when the sun is most oblique—and he never reaches the same obliquity as in an English summer. The ground is hot, the houses are hot, wood and stone are hot, and they have all been hot from time immemorial.

Yet tropical and equatorial trees and plants have their definite seasons to flower and fruit, just the same as elsewhere. This seems surprising at first when one visits the tropics. You can not see why everything should not flower and fruit the whole year round. And yet, at one time pineapples are "in," at another mangoes. And these seasons differ in the northern and southern hemispheres; what is mango winter in the one being mango summer in the other. I do not say the seasons anywhere in the tropics differ markedly; still, they do differ; the tropical year is divided into times and months for agriculture just as much as any other. Thus there are regular dates in each hemisphere for planting, tending, and cutting the sugar cane. Now, what is the reason of these changes in vegetation, when temperature remains so constant? Why do not trees and shrubs of each kind flower up and down throughout the year irregularly—now one individual and now another? Why are there seasons for things at all in the tropics?

The answer is, because the same causes which produce summer and winter in temperate climate [233]
produce other changes of other sorts in the tropical region. The temperature, it is true, remains the same, or approximately the same; but the meteorological conditions vary. Even with ourselves, summer is not only hotter but also drier than winter; winter is marked by rain and snow as well as by lowered temperature. In the tropics, on the other hand, it is rather the summer or summers that are wet, for there is a certain moving zone of equatorial calms in which it practically keeps on raining always. But this zone is not fixed; it flits with the sun. When the sun goes northward for the northern summer the rainy zone goes with him; when he turns southward again the zone shifts after him. Thus places on or near the two tropics have one rainy season a year, while places on the equator have usually two. The intervening dry seasons are often very dry and parched, indeed; and where this is markedly the case, the rainy season acts just as spring does in the north, or as the inundation does in Egypt; it is the beginning of vegetation. The plants that were dry and dormant during the arid months wake up into fresh life; the branches put forth new leaves; the brown seeds germinate; the flowers appear; and in due time the fruit ripens. Everything in these cases depends upon the recurrence of the rainy season, just as everything in India depends upon the bursting of the monsoons, and everything in Egypt on the rising of the Nile. I have seen a dry plain in Jamaica bare and brown one day, and covered six or eight inches high with fresh green waving guinea-grass the day but one after. The rains had come meanwhile, and Nature had awaked with more than springlike awakening. In those hot climates everything grows by magic as soon as it gets the needed water.

Indeed, we may say that in half the world the seasons, organically speaking—I mean, the seasons of plant and animal life—depend upon heat and cold, summer and winter, snow or sunshine; but in the other half they depend almost entirely upon drought and rainfall. Even as near home and as far north as Algeria, the summer is far too dry and dusty for agriculture; the autumn rains set in about October or November; they are immediately followed by the plowing; and the winter becomes for most purposes the practical summer. Fruits and vegetables are at their best in January and February; the fields are full of flowers up to March or April; in June, July, and August the country is an arid and weary desert. But the seasons for dates are almost reversed; they ripen in autumn. In Egypt again, where everything depends upon the inundation, the seasons are still more complicated; the inundation begins to subside in October; in Upper Egypt the winter season which follows is far the most important for agriculture, and crops sown as the water subsides are [234] reaped from four to seven months after. But in the Delta, rice, cotton, and indigo are sown in the spring (March or April) and harvested in October, November, and December. Here, irrigation and temperature come in as disturbing elements, for the Delta feels something of the cold of winter.

I could give many other instances, but these will suffice. As a general rule, we may say that in the temperate and frigid zones the seasons for plants and animals are ruled by heat and cold, but that in tropical and even in subtropical climates, rainfall and drought, themselves largely due to the same circumstances, are the ruling factors.

Again, everybody knows that winter and summer, and the other phenomena which simulate or accompany them, such as wet and dry seasons, depend upon the fact that the earth's axis is not perpendicular to the plane in which the earth moves round the sun, but slightly inclined to it. Now, a year in itself, viewed as a measure of time, is merely the period which it takes the earth to perform one such complete revolution. During one half of each such revolution the north pole is turned at a considerable angle toward the sun, and during the other half, the south pole. When the north pole is so turned we call it summer in the northern hemisphere; when the south pole is being favored, and the north is receiving less light and heat, we call it winter. Let us suppose for a moment that the earth had not got this twist or kink in its axis; that the equator was always presented exactly toward the sun; what then would happen? Obviously, there would be no change of seasons. The day and night would have fixed lengths which never varied; climate would in each place be uniform and, barring accidents of elevation or distribution of land and water, the climate of each place would also depend entirely the whole year round on its distance from the equator. Roughly speaking, the temperature of a district would be the temperature it now possesses in March and September, only not quite so cold as March nor so warm as September, owing to the absence of accumulated heat from summer or of reserves of ice and snow from winter. In one word, under such conditions there would have been climates—marked belts of climate; but there would not have been seasons.

Seasons, however, depend in great part, as Mr. Alfred Russel Wallace has ingeniously shown, on a great many things besides this mere inclination of one end or the other of the earth toward the sun in June and January. Much must be laid to the count of accumulated stores of heat or cold; and though accumulated cold is physically a misnomer, still for all practical purposes we may apply the words fairly enough to the ice caps of the pole and the glaciers of mountain systems. [235] And here we come face to face with the very core of our problem: for the odd part of it is that seasons (at least as we know them) seem to be quite a recent and exceptional phenomenon in the history of our planet. So far as we can judge, geologically speaking, the earth during all its earlier life enjoyed, over all its surface, what we should now consider tropical or subtropical conditions. England—or rather the land that occupied the part of the earth's crust where England now stands—had a vegetation of huge tree ferns and palms and cycads during the Primary period; as late even as the middle Tertiaries it had a vegetation like that of South Carolina or Upper India. Greenland itself, in quite recent times, flourished like a green bay tree, and did not belie its odd modern name. The world as a whole enjoyed perpetual summer. In one word, except in something like the equatorial sense, there were practically no seasons. The sun went north and south, no doubt, as now, but the temperature, even in the relative winter, seems to have remained perennially mild and genial.

It is true, occasional slight traces of glacial epochs, earlier than the great and well-known Glacial epoch, break here and there the almost continuous geological record of palmy and balmy world-wide summers; yet, taking the geological monuments as a whole, they show us few or no signs of anything worth calling a serious winter till quite recent periods. Large-leaved evergreens are still, in the day-before-yesterday of geology, the order of the day; magnolias and liquidambars, cinnamons and holly oaks, vines and rotang palms formed the forests even of Miocene Britain. The animals during all the Tertiary period were of what we now regard as tropical or subtropical types—lions, rhinoceroses, hippopotamuses, monkeys, or more antique races, equally southern in aspect. There could have been little change of winter and summer during this long warm spell; the variations can have been scarcely more than those of dry and rainy seasons. The trees never lost their leaves; the fruits and flowers never ceased to follow one another; no interruption of the food supply drove insects to hibernate in their silken cocoons, or squirrels and bears to lay by stores of food or fat for the cold and hungry winter.

Nevertheless, taking the world round as it stands, we must believe that the distinction of seasons grew up, both for plants and animals, and for man or his ancestors, during this age of relatively unmarked summers and winters. For the tropics more than anywhere else preserve for us to-day the general features and aspect of this earlier time; they have never had the continuity of their stream of life rudely interrupted by the enormous changes of the Glacial epoch. Yet, even in the

[236]

tropics, things, as we saw, have seasons. There are annuals and perennials there, as elsewhere. Each kind has its month for sprouting, for flowering, for fruiting, for shedding its seed; and men in the tropics, some of them long isolated in oceanic islands, or in great insulated regions like Australia or New Guinea, from the rest of their kind in the temperate regions, nevertheless know and observe the year, and perform all their functions, agricultural or religious, by yearly cycles. For example, there is among them all an annual feast for the dead, and widows mourn their husbands for one year from their burial. Observation of the year, therefore, both automatically by organisms at large and consciously by man, antedates and is independent of observation of the existence of summer or winter.

I do not think, however, that man would have noted the merely astronomical year—the year of the sun's position—at least till a relatively late stage in culture, if he had not first noticed the organic year—the regular recurrence of plant and animal seasons. So many yams—that is to say, so many yam harvests—in other words, so many years, is a common savage way of reckoning times and ages. But they call it "yams," not summers or winters. And when I say yams, I give that merely as a single instance, for elsewhere the "seedtime and harvest" are reckoned indifferently in maize or millet, rice or barley, according to the agriculture of the particular people. Even hunting races know that at certain times of year certain foods abound; and this is true of equatorial savages and equatorial plants or animals, as well as of others.

Moons are more obvious measures of time than suns, in the tropics at least—probably everywhere; for the waxing and waning of the moon mean much to people who live largely out of doors; and the month is, perhaps, the earliest fixed mode of reckoning time beyond a day or two. Most savages count time mainly by so many moons. But they must also have noticed early that after a certain number of moons (usually about thirteen), certain fruits or seeds were ripe again; especially must they have noticed it when this recurrence coincided with the return of the rainy season, or of some other annual meteorological phenomenon, like the bursting of the monsoon or the Nile inundation. Thus, even in the tropics, and before the coming on of the Glacial epoch, men or the ancestors of men (one can not draw precise lines here) must probably have observed a certain rough relation between the months and the vegetative cycles; after so many moons, about say thirteen, the yam, or the mangoes, or the grains are ripe again. These organic years, I take it, must have been noticed before the astronomical ones. For it is now beginning to be more and more believed that man is of preglacial origin; and even if something worth calling a man were not, then at least man's pre-human ancestors go back far into the Tertiary period. Only later [237] would men begin to note that some thirteen moons, and the recurrence of a food stuff, concurred with a particular solar season.

Indeed, if one comes to think of it, how much even now do any of us, save the most scientific, mean by the year, beyond the visible change of summer and winter? What we are thinking of is the leafless trees, the ice and snow, the green grass in spring, the flowers and warm days in summer, not the abstract astronomical fact of the earth's revolution round the sun, or the due succession of the signs of the zodiac. It is that visible organic year that must have counted most with man from the first; though no doubt its meaning and reality are much more vividly present since the coming on of the Glacial epoch, and the more so in proportion as we live nearer to the north or south pole; while at the equator the year is to the last a much more inconspicuous period —a largely artificial mode of reckoning.

Still, from the very first, there was one element of diversity in the year which must have struck all men, in the temperate and frigid zones at least, perhaps even in a certain way in the tropics. I mean, the varying length of the day, always perceptible in the frigid and temperate zones; for as soon as men in these regions began to think and to observe at all, they must have noticed that the days increased in their summer and lessened in their winter; and they must have learned to correlate this waxing and waning of the day with the appearance or abundance of certain fruits, seeds, birds, fishes, game, roots and other food stuffs. It is at least certain that all the world over men do now celebrate the solstices and the equinoxes as special feasts; and the close similarity in most such celebrations leads one to suspect that the custom has been handed down from the very remote time when the human family was still a single continuous body.

In the tropics, it is true, the days vary so little that this difference in itself is not likely to have struck primæval man. But there, another point would come in—the annual movement of the sun overhead from south to north and *vice versa*; and though this would be less directly important to human life than in temperate regions, it would still be indirectly important. It would bring the rain with it. In Europe, of course, and in temperate America, we can see at once that the return of the sun northward must always have meant spring, the increase of food stuffs, the promise of corn or maize, the suggestion of harvest; and we can therefore understand why the midwinter feast, when the sun after his long journey south begins to move visibly north again, should have been both in pagan and Christian times the great festival of rejoicing for the men of the north [238] temperate region. Day by day they saw the sun recede and the cold deepen; at last, one evening, he sets a little nearer, and they know that he has not deserted them forever. Similarly, the promise made at Yule begins to be realized at that other great feast of the spring equinox, which we still call in England by its ancient heathen title of Easter; the day by that time has got the better of the night, and "the sun dances on Easter Sunday" in commemoration of his completed victory over the combined powers of winter and darkness. In the tropics, on the other hand, the connection is less clear; but even here the shifting of the sun's apparent place is closely correlated with the shifting of the rain zone; and therefore it would not be long (after man was man) before tropical savages began to perceive a constant relation between the movements of

the sun to north or south, and the occurrence of the fertilizing rainy season. We must remember that savages, with their improvident habits, are much more dependent upon rain than we are, and that magical ceremonies for breaking up a drought are among their commonest and most universally diffused superstitions.

On the whole, then, before the coming on of the Glacial epoch, we may be pretty sure that plants and animals on the one hand had learned organically and automatically to recognize the existence of the year and to adapt themselves to it; and that men or the progenitors of men on the other hand had also learned to correlate the recurrent seasons of food supply with the movements of the sun, though nothing equivalent to winter and summer as we know them to-day existed as yet on any part of our planet. I say advisedly "on any part of our planet," because even near the pole itself remains of a subtropical vegetation in Tertiary times have been amply indicated. Nevertheless, in all parts of the world then, as in the tropics now, we may gather that plants and animals ran through annual cycles—that the year, as I have put it, was organically recognized. Trees had their time to sprout, to bud, to flower, to fruit, to seed, to shed their leaves (in the evergreen way); birds had their time to nest and hatch out their young; insects had their fixed periods for laying, for larval life, for assuming the chrysalis form, for becoming winged beetles or bees or butterflies. In one word, the year is a terrestrial reality, not merely an astronomical fact, in the tropics now; it was a terrestrial reality over the whole planet in the Tertiary period. But it was hardly more marked, apparently, into distinct seasons than it is marked to-day in the equatorial region. Rainfall and drought must have had more to do in determining the annual cycles than winter and summer.

From all this it must result that the conception of the year as an epoch at all (save for advanced [239] astronomy) is almost or entirely due to that tilt of the earth's axis which causes the seasons—dry or wet, cold or hot. Without the seasons, in one form or other, we might have been ages longer in discovering the fact that the earth moved round the sun, and that some three hundred and sixty-five days (I omit those important fractions) were needed for its revolution. Certainly, without the seasons, at least to the extent that they occur in the tropics, plant and animal life could hardly have assumed its fixed annual cycles, nor could early men have caught at the idea of the year at all as a period of time, a unit of measurement.

Before the Glacial epoch, in particular, the discovery of the year, organically or consciously, must have been much more difficult than it is now in high latitudes. It must have been almost as difficult in what are now the temperate zones as it is to-day in the tropics. Far north or south, of course, the length of the day would tell; and within the Arctic and Antarctic Circles the long night would form an unmistakable feature. But if the plane of the equator had always found itself vertical to the sun, there could have been no recognition of the year at all, either organic or conscious. In other words, from the point of view of organic life, the year does not mean the revolution of the earth round the sun: it means the apparent northward and southward movement of the sun on either side of the equator; it means the seasons, whether recognized as winter and summer, or as dry and wet periods. That is really the year as man knows it, as plants and animals have always known it.

With the coming on of the great cold spell, however, the importance of the seasons in the temperate and frigid zones, perhaps also even in the tropics, became much more marked. I will not go here into the suggested reasons for that vast revolution, perhaps the greatest our planet has ever suffered. Most physicists now accept more or less the theory put forward with great ingenuity by Mr. Croll, which sets it down to a period of extreme eccentricity in the earth's orbit; but some weight must also be allowed, as Mr. Alfred Russel Wallace has clearly shown, to the local arrangement of land and water on the globe at the time of its origin, as well as to the occurrence of mountain ranges just then at the poles, and to other purely terrestrial causes. Never before, in all probability, had the poles been occupied by great glacier-clad mountains. It seems most likely, indeed, that we are now practically at the end of the Glacial epoch, and that if only we could once get rid of the polar ice caps, which keep a stock of chilliness always laid on (I speak the quite comprehensible language of everyday life), we might recur forthwith to the warm and almost imperceptible winters of the preglacial period. But, as things stand, the stock of ice at the poles never gets melted away in the existing northern or southern summer; fresh ice [240] accumulates on top of the old mass with each winter; prevailing winds, blowing over this ice, chill regions lying much farther toward the tropics; icebergs detach themselves and float off, thus lowering the temperature of the sea in the middle zones; arctic or antarctic currents spread round the coasts and absorb the solar heat in enormous quantities. We have only to remember the trenchant difference in England between a parching cold east wind and a mild sou'wester to realize what an immense part these polar ice caps and frozen highlands play in the production of our existing winter. Alps, Pyrenees, Himalayas, Rocky Mountains, further assist in the same direction.

On the other hand, currents in the sea may cut either way; the Gulf Stream makes England warm, while the arctic current makes Labrador, much farther south, practically uninhabitable.

Ever since the Glacial epoch, therefore, it has been quite easy for man in the temperate and frigid zones to recognize the year as a natural reality. The annual cycles of heat and cold are far too marked to be overlooked by anybody. Organically, they made themselves felt at once by extraordinary changes induced in the fauna and flora. Before the steady advance of the annual cold wave, vegetation had perforce to alter its ways. The large-leaved evergreens went out altogether in frigid and high temperate regions; deciduous trees, or needle-leaved types like the pines and firs, took the place of the luxuriant Miocene foliage in Europe and North America.

Every autumn the larger number of trees and shrubs learned to shed their leaves all together; every spring they came out anew in fresh green and in masses of blossom. Similarly with animals. Birds learned to migrate, or to accommodate themselves to the winter; insects learned to hibernate in the egg or the cocoon; pigs fattened themselves on mast against the frozen time; moles slept over winter; squirrels hoarded nuts for a store to bridge over heavy frosts; frogs retired to the warmer mud in the depths of ponds; adders coiled themselves in holes and dozed away the cold season. Innumerable adaptations sprang up at once, those species or individuals which failed to meet the new conditions perishing in the struggle. In proportion as we recede from the tropics, the more marked do the annual cycles of life thus induced become, many species practically ceasing to exist as such for several months of the year, and being only potentially represented by eggs, germs, or seeds, and sometimes by dormant pregnant females.

At the same time, while the cause of the seasons as a whole is the obliquity of the earth's axis, with the resulting inclination of either pole toward the sun alternately, we must not forget that the seasons and the climate in each particular country depend in part upon many minor [241] contributory causes. It is not merely nearness to or distance from the equator that counts; we have to consider also relative distribution of land and water, elevation, prevalent winds, exposure, condensation, and many other elements of a complex problem. In Ecuador, for example, whose very name means the equator, the plain is always in scorching summer, the mountains are always in perpetual spring. The monsoons, again, produce in other countries some curious results: they depend themselves on the change of relative temperature in sea and land at different seasons; and they break upon the Himalayas with this odd and unexpected effect, that the snow line on the southern side of that vast range goes very far down, owing to the immense rainfall (or rather snowfall) and the consequent spread of snow fields and glaciers; while on the northern side it descends but a very little way, owing to the extreme desert drought and the great summer heat of the central Asiatic table-land. We have thus the apparent paradox that millions of Tibetans occupy towns and cultivate farms to the north at a height from three to four thousand feet above the snow line on the southern slope of the same mountains.

Looking at the matter broadly, then, and taking for granted the now generally accepted modern view that the great oceans and great continents have been relatively fixed (though liable to minor fluctuations and variations of outline) throughout all geological time, and that the earth's crust has not shifted from pole to equator or vice versa, we arrive at last at the following probable conclusions: There have always been seasons more or less marked, and these have been more or less organically answered by corresponding changes or cycles of change in plants and animals. Rain and drought have in many cases more to do with such changes than variations of temperature. The seasons, again, are less marked in the tropics than in temperate and circumpolar climates. Nevertheless, even near the equator, they exert and have always exerted certain organic influences-have resulted in annual cycles in the life of species. Even before the coming on of the Glacial epoch, the seasons were probably somewhat more marked in the temperate and polar regions than in the tropics, the longer day in summer and the greater directness of impact of the rays making the summer months always warmer. But for various reasons, among which we may presumably rank the absence in early ages of high land at the poles and of an accumulated polar ice cap, together with the existence of warm sea currents from the tropics to the poles, the winters of preglacial ages seem to have been relatively mild, perhaps (if we may judge by the types of plant life) milder than those of South Carolina and Georgia in our own period. No cold winds of importance seem then to have blown with blighting effect from [242] glaciated or snow-clad districts. (Mars in our own time appears to enjoy winters somewhat of this character, though a little colder, with a temporary snow cap.) The seasons as we know them in temperate and arctic climates, however, seem to be largely the result of the glacial epoch, and its persistent legacy the arctic and antarctic ice caps. If we could once manage to get rid of those, it is possible that our planet might again enjoy in all its zones the mild and genial preglacial winters.

These are rough notes, I know; mere adumbrations of a probable truth: but adequately to develop the subject would require a very big volume. My object here is simply to suggest that in many inquiries, both into human and animal or vegetable life, we must never take the existence of seasons as we know them for granted, except in very recent times. The year, for organic beings, means essentially the seasons; and the seasons may mean and have meant many separate things, as time and place vary—heat and cold, food and scarcity, foliage and leaflessness, drought and wet; longer or shorter days, the midnight sun and the winter darkness; hibernation and wakefulness; the egg, the cocoon, the seed, the plant, the flower, the fruit; dormancy or vitality. According as human life started at the poles or the equator, for instance, it would view in the beginning many things differently. All I wish to point out now is merely this, that we must bear such possibilities ever in mind; and that we must never take it for granted in any problem, human or biological, that the seasons were always just what we know them, or that the year to any organic being meant anything more than the seasonal cycle then and there prevalent. —*Longman's Magazine.*

In the excavations of the ancient cemetery of Antinoe, near Lyons, France, a "party dress" of the time of the Emperor Adrian, very fine silks, jewels, etc., have been discovered. One sarcophagus held the remains of a woman musician with a rose chemise, a cythara, pearls, castanets, etc.; in another was a child's costume with its

little laced shoes, its vest ornamented with flowers *appliqués*, and its robe of gauffered crape. It appears that the women of sixteen hundred years ago dyed their hair with henna, and twisted ribbons round their heads. Nothing changes.

M. A. Thieullen, publishing the results of fifteen years' studies among the flint implements of the French beds, draws the conclusions that the elaborate palæolithic flint axe and hammer and the typical neolithic implements were luxuries used by the more distinguished members or for the more important purposes of the flint-implement-using community, while the ruder implements which are found in enormous numbers were the objects of general and daily use throughout all the flint-using ages, whether palæolithic or neolithic.

BRAIN WEIGHTS AND INTELLECTUAL CAPACITY.

[243]

By JOSEPH SIMMS, M. D.

Having been for thirty years a lecturer on man and his character as evinced by his form, features, head, and gestures, and having made observations on the subject in all parts of North America, in continental Europe and Great Britain, and parts of Asia, Africa, and Australia, I should not be deemed presumptuous when I present a few facts regarding the relations of mind and the size and forms of heads and weights of brains. It has been observed by many persons versed in the branches relating to the subject that men with the largest brains are not those of most talent, power, or intellect; but many such have been only ordinary or inferior men, or even idiots; while some men of most powerful and comprehensive minds have had unusually small brains. Esquirol's assertion that no size or form of head or brain is incident to idiocy or to superior talent is borne out by my observations.

After long and careful research in the great libraries and museums of the world, I have collected a table of brain weights of eminent men, along with which are entered, in my original document, the occupation of the subject, age at the time of determination, and the source whence the item is derived. These can not be given within the limits of this article, and only the briefest and most generalized summary of the main features can be indicated. The largest weight of brain in the whole list is that of the Russian novelist Turgenieff, whose brain weighed, at the time of his death, at sixty-five years of age, 71 ounces.[32] It is a considerable step from him to the next in order, the English mechanician and author, Knight, whose brain weight at the age of fifty-eight was 64 ounces. Then follow the Scottish physician Abercrombie, 63 ounces; General B. F. Butler, 62 ounces; and the Scottish general Abercromby, 62 ounces. Another group of nine, including weights from 58.6 ounces to 54 ounces, includes Jeffrey, Scottish judge and author, Thackeray, Cuvier, George Combe, United States Senator Atherton, Spurzheim, and the Scottish physician Simpson. The next group, 53.6 to 50, is larger, including twenty-one names, among which are Daniel Webster, Agassiz, Napoleon I, the Scottish divine Chalmers, the mathematicians De Morgan and Gauss, the anthropologist Broca, and the generals Skoboleff and Lamarque. The last group, 49.9 to 40 ounces, contains twenty-five names, including those of the philosopher Huber, Grote, Babbage, the anthropologist Bertillon, Whewell,[33] Liebig, Gall, Gambetta, and Bishop, [244] the mind reader. Only one remove from the foot of the list is Gambetta, a man of indisputably high genius and ability, with a brain weighing only 40.9 ounces.[34]

The table goes to illustrate a general rule which I discovered and published several years ago, that larger brains appertain to natives of colder climates. Dr. John Abercrombie, for instance, was born at Aberdeen, Scotland, on the German Sea, and farther north than any part of the United States. Sir Ralph Abercromby was born in the county of Clackmannan, Scotland, where it is far colder than any part of southern Europe. Lord Francis Jeffrey first saw light in Edinburgh. General Butler was born in Deerfield, New Hampshire. Ivan Turgenieff, with the heaviest brain of all, was a native of cold, inhospitable Russia. Dr. Franz Joseph Gall (brain weight 42.2 ounces)[35] was born in Würtemberg, in southern Germany, passed most of his life in Vienna and Paris, and, being a student, spent much of his time indoors. Gambetta was born at Cahors, France, of Italian parents. This climatological view of the size of brains is confirmed by a paper, "Crania," of the Philadelphia Academy of Sciences, which gives as the average size, in cubic inches, of the cranial cavities of various nationalities, taking the results of many measurements: Lapps, 102; Swedes, 100; Anglo-Saxons, 96; Finns, 95; Anglo-Americans, 94; Germans, 92; Celts, 88; Malays, 86; Chinese, 85; Tombs of Gizeh, 84; embalmed Semitic, 82; Egyptians, 80; Fellah, 79; Bengalese, 78.

A table of average brain weights of various nationalities, compiled from Topinard's and Manouvrier's works and other standard anthropological publications, illustrates the same tendency toward greater brain weights in colder countries. One of its results is to show that the colder air of the United States produces larger brains in the negroes than the warm air of Africa. The table further shows, in the comparisons of Hindus and African negroes, that the brains are smallest in the warmest countries, irrespective of race or nation; and that the largest average attained is in Scotland, where it is never extremely warm.

The measurement of the cranial cavity is a very uncertain gauge of the size of the brain, for the cerebro-spinal fluid may occupy a large share of the space. Weighing the brain is without doubt the only scientifically certain method of determining its size and mass.

Perhaps the most remarkable case in the table of great men's brains is that of Gambetta, who was behind none of his compeers in ability, and yet had the smallest brain of all. The first table of the "Average Weight of the Human Body and Mind," compiled from Dr. Boyd's researches among the sane, which was based on more than two thousand post-mortem examinations, gives 45.9 ounces as the average brain weight of boys from seven to fourteen years of age, and 40.2 ounces as that of boys and 40.1 ounces of girls from four to seven years of age. And this little brain of 40.9 ounces appertained to a man, "a lofty, commanding, mental figure, standing out in bold relief from the crowd of mediocrities which he dwarfs and shadows," the embodiment of the French Republic, who steered it through one of its most perilous crises, "the foremost Frenchman of his time," who "established his claim to be placed in the very front rank of European statesmen," and whose untimely death was spoken of as "nothing less than the sudden extinction of a powerful individual force, one of the most powerful, indeed, of such forces hitherto operating in Europe." [245]

In illustration of the association of large brains with small minds, we have compiled from various sources of recognized authority a list of one hundred and twenty-five persons of ordinary or weak minds, idiots, imbeciles, and criminals, whose brains were generally larger than those of the distinguished men subjects of the preceding notes. Of these, Rustan, an ignorant and unknown workman, appears with a brain weighing 78.3 ounces;[36] the dwarfed Indian squaw who follows him, of 73.5 ounces;[37] an illiterate and weak-minded man had a brain of 71.3 ounces;[38] and a congenitally imbecile person cited by Dr. Ireland, with one of 70.5 ounces.[39] Another imbecile cited by Dr. Ireland had a brain of 63.2 ounces, and the brain of an idiot with a large head, eighteen years old, who had an idiotic sister, weighed 62.8 ounces. The brain of the idiot, No. 56 of the men in the table, 59.5 ounces, is exceeded in size by those of only five on the list of famous men, while eleven persons recorded as idiots, imbeciles, and children had brains heavier than his. An idiot boy of fourteen years, very malicious, who never spoke, and who nearly killed his sister with a pick, had a brain weight of 57.5 ounces. Thirty men out of three hundred and seventy-five examined in the West Riding Asylum gave brain weights of 55 ounces and upward, showing that such weights are not so rare as some have supposed. In another asylum in England one out of every dozen brains examined showed a weight of 55 ounces or more. [246]

In *Nachrichten*, of Göttingen, 1860, pp. 70-71, Dr. Rudolph Wagner gave a table of thirty-two persons whose brains he examined, among whom were five distinguished men; but the largest brain weight recorded in it, 55.9 ounces, has opposite to it the legend, "Idiotic grown man."

To this list we might have added a large number of persons whose brains weighed less than 53 ounces. Yet the brains of Daniel Webster, Agassiz, Napoleon I, Lord Byron, Baron Dupuytren, General Skoboleff, and other famous men concerning whose large brains much has been said, weighed less than this; and we might have appended hundreds of brain weights of idiots, imbeciles, and other insignificant persons, from 53 ounces down to 49 ounces—probably about the average weight in central Europe. In support of our contention is, further, an observation by Dr. Rudolph Wagner in *Nachrichten*, February 29, 1860, pp. 71, 72, that "very intelligent men certainly do not differ strikingly in brain weight from less gifted men."

Dr. Clendenning presents in the Croonian Lectures the following entries of brain weights of male subjects of different ages, the tendency of which is to show that the male encephalon loses, after it is grown, more than an ounce every ten years:

15	to	30	years	50.75	ounces.
30	to	50	"	49.66	"
50	to	70	"	47.1	"
70	to	100	"	41.5	"

A number of other eminent anatomists have given similar evidence of decrease in brain weight as intellectual power increases.

The "Professor at the Breakfast Table," the late Dr. O. W. Holmes, a learned man and experienced physician and professor of anatomy in Harvard University for thirty-five years, says: "The walls of the head are double, with a great chamber of air between them, over the smallest and most crowded organs. Can you tell me how much money there is in a safe, which also has thick walls, by kneading the knobs with your fingers? So, when a man fumbles about my forehead, and talks about the organs of individuality, size, etc., I trust him as much as I should if he felt over the outside of my strong box, and told me that there was a five-dollar or a ten-dollar bill under this or that rivet. Perhaps there is, only he doesn't know anything about it. We will add that, even if he knows the inward dimensions of the strong box, he could not thence determine the amount of cash deposited in it."

The internal size of Spurzheim's skull was in cubic inches exactly the same as that of the skull of Joachim, an imbecile six feet nine inches in height, with a brain weight of 61.2 ounces, whereas Spurzheim's brain weighed only 55 ounces. [247]

Whoever has examined heads in the dissecting room of a medical college knows that, except in rare cases of disease, the brain does not fit the skull, but is surrounded by three membranes and a watery fluid; and this liquid, it has been ascertained, is generally sufficient to admit of its performing certain movements.

There can be no doubt that the brain moves in the skull, changing its position, according to the

laws of gravitation, in much the same way as the lungs, heart, and liver do in the body. It has been observed many times to move, as well as to pulsate, when exposed to view during the life of the individual. It is subject to two regular and constant motions—one produced by the arteries, the other by respiration. It has also a third motion, discovered and described by Dr. M. Luys, who stated, in a paper read before the Academy of Medicine of Paris, that "the brain is subject to certain changes of position, dependent on the attitude of the body. Thus, if a man lies on his back or side, or stands on his head, the brain undergoes certain changes of position in obedience to the laws of gravity; the movements take place slowly, and the brain is five or six minutes in returning to its previous position." From these anatomical data M. Luys deduced some interesting and practical conclusions, by which he explained, for example, the symptoms of vertigo which feeble persons experience when suddenly rising from a horizontal position. He suggested whether the pains of meningitis may not be due to an interference with these normal movements, and urges the value of giving the brain the change produced by a horizontal position at night.

The average cranial capacity is admitted to be 96 cubic inches in England and 94 in New York; and it is to the unusual quantity of fluid of some cases, and to the extraordinary thickness of the skull in others, that we are to attribute the frequent discrepancy between the external dimensions and the size of the encephalon. Daniel Webster's cranial capacity was 122 cubic inches, yet his brain of 53.5 ounces was just what George Combe has laid down as the average weight for an adult man. Water and lymph, we are told, filled the skull. Professor De Morgan's head, almost free from hair, measured 24.87 inches in circumference, and the dimensions were all those of a very large head, sufficient to contain from 65 to 70 ounces of brain, yet his brain weighed only 52.75 ounces, or little, if at all, above the average in the cold parts of the temperate zones. De Morgan was sixty-five years of age when he died. He was much emaciated, and "the brain was distinctly shrunken," not filling the interior cavity, where its place was supplied, as is [248] usual in such cases, by serum or water. There is no known method whereby any man can determine whether brain or water fills the greater part of any living skull. A small orange may have a thin rind, and contain a good amount of eatable substance, while a large one may have so thick a skin that the fruit proves utterly disappointing.

Another proof that the skull is formed without regard to the brain is the following: "The bony cabinet and its contents are developed, to a certain extent at least, independently. This is very clearly demonstrated by a fact which was observed by Gratiolet, and is too frequently forgotten. The subject is an infant in whom the cranium presented the normal conformation. The brain was, nevertheless, almost entirely wanting."[40]

Dr. Gall was a poor arithmetician, and his biographer says that every kind of numerical calculation fatigued him. He could not go through a process of multiplication or division that was at all complicated, and knew nothing of geometry or of the problems of mathematics.[41] George Combe said of himself: "Arithmetic has always been to me a profound mystery, and to master the multiplication table an insurmountable task.... This faculty in me is, in fact, idiotic." Again he said: "When a boy, I never could learn arithmetic. At the end of five years' teaching I could not subtract, divide, or multiply any considerable number of figures with accuracy and facility, and can not now do so.... At the present day I can not sum a column of figures correctly."[42]

With these facts in view, our wonder at finding the theories of these men at variance with all exact calculation is considerably diminished. We propose to test some of their theories by arithmetical processes. We found that the sixty famous men entered in the table of authenticated brain weights show an average of 51.3 ounces. We now take all the idiots and imbeciles in the table of "Large Brains and Small Minds," and find the average 59.4 ounces; so that the matter is left to stand thus: Ten idiots and five imbeciles average 59.2 ounces; sixty famous men average 51.39 ounces: in favor of idiocy and imbecility, 7.9 ounces.

The heaviest brain in the table of small minds is that of Rustan, an ignorant and entirely unknown laborer. He was a healthy man, and his brain, when it was weighed, was in a healthy condition. Its weight was recorded by Dr. Carl A. Rudolphi, a Swedish naturalist and physiologist of [249] Stockholm, who became professor of anatomy and physiology at Berlin in 1810. It reached the unexampled figure of 78.3 ounces; while the brain of Turgenieff, the heaviest among famous men, was 71 ounces—showing a difference of 7.3 ounces in behalf of the inferior mind.

Since writing the above, the following appeared in Tit-Bits, a weekly paper published in London, England, March 19, 1898:

"It must not be assumed, however, that intellect is in direct ratio to the weight of the brain; for while the brains of certain intellectual men, such as ... Dr. Abercromby, weighed more than 60 ounces, a certain Strand newspaper-boy, who was in intelligence almost an idiot, had a brain which weighed no less than 80 ounces."

Dr. Austin Flint, of New York, in his Physiology, gives the average weight of the brains of men as 50.2 ounces. Dr. Peacock, of Great Britain, makes it 50 ounces 3 drachms between twenty-five and fifty years of age. Dr. Thurman gives 49 ounces as the average throughout Europe, while Dr. F. Tiedemann, a famous naturalist of Germany, reckons it at 53.2 ounces.[43] Dr. Krause, a learned German, places it still higher, at 55.4 ounces.[44] Now, if we strike a balance between the highest and the lowest of these estimates, the mean will be 52.2. Then, recalling the average of our sixty famous men, which we found to be 51.3 ounces, it is shown to be nine tenths of an

ounce below the average of ordinary men.

Our tables of national average brain weights do not quite agree, because some of the subjects had been wasted by disease for many months before death, whereby the brain was diminished along with other parts of the body. Those who, like Dr. Boyd's subjects, died in hospital, showed too light an average for healthy Englishmen. Dr. Krause's subjects may have been healthy men killed in battle, and those of Tiedemann persons who died suddenly. Executed criminals show a fairly high average of brain weight, because there has been in their case no diminution through long-continued illness.[45] We should recollect that Whewell, the famous English philosopher and head master of Trinity College, Cambridge, England, was in good health when killed by a fall from his horse; so was Gambetta, when his life was ended by a pistol shot. The brain, however, suffers less from the power of disease than the general bodily form. One month under the most wasting sickness would probably not diminish the brain more than an ounce or two, but a year or more would make a considerable difference. [250]

Taking, now, the sixty heaviest brains of persons not noted for intellectual greatness, we find the averages to be 63.2 ounces. Comparing this with the average of sixty famous men, 51.3 ounces, we find a difference in favor of imbeciles, idiots, criminals, and men of ordinary mind of 11.9 ounces. George Combe estimated that about 53.5 ounces was the average weight of the adult brain. Thus the average brain weight of all the eminent men whom we have brought into the comparison, 51.3 ounces, is below Combe's estimate of that of mankind in general. Again, the ten heaviest brains of our list of famous men give an average weight of 61.1 ounces, while the average given by the ten heaviest of the opposite class is 70.4 ounces, or 9.3 ounces greater. While our list of eminent men shows only five whose brains exceeded 58.6 ounces in weight, those of seventy-six of the common throng—seven of them idiots or imbeciles—rise above that figure. These figures augur badly for the doctrine that would attach importance to heavy brains for giving force and depth of individual character.

Phrenologists assert that each organ of a mental faculty occupies a certain position perceptible on the outside of the brain, with a definite area which they have mapped out. They also hold that each of these organs extends to the center of the base of the brain, tapering to it somewhat like a cone, having its base turned toward the outer world. They make no account of the fissures, the intervening sulci and anfractuosities that must cut many of these supposed cones, some at right and some at oblique angles. Then the large, long cavities or ventricles intercept and would hinder many of them from reaching the central, basilar part of the brain. The anatomical structure of the brain thus appears fatal to this theory of the organs.

Large and complicated convolutions of the brain with deep sulci have been regarded by some persons as inseparable from superior powers of mind. The supposition is erroneous and groundless. The rodents, such as beavers, squirrels, rats, mice, etc., have but little brain and no convolutions whatsoever;[46] yet the beaver exhibits great foresight, economy, industry, and mechanical skill in building his dam, erecting his house, and storing up bark as food for the winter. Moreover, these animals live in societies and labor in union by ingenious methods for a common purpose, with nice judgment. "So great a variety of labors," says Dr. Leuret, "is needed for the constructions carried on by the beaver; they include so many instances of well-made choice, so many accidental difficulties are surmounted by these animals, that it is impossible not to recognize in their actions the characteristics of a rather high intelligence."[47] The sheep has a much larger brain than the beaver, with numerous and complete convolutions, yet it is one of the most stupid of domestic animals. Again, though birds have convolutions in the cerebellum, they have none in the cerebrum, and yet they are more capable of education than any living beings except the human race. The eagle is complete master of the lamb; the magpie, the hawk, the raven, and the parrot with his talking powers, are not excelled in sagacity by the dog, the horse, or the elephant, notwithstanding the latter animals have brains of superior size and elaborate convolutions. [251]

Squirrels manifest foresight and economy in storing nuts for the winter's use; yet they have no brain convolutions. The cetacea, especially whales, have much larger brains than men, with more numerous and more complex convolutions and deeper sulci; yet their intelligence bears no comparison with that of the human race.

Three eminent men are known to have had very small convolutions of the brain—viz., Louis Asseline, Dr. Tiedemann, and Baron von Liebig. We have to add to this remarkable list two, not named, but described by Dr. Wagner as having been very intelligent, who yet possessed very few convolutions in their very small brains.[48] As Wagner's book was printed before Liebig died, he could not have been one of the two to whom the author referred.

Idiots often possess as large brains as men distinguished for intellectual power, and their brains have as deep sulci, and convolutions as fine, as large, and as complex. Our table of the common and weak-minded contains a mention of an idiot whose brain weighed 53 ounces, or exactly as much as Napoleon's, and had fine convolutions and a large frontal lobe, but who could never learn to speak.

The elephant carries a far larger brain than man, finely formed, broad and high in front, with much more numerous and complex convolutions and deeper anfractuosities, and yet no intelligent person would for a moment claim that its mind excels or even equals that of man.

It may be well here to allow some eminent physiologists to give their views on this subject. "The

researches of anatomists have disposed of every point advanced by Gall. Curiously enough, M. Camille Dareste has placed beyond dispute the fact that the number and depth of the convolutions bear no direct proportion to the development of intelligence, whereas they do bear a direct proportion to the size of the animal.... It is notorious that the instinct of propagation, the [252] instinct of destructiveness, the instinct of constructiveness, and other qualities are manifested by animals having no brains, nothing but simple ganglia."[49]

Dr. Bastian demonstrates the convolutional theory thus: "In animals of the same group or order, the number and complexity of the convolutions increase with the size of the animal.... There can not, therefore, be among animals of the same order any simple or definite relation between the degree of intelligence of the creature and the number or disposition of its cerebral convolutions." [50]

We have the following testimony in our favor from Dr. Rudolph Wagner, of Göttingen: "Examples of highly complicated convolutions I have never seen, even among eminent men whose brains I have examined.... Many convolutions and great brain weight often go together. Higher intelligence appears in both kinds of brains, where there are many or where there are few convolutions. It is not proved that special mental gifts go with many convolutions."[51]

Another theory of mind is based on the gray matter of the brain, the amount of which has been supposed to be proportionate to mental capacity. As this gray matter, however, averages only about one fifth of an inch in thickness, it seems rather a thin foundation for the human intellect if the condition is good that "size is a measure of power."

The late Dr. W. B. Carpenter stated the matter thus: "The cortical substance or gray matter of the hemispheres essentially consists of that vesicular nerve substance which, in the spinal cord as in the ganglionic masses generally, is found to occupy the interior. The usual thickness is about one fifth of an inch; but considerable variations present themselves in this respect, as also in the depth of the convolutions."[52]

Daniel Webster's brain had gray substance to the depth only of one sixteenth of an inch.[53] It thus appears that his brain had a thinner layer of gray matter than the average of common-minded men—one among the many proofs that facts are against all theories that connect brain conditions with intellectual power.

Dr. Ireland thus describes an idiot boy who, though thirteen or fourteen years of age, was only three feet eight inches in height: "In expression he was dull and inanimate, with an old face and a short, squat figure.... The convolutions were broad and simple, but not shallow. The gray matter [253] was as broad as usual."[54]

The writer has examined many brains of persons morally or intellectually below the average—such as murderers, negroes, and others sunk in ignorance. He has invariably found the layer of vesicular or gray matter to be thicker than that of Daniel Webster's brain. Elephants, porpoises, whales, dolphins, and the grampus all have this layer thicker than the most intellectual men. Another great objection to locating mind in the gray matter of the brain is that this substance is found in the interior part of the spinal cord, and in all the nerve centers throughout the body; so that, if mind is situated in it, it is not confined to the brain, but dwells in the spine also, and is distributed all through the human frame. Still another objection lies in the fact that wherever the gray matter exists near the surface of the brain, it consists of three distinct layers, separated by a white substance, and the outermost layer is white, not gray.[55]

The *septum lucidum* consists of gray matter. The *corpus striatum*, situated at the base of the lateral ventricles, nearly in the center of the brain, was from three eighths to half an inch in diameter in an ox which was dissected in Edinburgh. This is about the same amount as is found in the *corpus striatum* of the human brain. There would be lively times if it were possible for a mental faculty to occupy at once all the localities where gray matter is found!

None of the suppositions about certain qualities of mind inhering in particular portions of the brain have been proved, nor have they stood the tests of science.

The theories which have assumed that the cultivation of the intellect gives shape and size to the brain within and consequently to the skull without, advocates of which have not been wanting, have been disproved by the collected facts. "There is no proof," says Dr. J. C. Nott, in his Types of Mankind, "of the theory that the cultivation of the mind or of one set of faculties can give expansion or increased size of brain. The Teutonic races, in their barbarous state, two thousand years ago, possessed brains as large as now, and so with other races."

The St. Louis Globe Democrat of November 13, 1885, gives an account of some excavations on the Mount Ararat farm, east of Carrollton, Illinois, where the bones of thirty-two Indians or mound builders were unearthed. "They were not a diminutive race, as some people have supposed, some of the thigh bones being sixteen inches long, and some of the skulls twenty-four inches in circumference." A skull having a circumference of twenty-four inches means a head that [254] measured from twenty-five to twenty-six and a half in life, when the cranium was covered with skin and muscles. The average head of white men in New York to-day is only twenty-two and a half inches round. So the culture of the white race for centuries has not developed their heads to near the size of those of the uncultured mound builders who inhabited America many centuries ago. Our own opinion is that cultivation by means of a thorough classical education, where the

appetite is restrained, as usually occurs, tends rather to diminish the size of the head, by reducing the temporal muscles and the adipose tissue under the scalp.

The Engis skull is one of the most ancient known to exist, and belonged to the stone age, or about the same time as the Neanderthal skull. Professor Huxley describes it as being well formed, and considerably larger than the average of European skulls to-day in the width and height of the forehead and in the cubic capacity of the whole.

Quatrefages, in The Human Species, p. 312, says: "This skull (the Engis or Cro-Magnon), so remarkable for its fine proportion, is also remarkable for its capacity. According to M. Broca, who could only work under precautions calculated to diminish the amount, it is equal to at least 1,590 cubic centimetres (96.99 cubic inches). I have already remarked that this number is far higher than the mean taken from modern Parisians; it is equally so in comparison with other European nations."

These facts all conspire to prove that the cultivation of thousands of years has not increased the size of human skulls. In 1886, we measured many of the skulls unearthed at Pompeii, the remains of Romans who lived nearly two thousand years ago, and we found them on the average larger in every way, but especially in the forehead, than the skulls of Romans of this century.

In the museums of Switzerland we measured in 1887 several skulls of the ancient lake dwellers of that country, and found them larger in all respects, but particularly in the forehead, than those of the Swiss people of the last fifty years. The average circumference of the skulls we measured in the catacombs of Paris was twenty-one inches and a half, which is about an inch more than that of Parisians who have died within the past fifty years.

"The average internal capacity of the Peruvian skull is only seventy-three cubic inches; that of Toltec skulls, seventy-seven inches, and that of barbarous tribes, eighty-two inches; so that the extraordinary anomaly is presented of a larger brain being possessed by the barbarous tribes than by the nations who achieved no mean degree of civilization in Central America and Peru. The average European skull is ninety-three inches in bulk."[56] The author was informed by Mr. [255]
Lucien Carr, of the Ethnological Museum of Harvard University, that the capacity of the Peruvian skulls was about one hundred centimetres smaller than that of the skulls of any other people living in America at the same time. Yet that small-headed people was the most highly civilized of all.

SPELEOLOGY, OR CAVE EXPLORATION.[57]

By M. E. A. MARTEL.

The not very graceful word *speleology* was composed a few years ago by M. Émile Rivière out of Greek elements, as a translation of the German *Höhlenkunde*, to signify the study of caves. The study claims a place among the sciences, and is, I believe, able to justify its claim. Caves have been subjects of interest and curiosity in all times and countries. In the primitive ages, when palæolithic man was obliged to defend himself against the large Quaternary wild beasts, and did not yet know how to construct cabins, he lived in the most inaccessible caves, or those easiest to close, which he could find. Afterward, when man had advanced in civilization to the neolithic stage, and had somewhat improved tools and arms, having learned to build huts and villages, caves became simply burial places. In the historical periods of antiquity they were transformed into pagan sanctuaries or temporary hiding places in times of revolt, civil war, or invasion. Down to the middle ages and the renascence, they shared this function with abandoned quarries. Through these changes they gradually became objects of popular fear and absurd legend. I have nearly everywhere in France found legendary and profound belief in some monstrous basilisk or dragon in the depths of dark caverns, guarding immense treasures; and woe to the rash adventurer who tried to steal these riches!

In short, caves have suffered their vicissitudes; their use as habitations seems to be inversely proportioned to the degree of civilization. The miserable aborigines of Australia have not yet quite abandoned them; and in France the present occupation of the grottoes of Ezy, in the Eure, by some outcast families, who lead a sordid existence in them, indifferent to all social conventions, has recently been cited as an extremely curious anthropological phenomenon.

Science, too, has laid its hold on caves only within a little more than a century; for it was not till 1774 that Esper recognized that the large bones taken from the caverns near Baireuth, in [256]
Bavaria, were not those of human giants, but of extinct animals, and he called them, they being petrified by limestone, *zoöliths*, or animal-stones; and it was his remarks upon them that drew Cuvier's attention to paleontology.

Three sciences have of late years been advanced by the explorations of caves: paleontology; prehistory, or research among the remains of primitive men and their industries; and zoölogy, or the study of living beings. The animals of caverns—crustaceans, insects, batrachians, and fishes—constitute a special fauna, which has been for fifty years a subject of study to naturalists of various nations, and to the anatomy of which M. Armand Viré, of the Natural History Museum of Paris, has been giving special attention for five years past.

There are other sciences the study of which in connection with caves, while capable of yielding valuable fruits, has been too long neglected: geology, for their origin and formation; mineralogy, for their relations to metallic veins; meteorology, for thermometrical and barometrical variations and the formation of carbonic acid; terrestrial physics, for the experiments on gravity that might be carried on in deep vertical pits, supplementing the observations of Foucault in the Pantheon at Paris, and Airy in the English mines; hydrology, which has hardly yet perceived that caves are predominantly great laboratories of springs; agriculture, which might transform them into reservoirs for times of drought or storage basins in case of flood; and public hygiene, which is just beginning to discover that they may harbor in their fissures hitherto unsuspected causes of contamination of the water of the springs that issue from them. The number and importance of these new problems that have arisen from the recent extension of underground investigations seem fully to justify the specialization of the science of caves—another creation of the Speleological Society, now four years old. This special interest in the science of caves began about fifteen years ago, when, in 1883, three members of the Austro-German Alpine Club—Herren Harske, Marinitsch, and Müller—resumed in the limestone plateaus of Istria and Carniola called the Karst, explorations which had been actively and profitably carried on in the middle of the century, from 1850 to 1857, by Dr. Adolf Schmidt, whose discoveries in the caves of Adelsberg, Planina, and St. Canzion won him a membership in the Vienna Academy of Sciences. Their efforts and those of Herr F. Kraus, who died last year, had the result of interesting the Austrian Government in the subject; and since 1886 various engineers have been commissioned by the Minister of Agriculture to make official explorations and construct economical works in the caves and underground rivers of Istria, Carniola, and Herzegovina. Credits are granted every [257] year for enterprises which prove to be more useful than would at first be thought.

It was at the same time, between 1883 and 1885, that I made my first investigation in the Causses of Lozère, Aveyron, and the adjoining departments of France, the results of which were to reveal for the first time to the public, and even to geographers, the picturesque beauties, then unknown, and now becoming the fashion, of the gorges of the Tarn, Jenta, and Dourbie, the rocks of Montpelier le Vieux, etc. In my excursions over the plateaus of the Causses I frequently met, at the level of the surface, open, dark holes, and mouths of vertical wells—*avens*—the depths of which no one had ever looked into, unsoundable, they said, which the peasants naturally took to be real mouths of hell. Recollecting what I had admired at Adelsberg and in various caves of the Pyrenees, I guessed these avens might also be doorways to subterranean splendors and scientific treasures. So I began in 1888 the methodical exploration of the unexamined natural cavities of my own land first, and then of other countries of Europe; and since then I have devoted several weeks every year to this work.

These pits are simply horizontal holes opening upon the surface of the ground, of very different forms and dimensions. Herdsmen are very careful not to let their cattle go too near them, for they sometimes fall in.

The diameter of these pits varies from a few inches to several hundred yards, and they are sometimes more than six hundred feet deep. It is not easy to go down into them, especially when they are on high levels away from habitations and roads. In such cases a considerable apparatus of ropes, rope ladders, telephone, portable boat, tent, etc., has to be taken along. The first measurement with the sounding line gives the depth only of the first pit—and there are often several succeeding one another. A rope ladder long enough to reach the bottom is then let down, and the man who descends has a rope tied about him for additional security, which is held by the people above. A great many pits are narrower at the top than lower down, forming something like a reversed speaking trumpet, so that the explorer finds it very difficult to make himself heard at the top; hence I have adopted the practice of taking a telephone along. The interior shapes of the pits are very diverse. The narrower ones are easiest to go down, because they permit one partly to support himself against their walls. The wider ones leave him hanging loose, in a position which he feels to be very precarious. When there is a second or third pit, and we have not ladders enough, we have to trust ourselves to a simple rope with a board fastened at the end of it for a [258] seat. The *gouffre* of Vigne Close, in Ardèche, which is about six hundred feet deep, has five successive pits, and its complete exploration required three days. The bottom of the pit may be a simple cleft in the rock, or an immense cathedral-like chamber; as at Rabanel, near Ganges, and Hérault, the deepest abyss in France, the vault of which expands into a gigantic nave, five hundred feet high, which is lighted by the beam of light that falls through the opening, presenting a grand and indescribable spectacle. Some pits of less depth, as the Tin doul de la Vayssière, in Aveyron, and the Padirac well, in Lot, both leading to underground rivers, enjoy a still more complete illumination. Considerable talus banks close the ends of these broad pits, and are generally produced by the caving in of the roofs of caves.

Lively controversies and gross errors have prevailed concerning the geological formation of abysses. The abyss of Jean Nouveau, Vaucluse, among others, furnishes evidence against the false hypothesis that such pits are as a rule the results of cave-ins, whereas pits of that origin are rare and exceptional. These pits are for the most part fissures, the principal feature of which is their narrowness. At Jean Nouveau the greatest breadth is not more than about sixteen feet. It is the deepest vertical pit of a single shaft without intermediate terraces that we know of, and is about five hundred and thirty feet from the surface of the ground to its floor. The mass of stone rubbish at the bottom prevented our descending into a second pit.

Pits composed, like Vigne Close, of several successive wells, destroy another hypothesis—that of the formation of *gouffres* by the emissions from thermal springs.

The greatest danger in descending these pits arises from the showers of stones that sometimes come down upon the head of the explorer. These are often started by his friends the hunters, or by their dogs gamboling around at will.

While some of the caverns I have explored were stopped up by obstacles of one kind or another that prevented further progress, in others we found considerable rivers running a nearly free course. We rarely found pits formed by the collapse of the roofs of the cave in cases where the distance from the subterranean river which by its work of erosion provoked the catastrophe to the surface was more than one hundred metres. The pit of the Mas Raynal, Aveyron, is one hundred and six metres deep, and abuts upon a large subterranean river, which supplies the Sorgues of Saint-Affrique, one of the finest springs of France. When we explored it, in 1889, we could not pass the low chambers which occur in it because the water was too high, and we have not visited it since. Its exploration in a dry season might reveal many very interesting chambers. [259]

In the cave of Rabanel, the first well, which ends in a talus of fallen stones, furnishes an instance of a vertical fissure grafted, if we may use the word, upon an interior grotto that already existed. A stream runs through this grotto which falls into a second well twenty-six metres, and is then lost in smaller passages so nearly stopped up with earth that we were not able to follow it through its course of about a mile till it comes out at the Brissac spring.

The cave of Trebiciano, in Istria, near Trieste, the deepest known, has a total depth of more than a thousand feet. It is not, however, entirely natural, but is composed of numerous vertical fissures which lead, at about eight hundred and fifty feet below the surface, to a large cavern, at the bottom of which flows the subterranean river Recca. The fissures do not naturally communicate directly with one another, but the engineer Lindner was commissioned in 1840-'41 by the city of Trieste to construct for the municipality a supply of potable water from the underground streams, and after eleven months of labor made artificial connections between the different parts of the chasm.

These vertical pits are formed by the wearing down, from the top, by the waters which become ingulfed in them. This mode of their formation was demonstrated to me in 1895, when I was in Great Britain under a commission from the French Minister of Instruction. I then explored several caves in which the rivers were still running, and satisfied myself that the pits were simply absorbing wells. Such wells are not effective now in southern France and Austria, but in northern Europe, where rain is more abundant, they are still operative. I found the plainest evidence of this fact in Yorkshire, at the Gaping Ghyll, Ingleborough, where a river precipitates itself at one leap one hundred metres under the earth. English investigators and travelers had tried without success to descend into it in 1845, 1870, and 1894, having conquered only about one hundred and ninety-five feet of its total depth of two hundred and twenty-nine feet. It took me twenty-five minutes to go down upon a rope ladder which was suspended in the midst of the cascade. Fortunately, the pit had the daylight to the very bottom—a wonderful spectacle, compensating me for all my trouble and the long douche bath which greeted me at the end of the descent, where stretched an immense Roman nave nearly five hundred feet long, eighty feet wide, and ninety feet high, without any sustaining pillar. From the middle of the roof of this colossal cavern fell the cascade in a great nimbus of vapor and light—a wonderful fantastic scene, such as Gustave Doré or Jules Verne could never have imagined. The most pleasant feature of the whole [260] of it, however, to me was the thought that I had succeeded where the English had failed, and on their own ground. The people were nevertheless very pleasant to me, and at my instance have continued the exploration and made some new discoveries.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

SKETCH OF CHARLES HENRY HITCHCOCK.

The name of Prof. Charles H. Hitchcock is closely associated with the progress of New England geology, especially with the discovery of the great terminal glacial moraine, and, in connection with the name of his father, Dr. Edward Hitchcock, with the study of the fossil bird tracks of the Connecticut River Valley.

Charles Henry Hitchcock was born in Amherst, Massachusetts, August 23, 1836, the son of Prof. Edward Hitchcock, the eminent geologist, who was afterward president of Amherst College. The family is of English origin, and was planted in America by two brothers who came over at nearly the same time and made homes for themselves in New Haven, removing later to towns near by. Luke Hitchcock, the ancestor of the subject of this sketch, came in 1695, and finally settled at Wethersfield, Connecticut. His descendants in the direct line lived at Springfield, Granville, Deerfield, and Amherst, Massachusetts. Professor Hitchcock is in the seventh generation from Luke, and is equally removed from Elder John White, his maternal ancestor, who came to Canton, Massachusetts, toward the end of the seventeenth century, and removed thence to the Connecticut Valley. Both lines of ancestry were purely English, and all the progenitors were men of integrity, regarded in their times as worthy to fill offices of trust in church and town. Two of them served in the Revolutionary army.

The father of Professor Hitchcock was one of the most distinguished geologists and educators of his time, and his services, especially as State Geologist of Massachusetts, have already been described in the Popular Science Monthly.[58] His mother was the daughter of Jacob White, a

well-to-do farmer of Amherst, who, believing in the education of women, had given her the best opportunities for study available at the time. She could read the Greek Testament and calculate eclipses, and was a gifted artist with pencil and brush. She prepared with her own hands many of the numerous illustrations in her husband's reports, and also diagrams for the lecture room. She [261] took indefatigable pains with the education of her children, placing their moral and religious welfare first. Of the eight children of the family, six of whom reached maturity, the surviving brother is professor of physical culture, and, for the time being, acting president at Amherst College, and one of the two surviving sisters, the widow of the Rev. C. M. Terry, has been for several years matron of the Hubbard Cottage, Smith College, Northampton, Massachusetts.

Beginning with 1835, the year before Professor Hitchcock was born, his father, Professor Edward Hitchcock, was largely occupied with the study of the "fossil bird tracks" in the New Red Sandstone of the Connecticut Valley, and with the discussions to which the investigation gave rise, the story of which has been told by Prof. C. H. Hitchcock himself in the Popular Science Monthly (vol. iii, August, 1873). Besides the search for the fossils and their collection and comparison, and the examination of the literature that might throw light on the subject, there were studies into the proper interpretation of the early chapters of Genesis, the debate with Prof. Moses Stewart, of Andover, and the gradual approach of the American clergy to general acquiescence in the belief that geology is not at variance with Scripture. Professor Hitchcock's childhood was largely spent under the influence of these studies and discussions. The boy seemed to be full of promise, and because of his observing ways and proneness to speculation was called "the young philosopher." He used to bring his mother the very small flowers of *Spergula rubra*, which are so obscure that older eyes often fail to notice them. He seemed to be fonder of his father than the other children, and was never so happy as with him. Through this constant intercourse Charles became absorbed in his father's pursuits, and grew up into a knowledge of geology from Nature and from verbal explanations—a more satisfactory method than that of learning from books; and he was associated with his father in all his geological work from the time when he was first old enough to be of service. Thus, before 1856 he was acquainted, from inspection, with the terraces and reputed beaches and drift phenomena of all western Massachusetts; he had handled every specimen of a foot mark in the Appleton Cabinet, and by 1861 was the principal assistant on the Vermont Survey, having prepared for the press the greater part of the matter of the report. He had enjoyed the best educational advantages of his day, having completed the classical and preparatory courses of Williston Seminary, and been graduated thence in 1852, then graduated from Amherst College in 1856, a short time before his twentieth birthday. Among his early classmates and college friends were Dr. Cyrus Northrup, president of Minnesota University; Dr. Richard Mather, professor of Greek at Amherst College; [262] the Rev. Dr. Goodwin, of Chicago; and Dr. William Hayes Ward, editor of The Independent. After graduation he spent a year in special study of Hebrew and chemistry at Yale College, two years at Andover Theological Seminary, and one year in Europe, studying in the Royal School of Mines under Professor Huxley, and in the British Museum investigating the crustacea and trilobites. Here he enjoyed the friendship of Professor Richard Owen, and had the guidance of Dr. H. Woodward.

In 1857 Mr. Hitchcock was appointed assistant geologist to the Geological Survey of Vermont. He served the full term of the survey, and had charge of the preparation of the report relating to the stratigraphical geology, the measurement and delineation of the sections, and the compilation of the geological map.

In 1861 he received the appointment of State Geologist of Maine, in which service he spent two summers in field work, preparing two reports of progress, which were published in connection with the report of the secretary of the Board of Agriculture. Besides the general reconnoissance, he discovered the existence of large areas of Upper Silurian and Devonian terranes. He has embodied his views of the distribution of the formations in his general map of the United States.

Having chosen the ministry for his profession, Mr. Hitchcock studied theology under Dr. E. A. Park, of Andover, and the Rev. Dr. Taylor, of New Haven. Questions of the relations of theology and science were attracting much attention, and he treated of them in two papers in the *Bibliotheca Sacra*, one of which was afterward used for the guidance of theological students in several seminaries. As more opportunities were offered for scientific work, the ministry was given up. This was the time when the doctrine of natural selection came to the front for investigation, and the early history of mankind was receiving increased attention. Mr. Hitchcock came home from Europe in 1867 convinced of the truth of some form of evolution, of a considerable antiquity of man, and of the probability of a plural origin of the human race. Finding that some of his views on these subjects were not acceptable to his associates, he ceased to make them prominent in his class instructions, and devoted his attention to the more technical details of geology. Since then general opinion has advanced so far on these subjects that the views he held at that time seem now really conservative.

In 1868 he was appointed State Geologist for New Hampshire, and spent ten years in the survey of that State. The results of his work there were published in three large quarto volumes, with a folio atlas of maps, profiles, and sections. The rocks described consist principally of crystalline [263] schists and marine igneous ejections. The geology of New Hampshire is of peculiar importance, because the situation of the State is such that a correct knowledge of its rocks promotes the understanding of many obscure terranes in the adjacent regions of Maine, Quebec, Vermont, and Massachusetts. Professor Hitchcock's report of the survey may justly be styled his chief work. The part best studied relates to the White Mountains and the Ammonoosuc mining district.

Connected with the survey was the maintenance of a meteorological station throughout the year on the summit of Mount Washington. Daily statements of the weather conditions of this station during the winter of 1870-'71 were sent by telegraph to the principal newspapers, and called out much interest—before the United States Signal Service began its weather predictions.

The catalogue of Professor Hitchcock's publications comprises more than one hundred and fifty titles of papers, reports, and books. Perhaps the earliest thorough study represented among them was that of the fossil footmarks. The first of the published papers on this subject related to the tracks of animals in alluvial clay, and was published in the American Journal of Science in 1855. For several years after this he assisted his father in arranging the museum and compiling tables for the Ichnology. He made a complete catalogue descriptive of the more than twenty thousand individual impressions preserved in the Appleton Cabinet, which was printed, with descriptions of a few new species of footmarks, in the Supplement to the Ichnology of Massachusetts, edited by him after the death of his father in 1865. Although circumstances have prevented him from paying much attention to ichnology in later years, he has prepared several papers on the subject, the most important of which was one on the Recent Progress of Ichnology, which was read before the Boston Society of Natural History about twelve years ago. In it the ichnites were carefully catalogued anew and classified in the light of our knowledge of the numerous dinosaurs of the West; and the results of some studies of the slabs exhumed at Wethersfield, Connecticut, are well known. The list of the Connecticut footmarks was increased from one hundred and nineteen in the Ichnology to one hundred and seventy; and facts were cited to show that the *Grallator*, the three-toed animal most allied to birds, possessed a caudal appendage of a reptilian nature. The Trias of New Jersey had been found to illustrate new features in the *Otozoum*, whose tracks are often ornithic in aspect. A comparison of the features of the Triassic skeletons described by Marsh from Connecticut (*Anchisaurus*) shows that the creatures were rather allied to the *Plesiornis* than to the *Anomœpus* of the Ichnology, because of the great size of the fore feet. Notes upon footmarks have been gathered also from illustrations in Pennsylvania, Nova Scotia, [264]
Kansas, Nevada, and Florida.

Professor Hitchcock has studied the Quaternary or glacial deposits with great success. His first publication upon the terraces and allied phenomena of Vermont appeared while the old views of a submergence, with icebergs, prevailed, to account for the phenomena. A study of the glaciers of Switzerland in 1866 satisfied him of the truth of Agassiz's theory; and whenever the opportunity came for re-examination of the surface geology of northern New England, the facts were found to require a different theoretical explanation. He caused a thorough examination to be made of the Connecticut River terranes by Warren Upham in the New Hampshire Survey, and proved that all the high mountains of Vermont, New Hampshire, and Maine had been glaciated by a southeasterly movement. The ice came from the Laurentian highlands, pushed in a southern direction down the Champlain-Hudson Valley, with a southeasterly flow over New England and southwesterly over the Adirondacks; the last two courses having been subordinate to the first. At present the Laurentian hills are lower than the New England and New York mountains overridden by the ice, and probably the same was the case in the Glacial period. The best explanation of these paths is afforded by the suggestion that a gigantic ice cap accumulated north of the St. Lawrence, towering into the clouds so much that its overflow naturally descended over the White and Adirondack Mountains.

That glaciers should accumulate terminal moraines is axiomatic, but no geologist before 1868 had ventured to suggest where moraines might be located in the United States. In that year Professor Hitchcock delivered a lecture before the Lyceum of Natural History in New York and the Long Island Historical Society in Brooklyn, in which he affirmed that the drift deposits from Prospect Park along the backbone of Long Island for its entire length constituted the terminal moraine of the great continental ice sheet. This declaration inaugurated a new era in the study of the age of ice. The geologists in their several States found the terminal moraines, and the various phenomena began to be classified according to new laws. The search for moraines has resulted in a restatement of the incident of the age of ice; more than a dozen successive terminal moraines have been mapped between New York and Montana, which suggest to us the existence of several glacial periods. In compiling a catalogue of observations of the course of glacial striæ by the United States Geological Survey, it was found that Professor Hitchcock had recorded for New England as many as all other geologists had observed for the whole country.

Eskers are another interesting class of phenomena, and were first described as *horsebacks* in [265]
Maine, about seventy of them having been described in the report of 1861 and 1862. It was not till after the description of the Swedish Ösar that the nature of these lines or ridges was understood; and now they were found in every prominent valley in New England, as attendant upon the recession of the ice sheet. Professor Hitchcock gave the correct name of these ridges in his Elementary Geology, 1860; while for many years subsequently they were erroneously called *kames*, even in the geology of New Hampshire.

Professor Hitchcock gave the name of Champlain to the fossiliferous clays associated with the till of the Atlantic coast. The term has come into general use as connected with the melting of the ice in the latter part of the period. Because of the presence of boreal species, and of analogies with similar deposits in Europe, Professor Hitchcock has asked the question whether there may not have been a Champlain glacial epoch posterior to those named farther in the interior of the country, the Kansan, Iowan, and Illinoisian epochs.

Those who explore the geology of northern New England have to deal with crystalline rocks of various ages, and the opinions of our best geologists have not been in agreement respecting

them. Professor Hitchcock was the first to make a geological map of New Hampshire, and he also demonstrated the anticlinal nature of the Green Mountains of Vermont. His teachers had inculcated the view that these eminences belonged to a synclinal disposition, coupling this with theoretical assertions as to their age and metamorphism. Finding their main principle to be erroneous, he naturally disparaged their theories, though more recent studies are eliminating many of the schists from the Archæan. All the later explorers in the field—Canadians and members of the Geological Survey—accept a pre-Cambrian anticlinal in the heart of the Green Mountains.

The distribution of the New Hampshire formations was made out for the most part before any assistance was derived from the labors of Dr. G. W. Hawes and other petrographers. Twenty years ago, at the date of the final publication of the New Hampshire maps, the doctrine of an igneous origin of the crystalline schist had hardly been hinted at. What seems elemental to the modern petrographer who has acquired his technical education since 1890 was unknown then, and the classification given in the report may not agree with that now taught. In the midst of the diverse views entertained, Professor Hitchcock classified the rocks of northern New England according to this principle: rocks that are identical in petrographical composition are assumed to have had the same origin, and to be synchronous. Professor Hitchcock was almost the first of American geologists to employ the petrographer as a help to the understanding of the crystallines—as was evident by the very valuable contributions to knowledge in Part IV of the [266] New Hampshire Report as prepared by Dr. Hawes.

A vexing question concerning what are now called Cambrian terranes divided geologists for a quarter of a century after 1857, and had to be considered in preparing the geology of Vermont in 1861. This was the Taconic controversy. Trilobites had been discovered in Vermont, which were misunderstood by most of the American geologists following Hall, Logan, Dana, and others. In giving the species the technical name first of *Barrandesi* and then *Olenellus*, Prof. James Hall asserted its derivation from the Hudson River group—relying upon the stratigraphical determinations of Sir W. E. Logan. As soon as Barrandes's attention was called to these trilobites and the attendant publication, he wrote his famous letter to Logan in 1860, declaring that there must be a mistake somewhere. That error was discovered in time to be eliminated from the Vermont report of the following year. Professor Hitchcock had charge of the field work in this Cambrian district, and his views of the arrangement of the formations are in agreement with those of the latest workers in the field. He applied the term of *Georgia* to one division of the terrane in 1860; and the designation has been generally adopted since that time. Jules Marcou claimed priority in the suggestion of the application of the term, but upon the publication of Professor Hitchcock's statement on the subject the credit of priority was awarded to him by Director Walcott, of the United States Geological Survey.

Between 1860 and 1870 Professor Hitchcock was occupied largely as a mining geologist in the estimation of mineral deposits for mining companies, with his office in New York. In the prosecution of this business he traveled in Nova Scotia, New Brunswick, Quebec, Maine, New Hampshire, Vermont, New York, New Jersey, Pennsylvania, Maryland, Virginia, Ohio, Kentucky, and Alabama. Subsequently, the study of the phosphate beds led him to the island of Redonda in the West Indies. He further visited the phosphate beds of South Carolina and Florida, the gold fields of eastern Oregon, the Chalcedony Park of Arizona, the Grand Cañon of the Colorado, and the Yosemite and Yellowstone Parks. Studies made in the Hawaiian Islands and their volcanoes in 1883 and 1886 resulted in the contribution of important observations respecting those regions. At the present writing Professor Hitchcock is spending a year of further observations in those islands.

Mr. Hitchcock was appointed, in 1858, lecturer in zoölogy and curator of the cabinet in Amherst College; an office which he filled for seven years, retiring after the death of his father. In 1866 he [267] was elected professor of geology in Lafayette College, where he gave short courses of instruction to five successive classes. In 1868 he was called to the chair of geology in Dartmouth College, a position which he still occupies, receiving a year's leave of absence for 1898-'99 in consideration of thirty years of service. He taught geology and zoölogy as a provisional professor at Williams College in 1881, and in the following year in the Virginia College of Agriculture and the Mechanic Arts, Blacksbury. He received the degree of M. A. in course at Amherst in 1859, the honorary degree of Ph. D. from Lafayette College in 1870, and that of LL. D. from Amherst College in 1896.

Professor Hitchcock has been connected with the American Association for the Advancement of Science since 1856, and a nearly constant attendant upon its meetings and participant in the proceedings. He is a member of local scientific societies in Portland, Me., Boston, Mass., New York, Philadelphia, and St. Louis, and also of the Imperial Geological Institute of Vienna. He was one of the most prominent movers in the inception and early history of the Geological Society of America, and had much to do with the organization of the International Congress of Geologists, and with the preparation of special reports for the several meetings between 1876 and 1890. The handsome geological map of small scale compiled for the United States was prepared by him and published in the Transactions of the American Institute of Mining Engineers (1887), to illustrate the nomenclature and color scheme of the International Congress.

Professor Hitchcock is best known to many by his geological maps. The first efforts at mapping the geology of the United States were made independently by Edward Hitchcock and Jules Marcou in 1883—the work of Mr. Marcou extending only to the plains. Prof. H. D. Rogers, five or six years later, prepared a map for Johnston's Physical Atlas. In 1872 Prof. C. H. Hitchcock and Prof. W. P. Blake compiled a map for the ninth census of the United States, and for R. W.

Raymond's report upon the mineral resources of the country. The success of his small scale map led Professor Hitchcock to undertake the preparation of a map on a scale of twenty-five miles to the inch for the whole country. For this he consulted every work that had been printed upon the geology of the United States, and obtained the privilege of using many unpublished data collected by geologists of States and Territories in which the work had never been carried to actual completion. The map prepared by the General Land Office was used as the basis for the geological coloration, and the work appeared in 1881, of a size adapted to use in the classroom. Its compiler has never seen any criticism of its accuracy. The edition prepared for the Mining [268] Institute embodies all the information acquired for the large map, with such additional facts as had been learned since that map was published. Prof. Hitchcock's services were called into requisition in the compilation of a similar map for the United States Geological Survey, which was published in its annual report for 1886, under the editorship of W. J. McGee; in fact, the two maps were printed from the same plates, but Dr. Hitchcock's contained certain features not found in the other one—the result of different interpretations—and was more complete. In the Government edition a system of coloration devised by Major J. W. Powell, which was afterward abandoned, was employed.

Professor Hitchcock contributed extensively to the collection of State geological maps in the Centennial Exhibition of 1876, when large scale sheets of New England, and a large copy of the Hitchcock and Blake map of 1872, were exhibited. A medal was awarded for a sheet of thirteen sections illustrating the stratigraphy of Vermont and New Hampshire. The beginning of the measurement of sections was made for the Vermont Geological Report under the direction of Dr. Edward Hitchcock in 1861. Twelve lines of exploration across the entire State were determined upon, and specimens were collected to illustrate all the varieties of rock seen upon each. The specimens were arranged in the State Museum at Montpelier in geographical order. A similar plan of collection and arrangement was projected for the New Hampshire survey, but it was made to extend across the two States, from Maine to New York. Besides the two State reports, later publications were issued, descriptive of explorations and collections for the Bulletin of the American Museum of Natural History in New York, and the New Hampshire Agricultural Report for 1883. The work did not cease with these publications, for after the transfer of the collection of sections from the New Hampshire College of Agriculture and the Mechanic Arts to Dartmouth College in 1894, additional explorations were made; the number of sections was increased to eighteen; improved drawings of the profiles, colored geologically, were prepared for the cases in the new Butterfield Museum; and the explanation of the details was further facilitated by the construction of a large relief map on the scale of one mile to the inch horizontally, twice as much vertically, and having colors corresponding to those on the profiles between the shelves. About five thousand specimens have been gathered to illustrate the profiles.

The Dartmouth College Museum is filled with specimens accumulated by the energy of Professor Hitchcock. They concern geology, paleontology, petrography, economic botany, and conchology.

Editor's Table. [269]

EVOLUTION AND EDUCATION.

Our attention has been drawn to a lively discussion that has lately taken place in the St. Paul papers over the utterances, on the subject of the doctrine of evolution in its relation to education, of a certain Mr. Smith, who was appointed not long since superintendent of the public schools of that city. What seems clear is that Mr. Smith is a very ignorant man, whose views in regard to education are of an altogether retrograde character. How he came to be appointed to his present position is a question which is being gravely pondered by many of the citizens; but probably the explanation is not very far to seek. The dispensers of patronage in State and municipal affairs are not always competent to make the best nominations to offices calling for high qualifications; and sometimes they do not even act up to their own indifferent lights. The man that has the pull is very apt to be the man that gets the office, and it is not often that the strongest pull goes with the highest professional fitness.

However this may be, there Mr. Smith is, and what kind of a man he is may be judged from his utterances. It is thus that he refers to Mr. Spencer: "There is an old man in England who for years has spent all his time and devoted all his energies to the attempt to create a system which shall entirely ignore the name of the Deity. He will shortly die, and it shall not be remembered that he ever performed an act or said a word that blessed or comforted or relieved his suffering fellows." To further darken the picture, he contrasts Spencer with the late Cardinal Newman, who wrote the hymn "Lead, kindly light," and who, we are told, if he had done nothing more, would have been "followed by the blessings and the prayers of those whom he had comforted and saved." Again, dealing with the modern scientific view that, in the development of the human individual all antecedent stages of human development are, in a manner, passed through, he says: "Let us discard the primitive-man theory. You do not believe it. Rather shall we not hold with Emerson that every child born into the world is a new Messiah given into the arms of fallen humanity to lead them back to paradise?"

It is no part of our purpose to defend Mr. Spencer against the attacks of so negligible an assailant as Mr. Smith, of Minnesota. The words that Mr. Spencer has spoken for truth, for justice, for

humanity, for peace, are his sufficient commendation and vindication—were vindication needed—in the eyes of all who have any competent knowledge of contemporary thought. If these words do not help to make the world better we should feel little inclined to put our trust in the most skillfully constructed sacred lyric. Men do not always know their benefactors; and it is altogether possible, nay probable, that thousands who perhaps never heard Mr. Spencer's name have benefited through the greater consideration with which they have been treated by others, owing to his teaching. It is quite possible for men, yes, and women too, to sing "Lead, kindly light" with great unction, and yet to be the ardent abettors of warlike sentiments and warlike acts—to revel in a ruthless and immoral jingoism. Dryden was not referring to the adherents of any evolutionist [270] philosophy when he wrote:

"In lusts we wallow, and with pride we
swell,
And injuries with injuries repel;
Prompt to revenge, not daring to forgive,
Our lives unteach the doctrine we
believe."

"Not daring to forgive" is good, and nearly as true in the nineteenth century as it was in the seventeenth. The one English statesman who dared to forgive a defeat inflicted on English arms and to acknowledge an error, incurred by that single act a deeper hatred and contempt than he earned by anything else, or all else, in his long and storm-tossed career. We refer to the action taken by Gladstone after the battle of Majuba Hill. And we are much mistaken if the majority of those who execrated him most deeply for not crushing the Boers under England's overwhelming force were not immense admirers of the cardinal's hymn. What is certain is that they were not immense admirers of Spencer, and that Spencer did not immensely admire them.

Superintendent Smith has quoted Emerson, but he does not occupy the standpoint that enables him to see Emerson in true perspective, or to feel what his philosophy lacks when confronted with the newer knowledge of the century. Mr. J. J. Chapman, in his recent memorable book of essays, gives us a better view. "A critic in the modern sense," Mr. Chapman says, "he (Emerson) was not. He lived too early and at too great a distance from the forum of European thought to absorb the ideas of evolution, and give place to them in his philosophy.... We miss in Emerson the underlying conception of growth, of development, so characteristic of the thought of our own day, and which, for instance, is found everywhere latent in Browning's poetry.... He is probably the last great writer to look at life from a stationary standpoint."

That the doctrine of evolution constitutes to-day a most important guiding principle in education no competent educationist could be found to deny. It teaches us to deal with the young as in a very true sense the heirs of all the ages, to make due allowance in childhood for instincts and habits which partake of the earlier stages of human development, and to look forward with confidence to later and higher manifestations. We have less faith than our ancestors had in the rod, and more in the gradual unfolding of the powers and capacities of the mind, and therewith the enlargement and improvement of the moral nature. We do not believe as our forefathers did in breaking children's wills; nor do we view their peccadilloes in the lurid light of a gloomy theological creed. We recognize that veracity, in the sense of strict accuracy of speech, purged of all imaginative elements, is a virtue which not all adults are able to practice, and which is not a natural product of the child mind. We can not accept Emerson's doctrine of infant Messiahs, and yet we can recognize very fully the mission of the child in the home, the demand it makes for tenderness, for patience, for thoughtfulness on the part of parents, the hopes and fears and heart-searchings that it calls into play, the aspirations that it promotes toward the realization, if for its sake only, of a higher life. Froebel grasped a large measure of truth in regard to children, but too much of sentiment, in our opinion, entered into his treatment of them. In the full light of the doctrine of evolution we take them as they are, and help them to work out under favorable conditions that development of which they are capable. We are not imposed upon by childish imitations of mature virtues, and are rather disposed to repress recognized tendencies to [271] precocity; but we believe that the germs of good are sown in every normal human being, and that, unless killed by most unwise treatment, they will fructify in due time.

What we may well consider seriously is whether our modern modes of life enable us to do that justice to children which evolutionary teaching requires. Can true health of body and mind be conciliated with social ambition or with commercial ambition? Are we not hampered at every turn by false schemes of education, the object of which is to turn out certain conventional products? How many of us can rise up in effective rebellion against the very fashions that in our hearts we most condemn? Before there can be anything like a perfect education for the young there must be a much more fully developed sense of duty than we see as yet in the older generation. The doctrine of evolution is putting the key to a true system into our hands; but to use that key aright requires courage and high purpose—qualities that are not of everyday occurrence. Still, it is matter of congratulation that the truth is not far from us. It is well established in our theories, and one of these days we may hope it will gain a wide and secure footing in our practice.

DAVID AMES WELLS.

In the death of David A. Wells, which occurred at his home in Norwich, Connecticut, on the 5th of November, 1898, America has lost one of her ablest and most productive men of letters and science a distinguished representative. Out of a life of seventy years it may fairly be said that Mr.

Wells gave fifty of them to intellectual pursuits, which were mainly devoted to the advance of science and its application to practical affairs. After passing the period of early study, and particularly since he became interested in economic questions, much of his work was in the line of original investigation, the results of which have from time to time been given to the public either through his books or in the magazines. Another and more conspicuous feature of his career, the one perhaps that made him best known at home and first gave him reputation abroad, was the valuable service that he rendered the country at large in straightening out the financial tangle the Government had got itself into during and after the civil war. In this undertaking his great store of learning, rare practical sagacity, and unwavering confidence in the final result, carried him through to a brilliant success, earning for him in high quarters the most flattering testimonials of admiration and respect.

Looked at in the light of what he actually achieved, Mr. Wells's preparation for his life work seems to have been almost an ideal one. Gifted with a strong love of Nature and having a decidedly practical turn of mind, he early showed a fondness for the study of science. This led him, soon after graduating from Williams College in 1847, to enter the Lawrence Scientific School of Harvard University. Here he completed the course with the first class that was graduated by that institution in 1852. While studying in the scientific school young Wells became the special pupil of Agassiz, and, as the sequel shows, caught the enthusiasm with which that great master was wont to inspire the young men who were fortunate enough to come within the range of his influence. During this period Mr. Wells, in association with Mr. George Bliss, began [272] the compilation and publication of the Annual of Scientific Discovery, which he continued for some sixteen years. That he was a clever student with quite exceptional endowments is seen in the circumstance that immediately after graduation he was appointed assistant professor in the scientific school and lecturer on physics and chemistry in Groton Academy, Massachusetts. He also, between 1857 and 1863, prepared a series of scientific school books embracing the subjects of physics, chemistry, and geology, and a volume on the Science of Common Things, all of which attained a wide circulation.

Thus for a period of nearly fifteen years Mr. Wells had devoted himself assiduously to the cultivation of the physical sciences. Beginning with the practical operations of the laboratory, where the value of experiment and observation is made apparent, his work was continued in the strengthening and developing experiences of the teacher, and thence led up to that wider knowledge and that clearness of exposition which a bright mind would acquire in the preparation of a number of successful scientific class books. It may be presumed that by this time he was thoroughly acquainted with scientific method in its applications to the investigation and explanation of physical phenomena. With the results this had yielded in building up the great body of verified knowledge composing the several sciences he must also have been familiar. Mentally alert and with sharpened powers of observation, he was able to seize and classify the facts bearing upon the problem in hand, and subject them to systematic processes of scientific reasoning.

Such, in brief, was the training and such the equipment brought by Mr. Wells to the study of economic questions when he first began to write upon them in 1864. A better preparation for the work to which he was to give the next thirty years of his life can scarcely be imagined. While it is quite true that in entering this new field he was to encounter a class of facts and variety of phenomena that were of a very different order from those with which he had previously been dealing, their apparently haphazard character did not deceive him. Well versed in the practice of tracing effects to causes, gifted with remarkable powers of insight, and thoroughly believing that the methods of science would prove as available in the study of economics as in other fields, he began his investigations without misgiving, patiently accumulated and studied the facts, and when conclusions were arrived at, no matter how contrary they might be to current teaching, fearlessly announced and defended them. Though half his life a firm believer in the doctrine of protection, when Mr. Wells went to Europe for the Government in 1867 to investigate the subject of tariff taxation, high and low tariff countries alike were visited, with the determination to leave nothing undone that would aid to a better understanding of the question. All the varied aspects of the problem were carefully studied in connection with the principal industries of the respective countries, and, finding reason in the facts thus obtained to revise his opinions, he came home a convert to free trade. For an account of what he had observed during the course of his investigations, and of the conclusions based thereon, the reader is referred to the fourth volume of his reports as commissioner of internal revenue, published in 1869. His book on Recent Economic Changes, and the papers on The Principles of Taxation, that have appeared in this [273] magazine during the last two years, are records of equally painstaking research. Moreover, they are both excellent examples of what a strict adherence to scientific method has done and may yet be expected to do toward clearing up the knotty problems in economics that are now engaging public attention.

United with his great learning, and a rare power of generalization, Mr. Wells possessed in full measure that intellectual honesty which is the indispensable characteristic of the true man of science. This enabled him to follow without doubt or hesitation wherever the facts might lead; and with his clear perception of their real import, joined to his habit of independent thought, traits that are displayed throughout all his more formal writings, they are what in our opinion constitute his title to distinction. They give to his teachings, which have already done more than any other agency that we know toward placing the subject of political economy on a sound scientific basis, a high and enduring character.

A BORROWED FOUNDATION.

"The central idea of Professor Giddings's Principles of Sociology, a work that has the honor of being the first independent attempt in English to treat of sociology as such, is that we must postulate on the part of human beings what he calls a *consciousness of kind*. Critics of his volume have naturally told him that this is essentially a philosophical idea, found in Hegel and in British ethical writers of the eighteenth century."

We quote the above from an article by Professor Caldwell, entitled Philosophy and the Newer Sociology, in the October Contemporary. We are not prepared to dispute Professor Caldwell's statement that the idea of the "consciousness of kind" may be found in the writers to whom he refers; but it would have been very much to the point if he had mentioned that it is to be found most clearly enunciated in Mr. Herbert Spencer's Principles of Sociology. In an article contributed to this magazine in December, 1896, Mr. Spencer took occasion to point out that what Professor Giddings seemed to regard as an *aperçu* peculiar to himself had been distinctly formulated years before in his own writings. In proof of this he quoted the following passages:

"Sociality having thus commenced, and survival of the fittest tending ever to maintain and increase it, it will be further strengthened by the inherited effects of habit. *The perception of kindred beings, perpetually seen, heard, and smelt, will come to form a predominant part of consciousness*–so predominant that absence of it will inevitably cause discomfort." "Among creatures led step by step into gregariousness, there will little by little be established a pleasure in being together—a pleasure in the consciousness of one another's presence—a pleasure simpler than, and quite distinct from, those higher ones which it makes possible."

The fact is that there is much more in Spencer than most recent writers have ever explored; and the newer sociologists would do well, before putting forward claims to originality, to make sure that they have not been anticipated by the veteran philosopher.

Scientific Literature.

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SPECIAL BOOKS.

In *The Play of Animals*[59] we are offered a book upon an essentially new topic; for, although much has been written concerning the habits and intelligence of animals, no special consideration has been given to their play or its psychic significance. The survey of this virgin territory seems to the critical reader to have disclosed such limitless area to Professor Groos that he fails to indicate its legitimate boundaries. He confesses himself overcome by a sense of its vastness, stating that the "versatility needed for a thorough investigation is so comprehensive that it is unattainable by an ordinary mortal."

Play, he finds, is not "an aimless activity carried on for its own sake"; neither is it the product of surplus physical energy, as Mr. Spencer defines it, for in youth there is playfulness without this condition. Instincts useful in preserving the species appear before they are seriously needed, and are utilized in play, which serves as preparation for the tasks of life. "Animals do not play because they are young, but have a period of youth in order to play."

The special ends accomplished by play are control of the body, command of the means of locomotion, agility in pursuit of prey and in escaping danger, and prowess in fighting. The games pursued in attaining these ends are classified in nine groups, beginning with those of experimentation and ending with those referred to curiosity. They include plays of movement, hunting, fighting, love, construction, nursing, and imitation. For all of these Professor Groos finds but one instinct of play responsible, supplemented by the instinct of imitation. He enters into an elaborate discussion of instinct, giving an outline of Weismann's theory of heredity and the views of various writers. He adopts Herbert Spencer's definition of instinct as a complex reflex act, referring its origin to the operation of natural selection, acknowledging the process to be beyond our grasp. In seeking to explain bird song and the love play of animals, the theory of sexual selection is not accepted by him without qualification; a modification of the Darwinian principle is suggested in which the female exerts an unconscious choice. The psychic characteristics of play are the pleasure following satisfaction of instinct, energetic action and joy in the acquirement of power. The animal at first masters its own bodily movements, then seeks the conquest of other animals and inanimate objects. When a certain facility in play has been gained a higher intellectual stage is entered upon, that of make-believe, or playing a part. This state of conscious self-illusion is reached by many of the higher animals. Psychically, it indicates a divided consciousness, and occupies a place between the ordinary state and the abnormal ones of hypnosis and hysteria. To this condition Professor Groos ascribes the genesis of artistic production, an hypothesis that he has elaborated more fully in *Einleitung in die Aesthetik*.

The experimental plays of animals, divided into those of courtship, imitation, and construction, correspond to the principles of self exhibition, imitation, and decoration, which are claimed to be [275] the motives of human art. The acquirement of power through play develops a feeling of freedom, and this the artist likewise seeks to realize in the world of ideals.

Artists will not probably acknowledge that "life is earnest, art is playful," nor moralists agree that "man is only human when he plays, for there is no real freedom in the sphere of experience," yet both may find food for thought in Professor Groos's analysis of play.

In the spasm of unreasoning hostility to Spain which has come over the people of the United States, succeeding a period of effusive admiration, the public are apt to forget that that nation has done anything creditable for the promotion of civilization. Yet, leaving out other fields of culture for the present, it has produced two painters who rank among the great masters, besides numerous secondary artists, rivals of any of that grade in the world, and a voluminous literature which George Ticknor thought it worth while to make the study of his life, and which inspired the pens of Irving, Longfellow and Lockhart. One of the works of this literature ranks among the world's greatest classics, and has been, perhaps, after the Bible and Shakespeare more universally read than any other book; and numerous other works—chiefly romances—have furnished patterns or themes for the poets, novelists, and dramatists of other nations. Mr. *Fitz Maurice Kelly's* excellent and convenient *History of Spanish Literature*[60] therefore comes in good time to refresh our memories concerning these facts. One does not have to go very far in the history to find that of the great Latin writers of the age of the Cæsars, the two Senecas, Lucan the poet of Pharsalia, Martial the epigrammatist, and Quintilian the rhetorician—still an authority—and many minor writers, "were Spaniards as well as Romans." It also appears that of what Gibbon declared to have been the happiest epoch of man's history—from the death of Domitian to the accession of Commodus, seventy of the eighty years, if we take the liberty, as Mr. Kelly does, of counting Marcus Aurelius as a Cordovan, were passed beneath the scepter of the Spanish Cæsars. Prudentius, a distinguished Latin Christian writer of a succeeding age, was also a Spaniard. Although there were "archaic" works of *trovadors* before that time, traditionally preserved by *juglars*, Spanish literature proper began in the twelfth century. It owed much to French and Italian, and in course of time gave much back to them. Among its earliest signs was the development of the romance (ballad), while Arab writers (whose work Mr. Kelly considers of doubtful value) and Jews, who are better spoken of, were early contributors to it. The earliest works of importance were the Mystery of the Magian Kings, one of the first plays in any modern language, and the great heroic poem of the Cid, both anonymous. The first Castilian poet whose name has reached us was Gonzalo de Berceo, 1198 to 1264, who wrote much, and was, "if not an inventor, the chief of a school." Permanent form was given to Spanish prose by King Alfonso the Learned, 1226 to 1284, who, "like Bacon, took all knowledge for his province, and in every department shone pre-eminent." He had numerous collaborators, and "his example in so many fields was followed"—among others (in some of them) by his son and successor, Sancho IV. The Infanta, Juan Manuel, nephew of Alfonso, in one of the stories of his Conde Lucanor—"one of the [276] books of the world"—created the germ of the Taming of the Shrew. Passing a numerous list of writers of respectable merit, for whose names even we have not room, we come to the age of the Catholic kings and Charles V, when for a hundred and fifty years literature most flourished in Spain. Among the features of this period are the Amadis de Gaul—"the best in that kind"—which inspired Cervantes; Columbus, who, though of Italian birth, "was probably the truest Spaniard in all the Spains," the poet Garcilaso de la Vega, and Bernal Diaz and other historians whose names dot Prescott's books. Passing a large number of writers of mark whose works appeared in this age, and stopping only to mention Alonzo de Ercilla y Zuñiga's Araucana as the first literary work of real merit composed in either American continent, we come to the age of Cervantes, whose story of Don Quixote—"the friendless people's friend," as Browning styles him—is not more distinguished for its satirical wit and humor than for its kindly humanity; and Lope de Vega, that most prolific of all dramatic authors, who "left no achievement unattempted," and died lamented by a hundred and fifty-three Spanish and fifty Italian authors, who sang his praises. Among other of the most distinguished writers of this and succeeding periods are Mariana, "the greatest of all Spanish historians"; Góngora, a famous poet in his day; Quevedo; Tirse de Molina, the creator of Don Juan; Calderon, second as a dramatist among Spaniards, if second, only to Lope de Vega, and Alarcón his compeer; and Velasquez, great in art and not small in letters. An interregnum came in during the reign of Carlos II, and French influence made itself felt. The age of the Bourbons produced among others the Benedictine Sarmiento, who as a botanist "won the admiration and friendship of Linné." The present century has been marked by the names of many authors of merit, novelists known to us in translations, by an active movement of historical composition developing brilliant monographs, and by a marked advance of scholarship and tolerance, led by Marcelino Menéndez y Pelayo; with a tendency to produce "a breed of writers of the German type."

GENERAL NOTICES.

The great importance of the problems of forestry and all that pertains to them can not fail to be appreciated by any one who has seen the devastation wrought in many sections of this country by the "wood chopper." Forestry is one of the subjects where natural science can step in and guide the way to economic success, and where, in default of scientific methods, economically fatal results inevitably ensue. The preservation of forests has been an important problem in Europe for many years, but until quite recently it has received little attention in the United States. One of the pioneers in the field of forestry in this country was Franklin B. Hough, whose Elements of Forestry is still a used and useful manual. Among his many schemes for attracting attention and study to this important subject was one of making actual sections of the wood of American trees,

and arranging them in a compact and attractive manner for general distribution. This idea he never carried out, and it has remained for his son, Mr. R. B. Hough, to finally carry out the scheme, by publishing a complete series of such sections, carefully prepared and compactly bound.[61] In Part I of the series there are cuttings representing twenty-five species of American trees. The sections are sufficiently thin to allow of their study by transmitted light. There are [277] three cuttings from each species, transverse, radial, and tangential to the grain. An accompanying text gives a condensed description of each tree, including its physical properties, uses, and habitat. These descriptions are preceded by a useful introduction to the study of general botany, describing the methods of distinguishing and naming the various parts of plants and trees, and giving an account of their structure and methods of growth. The actual wood sections, quite apart from their scientific value, are worthy of attention because of their great beauty. They are substantially mounted on black cardboard, each card containing the three sections of a species, and its common name in English, French, German, and Spanish. The thinness of the cuttings makes it possible to use them as transparencies, thus bringing out the texture of the wood in a very effective way.

Prof. *Charles Reid Barnes* is impressed with the fact that while laboratory work has become nearly universal in botany, and laboratory manuals are numerous, there is still a lack of books giving an elementary account of the form and functions of plants of all groups. To supply this want he offers *Plant Life*[62] as an attempt to exhibit the variety and progressive complexity of the vegetative body; to discuss the more important functions; to explain the unity of plan in both the structure and action of the reproductive organs; and to give an outline of the more striking ways in which plants adapt themselves to the world about them. He has made the effort to treat these subjects so that, however much the student may still have to learn, he will have little to unlearn. The book is not intended to be memorized and recited, but to be intelligible to pupils from thirteen to eighteen years of age who are engaged in genuine laboratory study under the direction "of a live teacher who has studied far more botany than he is trying to teach." It is adapted to use supplementarily to any laboratory guide or to the directions prepared by the teacher. The directions are made fullest in relation to cryptogams and physiology, because these fields are at present most unfamiliar to teachers.

Attaching great importance to *Electro-Dynamics*, which he thinks will in the near future assume the same relation to the electric motor that the science of thermo-dynamics already bears to the steam engine, Mr. *Charles Ashley Carus-Wilson* aims in the book of that name[63] to apply the principles of that science to the direct-current motor. Writing for electrical engineers particularly, he takes for granted a certain acquaintance with the use and design of motors, but avoids unexplained technicalities as far as possible. He has not deemed it necessary to deal with self-induction, except in connection with the question of sparking. The numerical accuracy attempted has been limited to that attainable with an ordinary ten-inch slide rule, on which all the examples have been worked out. Importance is attached to the graphic method of solution.

Of Dr. *Frank Overton's* three books on *Applied Physiology*,[64] the first or primary grade follows a natural order of treatment, presenting in each subject elementary anatomical facts in a manner that impresses function rather than form, and from the form described derives the function. The facts and principles are then applied to everyday life. The intermediate grade, besides being an introduction to the study of anatomy and physiology, is intended to be a complete elementary book in itself, giving a clear picture of how each organ of the body performs its work. The advanced grade book was suggested by a series of popular lectures in which the author presented the essential principles of physiology about which a physician is consulted daily. His explanations of many common facts were novel to his auditors, and it was found that the school books were silent upon many of these points, especially with regard to the cells. Throughout the series the fact that the cells are the units in which life exists and acts is emphasized. The author [278] has endeavored to include all the useful points of the older text-books, and to add such new matter as the recent progress of physiological and hygienic science demands. Avoiding technical terms, he has sought to express the truths in simple language, "such as he would use in instructing a mother as to the nature of the sickness of her child." The subjects of alcohol and other narcotics are made prominent in all the books, and are discussed fully in the third of the series. The relation of respiration and oxidation to the disappearance of food, to the production of waste matters, and to the development of heat and force, is dwelt upon. Simple and easy demonstrations, many of them new, are provided at the ends of chapters. A chapter on Repairs of Injuries, or the restoration of the natural functions, when impaired, by the body, is new in a school textbook.

In *Yetta Ségal*,[65] a slender thread of a story is used by Mr. *Rollin* as the vehicle for a theory of "type fusion" or convergence which he thinks has not received sufficient attention from social or scientific students. There are a pair of lovers, one of whom is discovered at a critical period in the courtship to have negro blood in his veins, and a philosopher who comes forward to satisfy the parties (who hardly need it) that this is no serious matter, but is all according to human evolution and the destiny of the race. "You must be impressed," he says, "by the fact that there are a great many people here and there, of mixed blood, and that the number is increasing; ... it is well that not a few are indeed truly admirable specimens of the human race. Such phenomena must be interpreted in a way consistent with man's nature: if he is developmental; if he shall attain a higher status through struggle, or through means that are seemingly, or for the time, degrading; if he is moving from the simple to the complex, as to organization; if universal movement tends to unific existence—then race interchange, with elimination of peculiar characteristics, has probably

made its appearance as a phase of infinite order, and for the benefit of future man.... It is presumptuous for the wisest to assert that the man of lower type has no element of strength peculiar to his race which the most advanced does not need in his present organization. It may be needed either for present protection in the way of re-enforcement, or as an element of strength for further advancement." Mr. Rollin does not advocate type fusion or wish to accelerate the movement, but presents it as a fact and factor in human evolution deserving more extensive and thorough study than it has received.

The increasing attention which of late years has been given to the study of comparative anatomy has finally resulted in what promises to be a complete and detailed account of the structure of a subhuman mammal.[66] The author, Dr. *Jayne*, believes that a course in mammalian anatomy offers a valuable preliminary to the study of medicine, and this is the purpose for which the book has been made. This is to a certain extent true, especially where, as in the case of the cat, there is so close a similarity to the structure of the human body. But the chief scientific interest and value of such a work must lie in its broader philosophic aspects; in the aid which it can not but give in clearing up some of the many mooted points of evolutional biology, and in the stimulus which it will impart to the study of relationships among the lower animals. The present volume, the first of the series, deals only with the skeleton of the cat, each bone being first studied individually, then in its relations to other bones and to the muscular system and the skeleton as a whole, and finally in comparison with the corresponding portion of the human skeleton. There are 611 extremely good illustrations, and the printing of the volume is unusually clean and attractive.

Among the articles of special value in recent numbers of the (bimonthly) *Bulletin of the Department of Labor*, under the editorial control of Commissioner *Carroll D. Wright* and Chief Clerk *O. D. Weaver*, are those on Boarding Houses and Clubs for Working Women, by Mary S. [279] Ferguson, in the March number; The Alaskan Gold Fields and the Opportunities they afford for Capital and Labor, by S. C. Durham, in the May number; Economic Aspects of the Liquor Problem; Brotherhood Relief and Insurance of Railway Employees, by E. R. Johnson, Ph. D.; and The Nations of Antwerp, by J. H. Gore, Ph. D., in the July number. Summaries of reports of labor statistics, of legislation and decisions of courts affecting labor, and of recent Government contracts constitute regular departments of the bulletin. (Washington.)

For delicate humor and refined art of expression few writers can excel Jean Paul Friedrich Richter, but the sources of his rich flow of humor are so deeply hidden and his expression is so very subtle that the generality of those who attempt to read his works fail to appreciate him or even to understand him, and give him up. The pleasure of appreciating him is, however, worth the pains of learning to do so. Those who are willing to undertake this, and who read German, may find help in the *Selections from the Works of Jean Paul Friedrich Richter*, prepared by *George Stuart Collins*, and published by the American Book Company. The book is intended for students of German who have attained a certain mastery of the language. Pains have been taken to avoid such passages as might from their mere difficulty discourage the reader, and to choose such as would be complete in themselves. The selections are made from the shorter writings of the author, and each is intended to be representative of some feature of his manifold genius and style.

A notice of the *Stenotypy*, or system of shorthand for the typewriter, of *D. A. Quinn*, was published in the Popular Science Monthly in March, 1896. It is really a system of phonography to be used with the typewriter whenever it is practicable to employ that instrument. A second edition of Mr. Quinn's manual and exercises for the practice of the system is published by the American Book Exchange, Providence, R. I.

A paper on *Polished-Stone Articles used by the New York Aborigines before and during European Occupation*, published as a Bulletin of the New York State Museum, is complementary to a previous bulletin on articles of chipped stone. Both papers are by the Rev. Dr. *W. M. Beauchamp*, and are illustrated by figures from his large collection of original drawings, made in nearly all parts of New York, but mostly from the central portion. While the chipped implements are more numerous and widespread than those treated of in the present bulletin, the latter show great patience and skill in their higher forms and taste in selecting materials, and they give hints of superstitions and ceremonies not yet thoroughly understood.

Henry Goldman has invented, in the arithmachine, what he claims is a rapid and reliable computing machine of small dimensions and large capacity, with other advantages. He now offers, as a companion to it, *The Arithmachinist*, a book intended to serve as a self-instructor in mechanical arithmetic. It gives historical and technical chapters on the calculating machines of the past, describes the principles controlling the construction and operations, and furnishes explanations concerning the author's own device. (Published by the Office Men's Record Company, Chicago, for one dollar.)

The *Bulletin from the Laboratories of Natural History of the State University of Iowa*, Vol. IV, No. 3, contains two technical articles: On the Actinaria, collected by the Bahama Expedition of the University, in 1891, by J. P. McMurrich, and the Brachyura of the Biological Expedition to the Florida Keys and the Bahamas in 1893, by Mary J. Rathbun; and a list of the coleoptera of Southern Arizona, by H. F. Wickham. Mr. Wickham observes that the insects of northern Arizona are widely different from those of the southern part, a fact which he ascribes to difference of altitude, and, consequently, in vegetation. The Bulletin is sold for fifty cents a copy.

Two books in English—*Elementary English* and *Elements of Grammar and Composition*—

prepared by *E. Oram Lyte*, and published by the American Book Company, are intended to include and cover a complete graded course in language lessons, grammar, and composition for study in the primary and grammar grades of schools. The endeavor has been made to present the subject in such a way that the pupil shall become interested in the study from the first. The first [280] book, Elementary English, is designed to furnish material for primary language work, and to show how this material can be used to advantage, embodying and representing the natural methods of language teaching. The child is given something to do—easy and practical—at every point, and is not troubled by formal definitions and rules to be committed to memory. The second book is also based on the principle that the best way to gain a working knowledge of the English language is by the working or laboratory method. It is therefore largely made up of exercises, and aims to teach through practice. The subject is unfolded from a psychological rather than a logical point of view. What is to be memorized is reduced to a minimum, and not presented till the pupil is ready for it. The lessons in literature and composition are designed to help the pupil to appreciate worth and beauty of literature, and lead him to fluent and accurate expression.

The Bulletin of the Geological Institution of the University of Upsala presents a series of special papers of much interest to students of that science, on studies in geology, largely of Scandinavia, but of other countries as well. Part 2 of Vol. III, now before us, has such papers on Silurian Coral Reefs in Gothland, by Carl Wiman; the Quaternary Mammalia of Sweden, by Rutger Sernander; Some Ore Deposits of the Atacama Desert, by Otto Nordenskiold; the Structure of some Gothlandish Graphites, by Carl Wiman; the Interglacial Submergence of Great Britain, by H. Munthe; Mechanical Disturbances and Chemical Changes in the Ribbon Clays of Sweden, by P. J. Holmquist; Some Mineral Changes, by A. G. Högborn; and the Proceedings of the Geological Section of the Students' Association of Natural Science, Upsala. The articles are in German, English, and (in previous numbers) French.

Two Spanish-American works of very different character have come to us from Valparaiso, Chili. One is entitled *Literatura Arcaica—Estudios Criticos*, or critical studies of old Spanish literature, by *Eduardo de la Barra*, of the Royal Spanish Academy, which were communicated to the Latin-American Scientific Congress at Buenos Ayres. The author was invited to present to the congress the fruits of his extensive studies on the Poem of the Cid, but afterward modified his plan and gave these, the results of his more general investigations of the romances of the fifteenth and sixteenth centuries, which Spanish critics regard as the most ancient they have, and other romances attributed to the twelfth and thirteenth centuries, with an article on the Cid. This work is published by K. Newman, Valparaiso.

The other book is a volume of *Rrimas*, or rhymes, by *Gustabo Adolfo Béker*, published by Carlos Cabezon, at Valparaiso. The ordinary student might think that the Spanish language is one of those least in need of spelling reform, but not so the author and publisher of these poems, which are presented in the most radically "reformed" spelling, and with them comes a pamphlet setting forth the character and principles of "Ortografia Rrazional."

The report of a study of seventy-three Irish and Irish-American criminals made at the Kings County Penitentiary, Brooklyn, N. Y., by Dr. *H. L. Winter*, and published as *Notes on Criminal Anthropology and Bio-Sociology*, contains numerous observations bearing upon the effect of hereditary influences in criminality, but hardly sufficient to justify the drawing of any general conclusions.

The late Mr. Lewis M. Rutherfurd, in developing the art of astronomical photography, naturally gave much attention to the star 61 Cygni—which was the first to yield its parallax, and through which the possibility of measuring stellar distances was shown—and its neighbors. A number of the plates of this series were partially studied by Miss Ida C. Martin more than twenty years ago, and the study has now been carried out by *Herman S. Davis*, as part of the work of Columbia University Observatory. The results of Mr. Davis's labors are published by the observatory in three papers: *Catalogue of Sixty-five Stars near 61 Cygni*; *The Parallaxes of 61^1 and 61^2 Cygni*; and *Catalogue of Thirty-four Stars near "Bradley 3077"*; under a single cover.

In a small work entitled *A Theory of Life deduced from the Evolution Philosophy* a few thoughts [281] are recorded by *Sylvan Drey* relative to the manner in which, from central doctrines identical with the teachings of Herbert Spencer, a system of religion, an ideal society, a theory of ethics, and a political creed—the doctrine of social individualism—may be built up. The religion is to recognize an inexplicable and inconceivable energy revealing itself in the universe, of which the highest theistic conception possible to human beings, free from the supposition that it represents a likeness, is the only one that can be accepted. "Absolute truth is beyond the grasp of human beings; but for all practical purposes the teachings of the evolution philosophy, relative truths though they may be, may be regarded as final and conclusive." Mr. Drey's paper of thirty-four pages is published by Williams & Norgate, London.

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Wyckoff, Walter A. The Workers. An Experiment in Reality. The West. New York: Charles Scribner's Sons. Pp. 378. $1.50.

Fragments of Science.

Tree Planting in the Arid Regions.—In planting the arid and subarid regions of the country, where no trees are growing naturally, Mr. B. E. Fernow says, in a review of the work of the Department of Forestry, different methods of cultivation from those given in the humid parts are necessary, and the plant material has to be selected with a view to a rigorous climate characterized by extreme ranges of temperature varying from -40° to +120° F. The requirements of the plants for moisture must be of the slightest, and they must be capable of responding to the demands of evaporation. At first, whatever trees will grow successfully from the start under such untoward conditions would have to be chosen, no matter what their qualities otherwise might be. The first settlers have ascertained by trials some of the species that will succeed under such conditions, but unfortunately most of them are of but small economic value, and some of them are only short-lived under the conditions in which they have to grow. A few years ago Mr. Fernow came to the conclusion that the conifers, especially the pines, would furnish more useful and otherwise serviceable material for the arid regions. Besides their superior economical value, they require less moisture than most of the deciduous trees that have been planted, and they would, if once established, persist more readily through seasons of drought and be longer lived. A small trial plantation on the sand hills of Nebraska lent countenance to this theory. It being vastly more difficult to establish the young plants in the first place than in the case of deciduous trees, much attention was given to the provision for protection of the seedlings from sun and winds; and they were planted in mixture with "nurse trees" that would furnish not too much and yet enough shade. "It can not be said that the success in using these species has so far been very encouraging; nevertheless, the failure may be charged rather to our lack of knowledge and to

causes that can be overcome than to any inherent incapacity in the species." The experiments should therefore be continued. [283]

"The Venerable Bede's" Chair.—In an article in a recent issue of Architecture and Building, on Ancient and Modern Furniture, by F. T. Hodgson, the following interesting account of the chair of "the Venerable Bede" occurs: "Perhaps the best-known relic, so far as furniture is concerned of this early period, is the chair of 'the Venerable Bede,' which is still preserved in the vestry of Jassova Church, Northumberland, England. This chair is distinctively an ecclesiastical one—a throne, in fact, of some dignity. It is made of oak and is four feet ten inches high. There are many engravings of it, but I reproduce from one of the best. The chair is now well on to twelve hundred years old, and if cared for as it ought to be is good for several hundred years more. There is a popular tradition concerning this chair that is worthy of notice. It is said that to this ancient relic all the brides repair as soon as the marriage service is over, in order that they may seat themselves in it. This, according to the popular belief, will make them joyful mothers of children; and to omit this custom the expectant mothers would not consider the marriage ceremony complete, and in default thereof of being enthroned in 'the Venerable Bede's chair' barrenness and misery would surely follow. Like all other relics of the sort, it is subject to attacks of the sacrilegious penknives, together with the wanton depredations of relic hunters, and has been so shorn of its fair proportions that very soon there will be little of it left but its attenuated form if stricter watch is not kept over it."

The Physics of Smell.—The principal subject of Prof. W. E. Ayrton's vice-presidential address on physics at the British Association was the physics of smell, which was presented as a subject that had been but little studied. In testing the generally accepted idea that metals have smell, based on the fact that a smell is perceived with most of the commercial metals when handled, the author had observed that when these metals were cleaned or made outwardly pure the smell disappeared. Yet it is shown that these metals acquire smells when they are handled or abraded by friction, which are characteristic and serve to distinguish them. This may be ascribed to chemical action, but not all chemical action in which metals may take part produces smell; for when they are rubbed with soda or with sugar no smell but that of soda or of sugar is perceived; nor is the metallic smell observed when dilute nitric acid is rubbed on certain metals, though the chemical action is very marked with some. But mere breathing on certain metals, even when they have been rendered practically odorless by cleaning, produces a very distinct smell, as also does touching them with the tongue. These smells have hitherto been attributed to the metals themselves, but Professor Ayrton looks for their source in the evolution of hydrogen, which carries with it impurities, hydrocarbons, especially paraffin, and "it is probable that no metallic particles, even in the form of vapor, reach the nose or even leave the metal. While smells usually appear to be diffused with great velocity, experiments prove that when the space through which they have to pass is free from draughts their progress is very slow, and it would therefore appear that the passage of a smell is far more due to the actual motion of the air containing it than to the diffusion of the odoriferous substance through the air." The power of a smell to cling to a substance does not appear to depend on its intensity or on the ease with which it travels through a closed space. Experiments to determine whether smells could pass through glass by transpiration either revealed flaws in the glass or ended in the breaking of the very thin bulbs and gave no answer.

The Cordillera Region of Canada.—A length of nearly thirteen hundred miles of the great mountainous or Cordillera region of the Pacific coast is included in the western part of Canada. Most of this, Mr. George M. Dawson says, in a paper on the Physical Geography and Geology of Canada, is embraced in the province of British Columbia, where it is about four hundred miles wide between the Great Plains and the Pacific Ocean. To the north it is included in the Yukon district of the Northwest Territory till it reaches, in a less elevated and more widely spread form, [284] the shores of the Arctic Ocean on one side and on the other passes across the one hundred and forty-first meridian of west longitude into Alaska. The orographic features of this region are very complicated in detail. No existing map yet properly represents even the principal physical outlines, and the impression gained by the traveler or explorer may well be one of confusion. There are, however, the two dominant mountain systems of the Rocky Mountains and the Coast Range. As a whole, the area of the Cordillera in Canada may be described as forest-clad, but the growth of trees is more luxuriant on the western slopes of each of the dominant mountain ranges, in correspondence with the greater precipitation occurring on these slopes. This is particularly the case in the coast region and on the seaward side of the Coast Range, where magnificent and dense forests of coniferous trees occupy almost the whole available surface. The interior plateau, however, constitutes the southern part of a notably dry belt, and includes wide stretches of open grass-covered hills and valleys, forming excellent cattle ranges. Farther north, along the same belt, similar open country appears intermittently, but the forest invades the greater part of the region. It is only toward the arctic coast, in relatively very high latitude, that the barren arctic tundra country begins, which, sweeping in wider development to the westward, occupies most of the interior of Alaska. With certain exceptions the farming land of British Columbia is confined to the valleys and tracts below three thousand feet, by reason of the summer frosts occurring at greater heights. There is, however, a considerable area of such land in the aggregate, with a soil generally of great fertility. In the southern valleys of the interior irrigation is necessary for the growth of crops.

The "Rabies" Bacillus.—Ever since the discovery of Pasteur that an attenuated virus made from the medulla or spinal cord of a dog affected by rabies was, when administered in graduated doses, a specific against the disease, bacteriologists have been eagerly seeking to isolate the

rabies bacillus. A number of observers, among them Toll, Rivolta, and San Felice, have succeeded in staining a bacillus which they claimed to be that of rabies. Memno, of Rome, confirmed the observations of the preceding, and proved the virulent character of the micro-organism, which he described as a blastomycete. He has quite recently succeeded in cultivating the bacillus in artificial media and producing typical rabies in dogs, rodents, and birds by inoculations. He found that the bacillus grew better in fluid than in solid media, the best being bouillon with glucose slightly acidulated with tartaric acid. The growth did not become manifest under a week, and was easily arrested by "air infection." It would thus seem that we have at last certainly established the bacterial origin of rabies.

The St. Kildans.—St. Kilda, the farthest out to sea of all the British Isles, is a rounded mountain with "stack rocks" and islets round it, rises twelve hundred and twenty feet in height, and contains a settlement of about seventy-five men, women, and children—almost the only representatives left on the British Islands of man in the hunting age. On one of the subsidiary islands, Boreray, is gathered the main body of the sea birds for which the island is famous; and on a third, Soa, are the diminutive descendants of Viking sheep, left by old sea rovers. Mr. R. Kearton, who has recently visited the islands for recreation among the sea birds, represents that in the little community of its people the ordinary and extraordinary operations of life seem inverted. Sport is a serious work; sheep herding and shearing are an exciting sport. A St. Kildan qualifies for marriage by proving his courage and skill as a fowler, by standing on a dizzy precipice called Lover's Stone, and goes out bird snaring with a serious face. When he wants a sheep for the butcher, he asks his friends to a sheep hunt in the island of Soa, in which dogs and men pursue the animals from rock to rock. An offer made by a factor to supply the people with nets, so that they might catch the sheep with more humanity and less waste of life, was rejected by them. They preferred the old methods, which supplied plenty of danger and excitement. While the sheep are hunted, the cows are thoroughly spoiled. Every day the women are seen hard at work picking dock leaves and storing them in baskets for the cows at milking time, for they will [285] not be milked unless they are fed. The sheep on Soa Island are plucked instead of being sheared, at the time when the wool would naturally be shed, and what wool will not come off in this way is cut off with a pocket knife. When the steamer with Mr. Kearton reached the island, no one came down to meet it till the whistle had been blown two or three times. "It was not etiquette to rush down like a parcel of savages," but the people "retire to tidy themselves, and then row out and call in proper form."

The Island of Sakhalin.—Mr. Benjamin Howard, an English visitor at the recent meeting of the American Association for the Advancement of Science, presented before Section E of that body an interesting account of the great but little-known island of Sakhalin, more generally spelled Saghalien in our geographies. Mr. Howard, however, strongly urged the former spelling, as most correctly representing the name, which is always pronounced by the Russians in three syllables, with the accent on the first. It is now used as a penal colony by the Russian Government, and a more hopelessly remote and inaccessible spot for such a purpose can hardly be found. To it are sent the hardest cases among the Siberian prisoners; and Mr. Howard spoke of becoming accustomed, during his stay there, to meeting scarcely any human beings but murderers, except, of course, the guards and officials. The island is extremely inaccessible; there is no commerce, and neither inducement nor opportunity for vessels to touch there, while much of the coast is ice-bound for a large part of the year. Mr. Howard, who was engaged in some scientific work on the island in the service of the Government, is one of the very few foreigners who have traveled or resided there at all. He predicts for Sakhalin, however, a future of considerable importance ultimately, though only after a long period of preliminary development and exploitation as a penal colony, which stage has but lately been begun. It has forest and mining resources—among the latter, coal; the deposits are near the surface, but thus far have been very little examined. He was unable to give any data as to their geological age or actual extent; but the Government will no doubt soon make investigations. The most remarkable possibilities, however, are in the line of fisheries, the coasts swarming with fish to an extent that is scarcely credible by one who has not seen them. Mr. Howard said jocosely that he would hardly dare to relate what he had personally witnessed, in view of the usual reputation of "fish stories." The climate is of course rigorous, under the influence of cold northern currents, and markedly in contrast with that of the same latitude on the American side of the Pacific, where the Japan current carries its modifying influence as the Gulf Stream does to northern Europe. Some agriculture, however, is possible during the short summer, and the penal colonists have made fair beginnings of self-support. He referred further to a remnant of native Aino population as very interesting from the fact that they have preserved their peculiarities of life and manners, and their purity of stock, much more completely through their isolation than the Ainos of the Japanese Islands, who have been modified more or less by association with the latter people.

Technical and Popular Names.—In a paper criticising the multiplication of local names in geology, Prof. C. E. Keyes distinguishes between names devised with a conscientious desire to better the condition of a science by clothing the new ideas with simple words and those which are the product of a name-making mania. "The first can not be too highly commended, nor the second too deeply deplored." Every progressive science must discard the names that have served their purpose, and must be prepared to receive all of the new ones demanded. The sciences have each two phases, for each of which a terminology is demanded, in one of which the names must be technical and special, established primarily for the investigator, and in the other general, popular, simple, and free from technical appearance; but the distinction is rarely made. Those who object to the prevalence of technical names in other sciences seldom reflect that they have them in their own art. Yet if a man of science should desire to familiarize himself with the

artisan's work, "he would be, after five minutes' talk with a machinist or electrician, confronted by so many unfamiliar terms—technical terms of everyday use—that he would at once cry out for greater simplicity of language." In the geological sciences the technicalities play the same part they do in the arts and in business. Every new name in geology, however, must be properly defined before it can be noticed, and its subsequent career will depend on its utility. It may be said that no greater boon to the working geologist has been devised than the plan of designating geographically geological units irrespective of exact position or age. Since its adoption a vast mass of valuable information has been obtained that was previously unthought of, and is in a shape to be always used; the other departments of geology have been much aided, and stratigraphical geology has been greatly helped. [286]

The Origin of a Curious Habit.—The following paragraphs are taken from a recent Nature. It is well known that the kea, or mountain parrot of New Zealand, has acquired the habit of attacking sheep, and making holes by means of its sharp and powerful beak in the backs of these animals for the purpose of abstracting the kidney fat, which appears to be esteemed as a luxurious diet. It is supposed that this peculiar habit or instinct was developed by the bird getting the fat from the skins of sheep that had been slaughtered, but this solution is not very satisfactory, as there appears nothing to connect the fat on the skins of sheep with the live animals. In a note published in the Zoölogist (May 16th), Mr. F. R. Godfrey, writing from Melbourne, offers the following solution of the mystery, which seemed to him to be simple and satisfactory, and more rational than the sheepskin theory: In the hilly districts of the middle island of New Zealand there is a great abundance of a white moss, or lichen, which exactly resembles a lump of white wool, at the roots of which are found small white fatty substances, supposed by some to be the seeds of the plant, and by others to be a grub or maggot which infests it, which is the favorite food of the kea. Probably the bird, misled by this resemblance, commenced an exploration in sheep, and this proving satisfactory, originated the new habit. In a note to this suggestion the editor points out that Mr. Godfrey is in agreement with another observer—Mr. F. R. Chapman—who in describing the hills of this island says: "A very interesting *raoulia*, or vegetable sheep, was very plentiful on steep, rocky places.... It is said that the keas tear them up with their powerful beaks, and that these birds learned to eat mutton through mistaking dead sheep for masses of *raoulia*."

Changes in Plant Characters.—From experiments upon the cultural evolution of *Cyclamen latifolium*, W. T. Thiselton Dyer finds that, when once specific stability has been broken down in a plant, morphological changes of great variety and magnitude can be brought about in a comparatively short space of time. It appears that though sudden variations do occur, they are, as far as we know, slight as long as self-fertilization is adhered to. The striking results obtained by cultivators have been due to the patient accumulation by selection of gradual but continuous variation in any desired direction. The size which any variable organ can reach does not appear to be governed by any principle of correlation. Large flowers are not necessarily accompanied by large leaves. The general tendency of a plant varying freely under artificial conditions seems to be atavistic—or to shed adaptive modifications which have ceased to be useful, and to revert to a more generalized type, or to reproduce characters which are already present in other members of the same group. But this statement must be accepted with caution. The most remarkable phenomenon in the cultivation of the *Cyclamen* is the development of a plume or crest on the inner surface of each corolla segment. This shows that the plant still possesses the power to strike out a new line and to develop characters which would even be regarded as having specific value.

Hanging an Elephant.—One of the elephants in Barnum and Bailey's show, having repeatedly shown signs of insubordination and bad temper, it was finally decided to kill him. From a note in Nature we get the following account of his execution: After considerable discussion it was decided to strangle him. A new Manila rope was loosely wound three times around his neck, and his legs, fully stridden, were securely chained each to a post firmly driven into the ground [287] alongside each limb. The animal was intentionally not isolated from his fellows, as it was feared that if placed by itself it would become restive and ill-tempered. The rope surrounding the beast's neck had one end secured to three strong pillars in the ground, some distance away and slightly in advance of the fore feet; and the other, which terminated in a loop, was hooked to a double series of pulleys, to the tackle of which ninety men were attached. When all was ready, the slack was gently, quietly, and without any apparent annoyance to the elephant—which kept on eating hay—taken in till the coils round its neck were just taut. The word was then given, "Walk away with the rope." Amid perfect silence the ninety men walked away, without apparently any effort. So noiselessly and easily did everything work that, unless with foreknowledge of what was going to take place, one might have been present without realizing what the march of these men meant. The elephant gave no sign of discomfort either by trunk or tail. Its fellows standing close by looked on in pachydermatous unconcern, and at the end of exactly thirty seconds it slowly collapsed and lay down as if of its own accord. There was absolutely no struggle and no motion, violent or otherwise, in any part of the body, nor the slightest indication of pain. In a few seconds more there was no response obtained by touching the eyeball. At the end of thirteen minutes after the order to "walk away" the eye had become rigid and dim. That no more humane, painless, and rapid method of taking the life of a large animal could be devised was the opinion of all the experts who witnessed the execution.

MINOR PARAGRAPHS.

Count Gleichen relates, in his story of the mission to Menelek, that besides the Maria Theresa

1780 dollars, the people of Abyssinia, for small change, use a bar of hard crystallized salt, about ten inches long and two inches and a half broad and thick, slightly tapered toward the end, five of which go to the dollar at the capital. People are very particular about the standard of fineness of the currency. "If it does not ring like metal when flicked with the finger nail, or if it is cracked or chipped, they won't take it. It is a token of affection also, when friends meet, to give each other a lick of their respective *amolis*, and in this way the material value of the bar is also decreased. For still smaller change cartridges are used, of which three go to one salt. It does not matter what sort they are. Some sharpers use their cartridges in the ordinary way, and then put in some dust and a dummy bullet to make up the difference, or else they take out the powder and put the bullet in again, so that possibly in the next action the unhappy seller will find that he has only miss-fires in his belt; but this is such a common fraud that no one takes any notice of it, and a bad cartridge seems to serve as readily as a good one."

A study of problems in the Psychology of Reading, by J. O. Quantz, bore upon the questions of the factors which make a rapid reader, the relations of rapidity to mental capacity and alertness, quickness of visual perception, and amount of practice; and whether those who gain their knowledge principally through the eye or through the ear obtain and retain most from reading. The author finds that colors are more easily perceived than geometrical forms, isolated words than colors, and words in construction than disconnected words; that persons of visual type are slightly more rapid readers than those of the auditory type; that rapid readers, besides doing their work in less time, do superior work, retaining more of the substance of what is read and heard than do slow readers. Lip movement is a serious hindrance to speed, and consequently to intelligence, of reading. The disadvantage extends to reading aloud. Apart from external conditions, such as time of day, physical fatigue, etc., some of the influences contributing to rapidity of reading are largely physiological, as visual perception; others are of mental endowment, as alertness of mind; still others are matters of intellectual equipment rather than intellectual ability, as extent of reading and scholarly attainment.

Mr. Merton L. Miller, of the University of Chicago, says, in his preliminary study of the Pueblo of Taos, New Mexico, that he was hampered in his researches there by a circumstance that [288] illustrates very well certain characteristics of the Indian. About fifteen years ago representatives of the Government were at Sia making investigations, and had to ask many questions. Some time after they went away there was much sickness in the pueblo, and many people died. It occurred to the Sia people that the presence of those white men, asking so many questions, was the cause of all their trouble; so they sent men to the other pueblos to warn them against white men who came to find out about their customs and beliefs. These messengers also came to Taos, and the people remembered their warning well. If a Taos Indian is caught now teaching the language or telling any of the traditions to a white man, he is liable to a whipping and a fine. This, Mr. Miller believes, accounts for the fact that he could rarely learn anything from his friend when they were at the pueblo, although when away in the mountains he became much more open and communicative.

NOTES.

The cigarette has found friends. The Truth about Cigarettes embodies the substance of papers read and discussed at the Medico-legal Society of New York. The gist of the papers is to the effect that the stories of harm done by cigarettes are fictions or gross exaggerations; that they contain no opium, arsenic, or other poisons, but are the best pure tobacco (1.0926 grammes each) wrapped in pure paper (0.038 gramme); that they never caused a case of insanity; and that they are simply injurious in the same way and to a corresponding extent as other forms of tobacco. These statements are supported by certificates of physicians and by reviews of special cases of insanity charged to cigarettes, showing that the insanity had matured independently of them.

The average annual temperature at Manila is given by Mr. W. F. R. Phillips, in a paper on the subject, as 80° F. April, May, and June are the hottest months, May being the hottest of the three, and December and January are the coolest. The highest thermometer reading recorded is 100° F. in May, and the lowest 74° in January. The average annual rainfall is 75.43 inches, more than 80 per cent of which descends in the months from June to October, inclusive. Departures from the average rainfall are sometimes excessive. For example, as much as 120.98 inches have fallen in one year, and as little as 35.65 inches in another. Still more remarkable were the fall of 61.43 inches in one September, and that of only two inches in another September.

At the observatory of Yale University, as we learn from the annual report, a planned series of twelve measures each has been completed for eighty-four stars of large, proper motion, with a view to determinations of parallax, and it is expected shortly to bring the number up to one hundred. A series of measures on highly colored red stars has been begun, and is in progress for the purpose of testing the possibility of a systematic error due to the lesser refrangibility of their light. The photographic instrument has been put into use at every suitable period of meteorological displays of consequence. Preparations are already making for a more complete observation of the Leonid meteoric shower expected in 1899.

The New York State College of Forestry, in connection with Cornell University, was presented by Professor Fernow, at the Boston meeting of the American Association, as a logical sequence to the policy to which the State of New York was committed in 1885 by the purchase of more than a million acres of forest land in the Adirondack Mountains, to be gradually increased to three million acres. A demonstration area of thirty thousand acres in the Adirondacks has since been

provided for it. The courses leading to the degree of Bachelor in Forestry occupy four years, of which the first two are devoted to the studies in which mathematics, physics, chemistry, geology, botany, entomology, political economy, etc., figure as fundamental and supplementary sciences, in addition to the professional courses; besides which two courses of a more or less popular character are contemplated.

The discovery is announced in a preliminary communication by Dr. Issutschenko, of Russia, of a microbe pathogenic to rats. An epidemic having broken out among the rats kept for experimental purposes in the Government Agricultural Laboratory, a bacillus was isolated from the liver and spleen of affected animals that proved excessively fatal to rats and mice. Experiments in making the organism useful as a living rat poison have not yet, however, had an encouraging success.

New Zealand has just definitely adopted a scheme of old-age pensions. In future the New Zealand workingman of sixty-five years of age, who has lived a life of honest toil, will be assured an income of one pound a week.

The Wilde prize of the French Academy of Sciences has been awarded by that body to Charles A. Schott, chief of the Computation Division of the United States Coast and Geodetic Survey, for his work on Terrestrial Magnetism.

FOOTNOTES:

[1] In the preparation of this article I have to acknowledge the courtesy of Mr. Joseph Jacobs, of London, whose works in this line are accepted as an authority. In its illustration I have derived invaluable assistance from Dr. S. Weissenberg, of Elizabethgrad, Russia, and Dr. L. Bertholon, of Tunis. Both these gentlemen have loaned me a large number of original photographs of types from their respective countries. Dr. Bertholon has also taken several especially for use in this way. The more general works upon which we have relied are: R. Andree, Zur Volkskunde der Juden, Bielefeld, 1881; A. Leroy-Beaulieu, Les Juifs et l'antisémitisme, Paris, 3e éd. 1893; and C. Lombroso, Gli Antisemitismo, Torino, 1894. For all other authorities to whom reference is made by name and year, consult our comprehensive Bibliography of the Anthropology and Ethnology of Europe, in a forthcoming Special Bulletin of the Boston Public Library. In its index under "Jews" and "Semites" will be found an exhaustive list of authorities given chronologically.

[2] Andree, 1881, pp. 194 *et seq.*, with tables appended; Jacobs, 1886 a, p. 24; and quite recently A. Leroy-Beaulieu, 1893, chapter i, are best on this. Tschubinsky, 1877, gives much detail at first hand on western Russia. In the Seventeenth Annual Report of the Anglo-Jewish Association, London, 1888, is a convenient census, together with a map of distribution for Europe. On America, no official data of any kind exist. The censuses have never attempted an enumeration of the Jews. Schimmer's results from the census of 1880 in Austria-Hungary are given in Statistische Monatsschrift, vii, p. 489 *et seq.*

[3] This is clearly shown by Schimmer in Statistische Monatsschrift, vii, pp. 489 *et seq.*

[4] See also map in Kettler, 1880.

[5] J. C. Majer (1862) ascribes the shortness of stature in Furth to this Jewish influence.

[6] 1892.

[7] 1895, p. 577.

[8] 1891.

[9] Glück, 1896; and Weisbach, 1877 and 1895 a.

[10] Majer and Kopernicki, 1877, p. 36, for Ruthenia; Stieda, 1883, p. 70; Anutchin, 1889, p. 114, etc.

[11] Zakrezewski, 1891, p. 38. In the October Monthly our stature map of all Russia brings out the contrast very strongly.

[12] Centralblatt für Anthropologie, iii, p. 66. Uke, cited by Andree, 1881, p. 32, agrees.

[13] Popular Science Monthly, vol. li, p. 20 *et seq.* (May, 1897), and vol. lii, p. 602 (March, 1898).

[14] Jacobs, 1889, p. 81.

[15] Talko-Hryncewicz, 1892, pp. 7 and 58.

[16] Collignon, 1887 a, pp. 211 and 326; and Bertholon, 1892, p. 41.

[17] Jacobs, 1891, p. 50, shows it to be less common in other parts of Europe. In the United States, Dr. Billings finds the marriage rate to be only 7.4 per 1,000—about one third that of the Northeastern States.

[18] 1877, p. 59.

[19] 1883, p. 71.

[20] 1889, p. 84.

[21] 1896, p. 591.

[22] 1895, p. 374.

[23] On Jewish demography, consult the special appendix in Lombroso, 1874; Andree, 1881, p. 70; Jacobs, 1891, p. 49. Dr. Billings, in Eleventh United States Census, 1890, Bulletin No. 19, gives data for our country. On pathology, see Buschan, 1895.

[24] The Jew as a Life Risk. The Spectator (an actuarial journal) 1895, pp. 222-224, and 233, 234. Lagneau, 1861, p. 411, speaks of a viability in Algeria even lower than that of the natives.

[25] From a lecture delivered at the Field Columbian Museum, November 13, 1897.

[26] Löwenstimm's studies, printed originally in the Journal of the Ministry of Justice in St. Petersburg, have been made accessible to a larger class of readers by being collected and translated into German in a volume entitled Aberglaube und Strafrecht (Berlin: Räde, 1897), with an introduction by Prof. Joseph Kohler, of the University of Berlin.

[27] As the Siberian Railway approached the northern boundaries of the Chinese Empire and surveys were made for its extension through Manchuria to the sea, great excitement was produced in Pekin by the rumor that the Russian minister had applied to the Empress of China for two thousand children to be buried in the roadbed under the rails in order to strengthen it. Some years ago, in rebuilding a large bridge, which had been swept away several times by inundations in the Yarkand, eight children, purchased from poor people at a high price, were immured alive in the foundations. As the new bridge was firmly constructed out of excellent materials, it has hitherto withstood the force of the strongest floods, a result which the Chinese attribute, not to the solid masonry, but to the propitiation of the river god by an offering of infants.

[28] See the case of Bridget Cleary, reported in Appletons' Popular Science Monthly for November, 1895, p. 86. We may add that her husband, Michael Cleary, was tried for murder and sentenced to twenty years' penal servitude.

[29] General Code, vol. xiii, edition of 1892, cited by Löwenstimm.

[30] A full account of the trial is given in a Latin manuscript preserved in the city archives of Nantes.

[31] Dr. Samuel Aughey, Physical Geography of Nebraska, 1880. Prof. J. E. Todd, Science, April 23, 1886, and January 8, 1897. E. H. Barbour, Publication No. V, Nebraska Academy of Sciences. J. A. Udden, The American Geologist, June, 1891, and April, 1893. R. D. Salisbury, Science, December 4, 1896. G. P. Merril, Proceedings of the United States National Museum, 1885.

[32] Medical Times and Gazette, London, England, November 17, 1883.

[33] Whewell also had "the scalp and skull thick." Brain weighed 49 ounces. The Lancet, London, England, March 17, 1866, p. 280.

[34] Medical Times and Gazette, London, England, May 12, 1883, p. 525.

[35] London Medical Gazette, London, England, September 13, 1828, p. 478.

[36] Brain Weight of Man. By Dr. Bischoff. Bonn, Germany, 1880, p. 137.

[37] Authority for this weight is the Medical Army Museum, Washington,D. C.

[38] This brain is kept in and its weight is recorded on the glass jar in the Pathological Museum at Munich, Germany.

[39] Idiocy and Imbecility. By Dr. Ireland. London, 1877, p. 75.

[40] The Human Species. By A. De Quatrefages. D. Appleton and Company, New York, 1884, p. 380.

[41] Dr. Gall's works, Boston, Massachusetts, vol. i, p. 36.

[42] Life of George Combe, London, 1878, vol. ii, p. 381.

[43] Medical News and Gazette, London, June 16, 1888, p. 521.

[44] Morning Herald, Sydney, Australia, February 23, 1884.

[45] Eleven Chinamen, found by Dr. C. Clapham to afford an average of 50.4 ounces, had been killed in a typhoon, and were therefore in no wise wasted by disease. (Journal of the Anthropological Institute, London, England, vol. vii, p. 90.)

[46] The Nervous System, London, 1834, p. 447.

[47] Anatomie comparative du système nerveux, tome i, 1839, p. 506.

[48] Ueber die typischen Verschiedenheiten der Windungen der Hemisphären und über die Lehre vom Hirngewicht, Göttingen, 1860. Also see Pathology and Therapeutics of Mental Diseases, London, 1870, p. 23.

[49] History of Philosophy, London, 1867, vol. ii, p. 433.

[50] The Brain as an Organ of Mind, London, 1880, pp. 276, 277.

[51] Nachrichten, Göttingen, February 29, 1860, p. 75.

[52] Carpenter's Principles of Human Physiology, London, 1881, p. 659.

[53] Edinburgh Medical and Surgical Journal, 1853, vol. lxxix, p. 360.

[54] Idiocy and Imbecility, London, 1877, pp. 216-219.

[55] See The Brain as an Organ of Mind, London, 1880, p. 465; also, The Human Brain,

London, 1847, pp. 288, 289.

[56] Eclectic Magazine, December 14, 1863, p. 428.

[57] From an address before the Société des Amis des Sciences.

[58] Vol. xlvii, September, 1895.

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[66] The Mammalian Anatomy of the Cat. By Horace Jayne, M. D. Philadelphia: J. B. Lippincott Company. Illustrated. Pp. 816. Price, $5.00.

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