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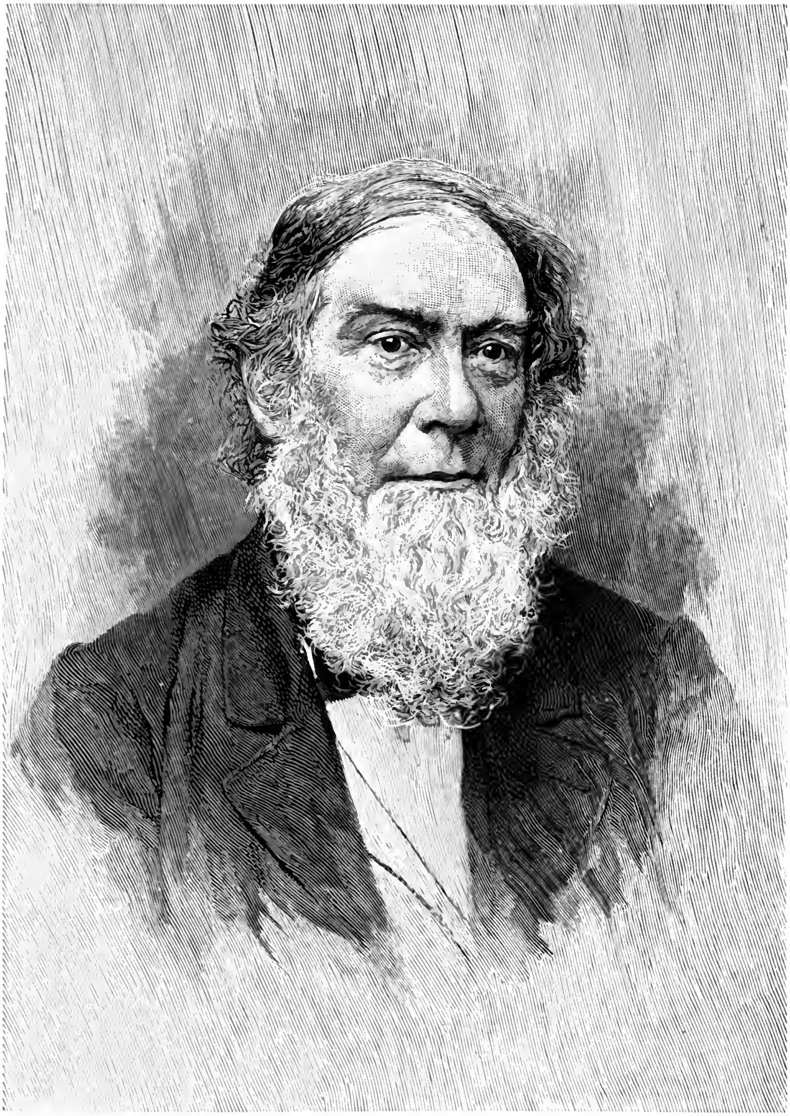

ALEXANDER DALLAS BACHE.

THE

POPULAR SCIENCE

MONTHLY.

NOVEMBER, 1895.

PRINCIPLES OF TAXATION.

By DAVID A. WELLS.

"*The principles of good government are far from easy to learn accurately; and very much harder to put in practice.*"—F. B. Sanborn.

INTRODUCTION.

It is the purpose of the writer in the chapters which follow, to discuss the principles of taxation from a broader basis and by different methods than have heretofore been attempted, special consideration being given to the experience of the United States.

Such a discussion primarily involves the inquiry, of how far the varied and curious experience of nations leads up through what may be regarded as a process of evolution, to a recognition of the underlying and essential principles of a just and at the same time an efficient system of taxation. And it also necessitates, for the attainment of correct conclusions in the prosecution of such inquiry, that illustrations drawn from the world's great record of experience should take precedence of theory, especially in the way of example and exhibit of the many abuses of the power of taxation which the ignorance of legislators and the cupidity of designing men have inflicted upon nations.

The subject is one of transcendent importance, perhaps more universally important than any other that can invite public attention. Its discussion opens questions of the widest possible range. There can be no civilization without government and no government without an adequate supply of revenue obtained from the persons and property of the people governed. There can be no health in the body politic without sound finance, and no sound finance without a sound system of taxation. In fact, taxation is to our body politic what blood is to the body physical: if healthy, infusing life and warmth; but if unhealthy, the agent for producing discontent, decrepitude, and paralysis.

The absence or existence of limitations on the power of a government to make compulsory levies on the property or persons of its people for its use or support, constitutes the dividing line between a despotism and a free government—a fact most pertinent to legal, economic, and societary studies which has attracted little attention.

The methods and scope of what is called taxation regulate more than all other agencies the distribution of wealth, which is really the great question of the future to all nations. Ever since Adam Smith wrote his paramount work on the Wealth of Nations the political economists and students of social science have concerned themselves mainly with the production of wealth. That problem has been practically solved. Wealth is now produced with a rapidity that the world had never before supposed possible,* and the laws governing its production have become well understood by those who have made a special study of the subject. An inevitable result of this condition of affairs has been, that wealth produced under the greater control that man in general has obtained over the forces of Nature has aggregated itself, as it always will, in the hands of those whose faculties especially qualify them to obtain and manage it, and who, in common parlance, have received the name of "*money-getters.*" These have become enormously rich, while the masses, whose material condition is also absolutely much better than at any former period of the world's history, are, however, relatively poorer. Improved facilities for transportation have greatly facilitated intercommunication,† and the opportunity thus afforded for the observation of extreme contrasts in individual conditions has operated as a very great factor in occasioning discontent among the masses, who by reason of the

* Recent investigations indicate that the absolute effective force available to the American people for the production of wealth is more than three times greater at the present time than it was in 1860. The outflow of British capital for investment in foreign securities and negotiated in London alone, during the eight years next previous to 1890, has been estimated by those best qualified to express an opinion, to have amounted to the large sum of nearly or quite $700,000,000 per annum. And this estimate does not comprise all the British capital loaned to foreign countries, but only such as was subject to public cognizance.

† The number of people annually transported on the railroads alone in the United States exceeds many times the total population of the country, the annual number for the New England States being more than sixteen times greater than their population. The widening of the sphere of one's surroundings, and a larger acquaintance with other men and pursuits, have long been recognized as not productive of content. Writing to his nephew more than one hundred years ago, Thomas Jefferson thus concisely expressed the results of his own observation: "Traveling," he says, "makes men wiser, but less happy. When men of sober age

never as yet fully tested experiment of universal suffrage, have become, at least theoretically in the United States, the sole arbiters of the policy of their Government and of the selection of the legislators who are to enact laws in conformity with such policy.*

The problem of the acquisition of wealth having thus been solved, that of the proper distribution of wealth logically and necessarily follows, and the character of the measures which directly or indirectly involve what is called taxation for the attainment of such result, which seem to commend themselves to the people of the United States, are especially worthy of attention. They are indicated in part by the adoption of a pension system unlike anything of the kind ever known in history, and which necessitates an annual expenditure of money (raised by taxation) to meet the military expenses of the country—army, navy, and pensions—in excess of that entailed by the immense military establishment of any of the countries of Europe, and the enactment of an income-tax statute whose primary object was not to raise revenue for the support of the Government, but an unmistakably political and socialistic measure, which threatened to annul the most important and exceptional feature of the Federal Constitution.

That the diminishing rate of returns, in way of interest or profits, by the force of laws which no combination of capital can resist, is seriously impairing the relative value of wealth, and may eventually reach a minimum which will greatly diminish the inducement to individuals to economize or save it, although not generally recognized or appreciated, can not be denied. And neither is it recognized that the current rate of taxation on capital in all civilized countries even now approximates, and to an extent actually exceeds, the current rates of interest or profit on its use. Thus, for example, the rate of discount at the Bank of England during the greater portion of the years 1894 and 1895 has not been in excess of two per cent, and the discount (borrowing) rate for three months during this period was not infrequently less than a rate of three quarters per cent per annum. If taxes, according to popular theory, do not diffuse themselves, but remain a burden on the person, business, and property subject to their

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travel they gather knowledge, but they are, after all, subject to recollections mixed with regret; their affections are weakened by being extended over more objects, and they learn new habits which can not be gratified when they return home."

* "The great, the unanswerable argument in favor of universal suffrage is, not that it insures a better or purer government, but that all must be contented with a government in which all have an equal voice. If it be deficient in this particular, if it fail to protect the poor against the oppression of the rich, or the rich against a destruction of their property by the poor, it is *pro tanto* a failure, and another method of representation should be adopted."—*Address of Justice Brown, United States Supreme Court, before the Law Department of Yale University, July, 1895.*

first incidence, there is a problem likely to come at no distant day before tax legislators, which up to the present time they have hardly thought of, and which is certain under a free government to be solved by human nature rather than by statute.*

The scope and methods of raising revenue for the support of a State are also some of the greatest, if not the very greatest, determining factors of the morality of a people. "I insist," said an eminent lawyer and member of the Constitutional Convention of the State of New York in 1868, "that a people can not prosper whose officers work and tell lies. There is not an assessment roll now made out in this State that does not both tell and work lies." And no member of the convention, or any representative of the press, either then or subsequently, has challenged the assertion. The extent also to which the existing system of taxation in the United States has obliterated the sense of honesty in its people in their individual dealings with the Government, removed all repugnance to the act of perjury, and caused each one to justify himself to his conscience for making a false return in the matter of taxes, by the supposition that every one is doing the same, is also strikingly illustrated by the circumstance, that a high court in one of the States of the Federal Union has recently decided that "perjury in connection with a man's tax lists does not affect his general credibility under oath."

The idea that the proper relation of a State to its people is essentially of a paternal nature finds much of popular approval, and is without doubt popularly desired. Accepting this idea as correct, let us exemplify it in its application to the State. Suppose a father in dealing with his family, placed, so far as his children are concerned, a premium on lying and concealment, and vested with a heavy penalty all truthfulness and straightfor-

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* M. Léon Say, the distinguished French economist, in a recent discussion of the income tax, asserts that the public and private financial history of France has been one of incessant abolition of private and state debts, and in substantiation of such a conclusion he shows that if a capital of 8,330 francs had been invested in national debt obligations of France in 1522 and allowed to remain subject to the various changes in respect to capital and interest which the financial policy of the state has necessitated and required under its successive governments, the present value of the investment to the legitimate heirs of the first investor would be but 83 francs.

The reduction of annual income to the holders of the national debts of Europe, contingent on the refunding of the same during the year 1894, is estimated at $24,000,000, requiring an addition of $960,000,000, with an earning capacity of two and a half per cent per annum, to the total of what is called capital, to make up for the subtraction of income from the individual holders of such securities in the previous year. In the United States the shrinkage in the amount of annual dividends paid on the capital stock of its railroads between the years 1892 and 1894 is reported as in excess of $14,000,000, and in the annual interest on bonds during the same period at $13,000,000, or a total greater than the losses contingent on the whole refunding operations of the states of Europe during 1894.

ward dealing, he would be regarded as a worthy inmate for the States prison. But this is exactly what the Government of the United States does, or proposed to do, in the case of many of its so-called tax statutes. Thus in the recent income-tax statute it offered to its citizens considerations in money if they would forswear themselves, or practice deception; and it imposed a direct and heavy fine on those who were conscientious and truthful. Again, when the Government imposes a tax of more than a thousand per cent in excess of the prime cost of the article taxed, as it did in 1864 in the case of distilled spirits (whiskey), it offered a premium for the perpetration of fraud that human nature as ordinarily constituted could not resist. Could any course of action, if deliberately intended, be more demoralizing to a people? Do not these experiences go far in support of the theory that if a people desire to have a paternal government it would be wise to choose a despotic form, inasmuch as all experience has shown that a republican or popular form of government is least fitted for such work? Give democracy a firm hold of the reins of government, and it is no easy matter, as the French Revolution of 1789 and the present fiscal condition of France exemplify, to restrain its excesses.

It should not furthermore be overlooked that that class of the community to whom the questions of morality and religion are especially intrusted, rarely, if ever, give this subject of taxation any attention. If any sermon has ever been preached in this country by any clergyman of any denomination on the moral and religious results of a defective system of taxation, the writer has never heard of it. One reason and apology for such conduct may be found in the circumstance that intelligent and reliable expositions of this subject are not readily accessible. Indifference or antagonism to the study of taxation is not, however, confined to the clergy. Minds trained in the law are not necessarily, and indeed rarely, trained thereby to esteem or intelligently discuss economic subjects. One of the most eminent members of the American bar recently remarked to the writer that, grant whatever measure of importance we may to economic principles and interests, they have no place in the legal profession, the business of which was, not to make or amend laws as expressed in enactments, but to interpret and determine their application. Hence the popularity at the American bar of the legal maxim *stare decisis*, which may be interpreted to mean, follow precedents, and do not attempt to invalidate the reasons and conclusions of the lawmakers. Such a theory and rule of practice would, however, close the door on reason and truth, and constitute an almost insuperable barrier to all social progress. If Lord Mansfield, when the negro slave Somerset came before him with a demand that he be given his freedom, had followed precedents, he would have denied the application, for such precedents were opposed to it. But recognizing the change which an advanced civilization had effected in the government of the English people, and that the slave was held, to quote his language, "in virtue of positive law" (precedent), "which preserves its force long after the reasons and occasions from whence it was created are erased from memory," he granted the application; and incorporated into the policy of the English Government the principle of which the British people have ever since been proud—that no person can continue to be a slave after he has planted his foot on English soil.

Other obstacles, at present almost insuperable, in the way of establishing a correct system of taxation, are that the subject is not properly taught, if taught at all, in the higher institutions of learning of the United States and Great Britain; that up to the present time there is rarely if ever given a correct and scientific definition of the terms "tax" and "taxation," which makes it somewhat doubtful if those who talk about their meaning and incidents know what they are talking about; that there are no text-books on the subject generally accepted as authoritative; that there is no clear and settled understanding even as to what constitutes the main subject of taxation—namely, property; that the meaning of terms which have formed the basis of statutes and legal practice is entirely different in the United States and other leading civilized nations; and that, as a rule, professors of economic science in the United States have failed to recognize in their reasoning and teachings of this whole subject, that the Government of the United States, both Federal and State, differs in many respects, both in theory and practice, from any other government that has heretofore existed; and that therefore ideas and experiences which are regarded as the basis of sound policy in respect to taxation in the former are not accepted as such in the latter. Thus the United States, alone of the great nations of the world, regards debts and credits as property rightfully subject to taxation. The United States is also the only nation in which the taxation of exports is forbidden both to Federal and State governments under any circumstances. To no other government, furthermore, than that of the United States is applicable the following principle enunciated by the United States Supreme Court (116 United States Reports, p. 631) respecting the assessment and collection of taxes: "Any compulsory discovery, by extorting the party's oath, or compelling the production of his private books and papers to convict him of a crime or to forfeit his property, is contrary to the principles of a free government. It is abhorrent to the instincts of an American. It may suit the purposes of despotic power, but it can not abide the pure atmosphere of political liberty and personal freedom." If this principle was recognized as the higher law in European states, it would be safe to say that the revenue collected from their income taxes would be exceedingly small.

It is also a very curious circumstance that an existing system of municipal or local taxation, which has proved itself to be most intelligent, satisfactory, and efficient for revenue, and most worthy of being studied as a model for adoption, has as yet almost entirely failed of recognition or consideration by any of the recent writers on taxation or authorities on general economic subjects on either side of the Atlantic.

Again, ignorance or willful disregard of the true principles of taxation in the United States has powerfully contributed to foster the idea among its people that they should look to Government for their support, rather than that the people should support the Government. The practical incorporation of this idea into the fiscal policy of the Government has enabled a comparatively few persons to accumulate vast fortunes, has built up class distinctions, promoted popular discontent, and established a precedent for state socialism. Figs, however, can no more be gathered from thistles than class legislation, whether it be the rich against the poor or the poor against the rich, can be looked to for the perpetuation of popular government or the spread of democratic virtues. The evil of bad taxation is not merely economic, it is moral, and no argument can change its character.

To defective elementary education, in respect to the principles of taxation, may also be attributed the almost universal disassociation in the minds of the masses between the payment of taxes and the benefit, or profitable return consequent upon such payment. The youth of the United States, and doubtless of all other countries, as he grows up, finds roads and bridges, schools, courts and churches, commercial regulation and police—in short, all national, State, or municipal machinery—provided for him almost as freely as air, sunshine, or water. He has but to live to experience their benefits or discomforts. At home these subjects, regarded as dry and abstruse, are rarely if ever selected as topics for social conversation, and, if casually brought up, are discussed merely in reference to their bearing upon the interests of this or that political party. The sons, therefore, of even refined and intelligent American families, so far as home education and influences are concerned, enter upon their duties as citizens, with votes and voices for determining the policy of their government, with not merely an entire ignorance of the principles or methods by which the cost of the benefits accruing from such policy are defrayed, but with a disinclination to receive instruction on the subject. Each one, indeed, seems to argue to himself that "as government and society went on very well without thought or care of mine during the first twenty years of my life, they will undoubtedly so continue during my manhood." And if they eventually become public functionaries, their tendencies, conjoined with not having inherited or acquired the value-perceiving faculty, are toward extravagance and waste in governmental matters. What would have been saved to the people of the United States since the beginning of the civil war through wise methods of taxation is almost beyond conception. The loss to the Federal Government during the single year 1864, when revenue was most needed on account of the war, through a needless imperfection of the law imposing taxes on the single item of distilled spirits, was proved to have been in excess of $50,000,000.

In short, it is a most singular idiosyncrasy of the American people, and perhaps the people of all other countries, that they will defer or neglect the study of the most vital question which can concern a citizen. Probably not more than one citizen out of a hundred, even among those who pay taxes, can be induced, as a rule, either to talk about, think about, or study how much national Government costs him per annum, or how much his State or local government costs. And as long as this is the situation, and until the American citizen does become a student of taxation, it is difficult to see how the national and State governments can be wisely and justly managed.

Of the utter lack of comprehension of the results of what may be termed everyday experiences of taxation, coupled with a general indifference to the subject, which often characterizes American legislators, even such as are popularly regarded and spoken of as statesmen, the following incidents will abundantly illustrate: Pending a recent presidential election, a distinguished member of the Senate of the United States, and also of the American bar, assured a popular audience that the people of the single State of Illinois paid a larger amount in taxes to the Federal Government than were paid by all the people of the former Confederate States. Such a statement was obviously made on the assumption that because the State of Illinois annually manufactured a very large amount of distilled spirits, the burden of a very heavy tax on the same rested upon its people; when a very little thought would have shown that the manufacturers of the spirits incorporated the tax in the market price of their product, and that the payment of the same fell entirely upon the people who consumed them, who were not in the main the people of Illinois. If this was not the case, the manufacturers of Illinois paid and assumed a tax obligation of ninety cents a gallon for the privilege of making whiskey costing and worth an average of but thirteen cents per gallon. The average annual consumption by the people of Illinois at the time, supposing that they actually paid the tax on their product of whiskey, must have also been at the rate of over six gallons per head for every man, woman, and child of its population.

When "an act to reduce taxation to provide revenue for the Government and for other purposes"—passed August 28, 1894—was under consideration by the Senate of the United States; and pending a proposition to increase the revenue by increasing an existing tax of about seven hundred per cent on the average prime cost of distilled spirits to a rate of near nine hundred per cent, a Senator of long experience, apparently utterly oblivious that the subject involved had years before been thoroughly considered by the United States Treasury Department and declared to be impracticable, submitted a motion, permitting the use of alcohol in the arts, or in any medicinal or other like compound, without the payment of any internal revenue tax. The motion in question, after very brief consideration, was accepted and incorporated in the statute and now forms a part of the fiscal obligations and laws of the United States. The result was that the Secretary of the Treasury reported, that in default of any appropriation to defray the expenses of the administration of the act and the repayment of taxes, and "after full consideration of the subject, and an unsuccessful attempt to frame regulations which would protect the Government and the manufacturers, the department was constrained to abandon the effort." It was also estimated that the expense to the Government of attempting to administer the act would probably be not less than one million dollars per annum; that the legitimate loss of revenue contingent on its enforcement would be about ten million dollars yearly, or "more than one half of the estimated increase of revenue" that it was expected to accrue from the increase of the tax, and that the loss of revenue from the opportunity for illicit and fraudulent practice, which the act would facilitate would be unquestionably very considerable—probably an equal amount. The inference from all of which is, that when a State sends a representative to the United States Senate who, through indifference or gross ignorance of the most common principles and domestic experiences of taxation prospectively, entails a loss to the Government of some twenty million dollars per annum, it pays a very great price for such a privilege.

During another comparatively recent fiscal debate in the United States Senate, a Senator, who is popularly and justly accredited with statesmanship, advocated certain proposed appropriations of the public money, which were opposed on the ground that they were in the nature of extravagances, by saying that they could not be grievous to the people "since they would not amount to more than *three* cents per day per capita." But three cents per day assessed on sixty-five millions of people would amount to nearly eleven dollars per head per annum, or over seven million dollars for the entire country.

Finally, there has been one most serious and unfortunate mistake, which nearly all who have undertaken to discuss the principles and practice of taxation have been prone to make—a mistake, moreover, which more than all else is responsible for the opinion which has come so generally to prevail, that the subject of taxation, through lack of any fixed principles or axioms, does not as yet rise to the dignity of a science; and that its practice at the best can be but a sort of empiricism, to be varied in proportion to the strength which a Government possesses to enforce its enactments, or in proportion to the prejudices of the people who are to be called on for a contribution. The mistake consists in taking up the subject for investigation and discussion, if we may so express it, wrong end foremost; or in devoting time and effort to warring against abuses; or in attempting to show how certain forms of taxation commend themselves in respect to productiveness, freedom from personal inquisition, and economy in collection, and how others are to be avoided for contrary reasons; and in not attempting to inquire whether the whole subject was underlaid by any general laws in accordance with which the contributions which the State is compelled as a condition of its existence to exact of its citizens diffuse themselves; and which laws, being once determined, will constitute a certain and sure foundation on which practical administration can be based and conducted.

The fact that such laws exist and only await discovery may be predicated, as it were, from surface indications, in the form of a great variety of disconnected economic facts, with just as much of certainty as the miner who, picking up here and there in the beds of streams fragments of coal or ore which the elements have scattered, predicates that somewhere there must be a larger vein or deposit from which the fragments have been derived.

The aggregates of the sums required by the governments of the world for their support are annually increasing, but probably in no greater ratio than the increase in their wealth, or property rightfully subject to taxation; and in those states in which there is a marked and continued increase in the control of the forces of nature for production, the ratio of taxation to aggregate wealth undoubtedly tends to diminish.

That there are, however, some striking illustrations that seem to prove to the contrary, is not to be denied. Thus, we have a recent statement that the expenses of the city of Philadelphia in eight years have increased two hundred and thirty per cent, while the taxable valuation of property in the same time has increased only twenty-five per cent. In 1862 the aggregate taxation of the city of Providence, R. I., was $379,000. In 1892 it was $2,333,000. In the former year the taxable real and personal estate was valued at $61,000,000, while for the year 1892 the valuation was $155,000,000. Thus the increase in the amount of taxes collected within the thirty years was five hundred and fifteen per cent, while in the amount of assessable property the gain was only one hundred and fifty-four per cent. The rate of tax increased during the same period from $6.50 per $1,000 to $15.

Among the leading nations of the world the comparative burden of exactions by Government is heaviest in Russia, Italy, and France. In Russia the present governmental exactions—under the name of taxes—from the agricultural peasant are reported to be about forty-five per cent of the value of his annual product or earnings. In Italy the State exaction is believed to absorb from one third to one half of the value of its agricultural product. The present aggregate of annual taxation in France is undoubtedly the greatest to which any country in modern times has been subjected; and including all taxes—national and local—is estimated as in excess of $1,400,000,000, or about one fourth of the annual income of its people. And yet it is claimed that the prosperity of the nation is increasing. There can, however, be no doubt that the financial strain caused by such great and continuous demands on the income of the French people is beginning to be severely felt; and in a recent budget discussion in the Senate of the republic, M. Loubet, chairman of its financial committee, insisted that taxation had reached its utmost endurable limit.*

As far back as 1879 the taxation imposed by Spain on her island of Cuba was reported to have made the latter the most heavily taxed country in the world; the rate on its free population being then estimated as equal to $34.50 per capita.

The cost of the Government of Great Britain for 1893-'94 defrayed by what are termed imperial taxes—mainly customs and inland revenue, and deducting all items of compensating revenue—as receipts from crown lands, etc.—was £75,427,000. The

* In a recent article in the Économiste Français, M. Leroy-Beaulieu presents some facts which enable foreigners to form an opinion of the financial management of France under its present democratic form of government. There is at present, according to this well-recognized authority, an actual annual deficit of between three and four hundred million francs. The floating debt, "official or concealed," has taken enormous proportions, and is met by a variety of expedients, and mostly by secret loans (which are always costly), because the Government does not dare contract a large public loan, the only regular and least expensive means of extrication from financial embarrassments. Expenses are piling up and nobody takes any thought of repressing them. In short, according to M. Beaulieu, there is under the present Government, notwithstanding "constant and vain buzzing on the subject of democratic reforms, the adhesion of a mollusc to the wretchedest routine and a downright hatred of every kind of improvement."

total expenditures of the local authorities of the kingdom for 1893, defrayed from rates on the annual value of houses, or lands occupied, from gas and water rents, tolls, dues, loans, etc., and less the grant of subsidies from the Imperial Government, was about £56,000,000, making an aggregate of £131,400,000—or $657,000,000.

For the year 1890 the aggregate receipts of the Federal and State governments of the United States, mainly from taxes, as reported by the census for that year, were $1,040,473,013, apportioned as follows: Federal taxation, $461,154,000; State or local taxation, $578,328,000. Deducting the cost of postal service repaid by postal charges, and the receipts from the sale of public lands, the aggregate expenditures of the Federal Government would have been about $390,000,000.

Of these large sums it is safe to say, more especially of the latter national summary, that very small proportion, not even as much as a single dollar, has been raised under a statute framed and enacted solely from recognition of and conformity with any correct economic principles; and that in most, if not all, tax legislation, ideas not warranted by thought and experience, and based on expediency or political considerations, have always predominated. Illustrations of the truth of this assertion are abundant, but for the present one most pertinent, drawn from recent experience, must suffice. In August, 1891, the Farmers' Alliance of the State of Maryland held a convention in Baltimore, for the purpose of advocating a complete revision of the tax laws of their State, the imperfection, injustice, and practical futility of which were not questioned. And after general debate the following resolutions were unanimously adopted, not one of which is economically true; not one of which in the light of experience can be successfully enforced by other than a despotic government; and every one of which, if enforced, would prove prejudicial to the interests of the community which sanctions and enacts them:

Resolved, that the burden of all taxation ought to be imposed equally and impartially on all property, of whatsoever kind, both personal and real, without distinction and discrimination; that every exemption from taxation is equivalent to direct appropriation for the benefit of the owner of exempt property, and an increased levy on the property of those who pay taxes; that no tax law which provides for the exemption of any property of any kind can be either expedient or just; that no law, no contract, no device which by any means directly or indirectly imposes the payment of any part of any tax upon any man not the *bona fide* owner of that property ought to be tolerated; that debts secured by mortgages at legal interest are among the best and most productive forms of property, and should be taxed when the mortgages are recorded.*

* In the following chapters the absurdity of the above resolutions will be specifically demonstrated.

A recent English writer has claimed that the experience in reference to taxation of the forty-five anomalous sovereignties which now make up the United States [none subordinate to a national Government except to a limited extent and in respect to particular questions], has thrown a great light upon the temper of democracies. "Half a century ago every thinker predicted that the one grand evil of democracy would be meanness; that it would display an 'ignorant impatience of taxation,' and that it would refuse supplies necessary to the dignity, or at least to the visible greatness, of the state." That prediction has, however, proved itself, not only by the experience of the United States, but also of the leading countries in Europe, to be the exact contrary of the facts. "The lower the suffrage, the higher the budget mounts. Democracy loves spending, is devoted to dignity, and, provided they are indirect, or fall heaviest on the rich, will pay any amount of taxes. The English democracy with household suffrage, though it has reduced its debt, has increased its budget, increased rates all over the country, and would not be frightened to-morrow if a great socialistic experiment were to cost it a hundred millions. It hardly shudders when it is asked to support in comfort, at a cost of about £17,000,000 ($85,000,000), its whole aged poor. The French democracy has nearly doubled its taxation and raised its debt more than a third, apart from the tribute paid to Germany. The German democracy, with enlarged suffrage, a poor soil, and nearly universal poverty, is always granting new demands, whether for soldiers, ships, colonies, or centralized officials."

But it is in the United States, with universal suffrage and the richest of estates, that the extravagance of government expenditures, sustained by taxation, rises to a point which fiscal experts, like Alexander Hamilton, Robert J. Walker, and Albert Gallatin in the United States, and Sir Robert Peel or Ricardo in England, could not have been persuaded to believe possible. Either of them would have declared an American pension list amounting to $155,000,000 (£31,000,000) a year too absurd for credence, and would have criticised the prophet who made the prediction for his poverty of invention.

That the interests benefited by national extravagance will, under free suffrage, always constitute a formidable obstacle to judicious tax reform, especially if such reform contemplates national economizing, can not well be doubted; and also that this opposition will be re-enforced to some extent by a popular feeling that something of color and dignity will go out of national life by any marked curtailment of the expenditures of the State. On the other hand, the political supremacy of the United States confessedly yet resides in its agricultural classes, who more than any other are characterized by a spirit of thrift and a desire for equitable and low taxes.

Such, then, is the situation which confronts any one who proposes to discuss broadly the great subject of taxation with a view of effecting reforms in the existing system. It exacts, on the part of him that is to attempt it with any prospect of success, a familiarity with theory, not merely gained from the study of books, but theory based on extensive practical administration. It requires, on the part of both the teacher and the taught, what Herbert Spencer has declared to be the conditions of success in all departments of scientific research, namely, "an honest receptivity and willingness to abandon all preconceived notions, however cherished, if they be found to contradict the truth."

PRIMIGENIAL SKELETONS, THE FLOOD, AND THE GLACIAL PERIOD.

By H. P. FITZGERALD MARRIOTT.

PART I. THE PALÆOLITHIC SKELETONS OF MENTONE.

IN the rocks near Mentone that go by the name of *Les Rochers Rouges* * there was discovered, on the 12th of January, 1894, another human skeleton. It is that of a man about six feet two inches in height, but, owing to the head having been crushed, accurate measurement is difficult. M. Adolphe Mégret,† however, has calculated the height of the living man to have been 1·984 metre. This he does by multiplying the length of the *phalangine* ‡ of the medial finger, 0·031 metre, by 64, a method that in every case proves successful. The first account of this find, in the local Anglo-American, mentioned two skeletons, and in spite of it being now affirmed that only one was discovered, we rather suspect that there was truth in the first statement, especially as the leg bones of another are admitted to have been found beside it; and all the more, knowing as we do how the skeleton of 1872 was accompanied by two others, the existence of which was kept a secret, as they were too imperfect for the scientific discoverer to describe conscientiously at the time. This skeleton of 1894, as we must hereafter call it, lay on its back, inclining to the left side, the body slightly bent, the legs stretched and crossed below the knee, the right arm bent and with the hand lying open over the left breast,

* In dialect their name is *Baoussé-Roussé*, the Italian for which is *Balze Rosse*.

† Étude de Mensurations sur l'Homme préhistorique, Nice, 1894.

‡ *La phalangine* is probably the smallest and last of the phalanges of the medius.

while the left hand was supporting the side of the head. The teeth are large and strong, but much used; the front teeth are nearly as thick as ordinary molars. Near the right hand was a crystal of quartz, similar to those found on the rocks around to this day, but pointed at one end, and about two inches long and an inch and a half thick; some suppose this to be the top of the handle of a knife. The head was ornamented with chaplets of deer teeth and shells. By the remains and on the bones is seen the same deposit of red ochre that was noticed on all the other skeletons. Several slabs of stone were found, which seemed to have formed part of a dolmen. The skeleton, however, was not resting in a palæolithic stratum, though it is considered that these remains are pre-neolithic. A few metres below it, however, in a stratum that is decidedly palæolithic, were found several huge mammoth bones—the hip-joint head of the thigh bone (femur) and the socket of the pelvis: *beneath* these was found the remains of a fire—a line of black in the stratum—and a large flint instrument, thus proving that man was contemporary with the mammoth.

The length, or depth, of this cave was once at least forty-five metres; and its mouth appeared smaller when it opened nearer the sea, before quarrying destroyed it, and, in particular, removed nearly the whole of its eastern side. At present its depth is about twenty metres, though the end is but a mere crack. It now appears as a huge fissure that rends the face of the lower end of the Rochers Rouges for fifteen metres to nearly the height of the cliff; but from the sloping and irregular level of its own earth floor, which rises several yards above that of the base of the cliff, it is only thirty or forty feet high, and narrows at the top to a mere crack. In width it is about four metres, diminishing inward. Within the dark brown mold filling the lowest levels of this cave, which for facility of reference is called No. 5, were found also the skeletons of 1884 and 1892.

The rocks in which these human remains, bones of animals, and flint instruments have from time to time been discovered are situated at the east end of Mentone, and extend toward the sea, which washes their rough rocky beach; they rise on the other side of the little stream of the St. Louis ravine that divides France from Italy, and are therefore on Italian soil. Round their base runs the narrow old Roman road, which crosses a little bridge of the same date, immediately after rounding the corner. These ruddy colored cliffs are composed of the secondary cretaceous limestone, and contain many crevices and small caverns, in which, mixed with the softer earth covering the floor to many yards in depth, have been found from time to time mammalian bones, with shells and crustacea, imbedded in places in hard sand and calcareous matter, mixed with flint instruments. Thus they were known in 1848, yet even as early as the last century De Saussure had drawn the attention of the scientific world to their existence. But in 1858 they were first actually described by M. François Forel, a Swiss. M. Rivière commenced excavations in 1869; it was not, however, till 1872, while making the cutting for the railway, that the first human skeletons became unearthed by him on March 26th, six metres and a half below the level of the older excavations, in cave No. 4. Beside the one on which M. Rivière wrote his monograph in 1873, two others * were discovered lying near it about the same time, but so badly were they broken that he made mention of only that one, which is now in the Natural History Museum of Paris. On its head were found some shells forming a circlet, as also some carved reindeer teeth in the same position, while beneath the head was found a curved flint blade. It was supposed to have been the skeleton of an Ethiopian, at first, but there were differences that marked a race that has now passed away, or become somewhat altered: the orbital cavities were larger, and its height, though not great, was abnormal. We pass over this skeleton,† and all that M. Rivière has already written about it, and all the names ‡ that he has given to the flint and

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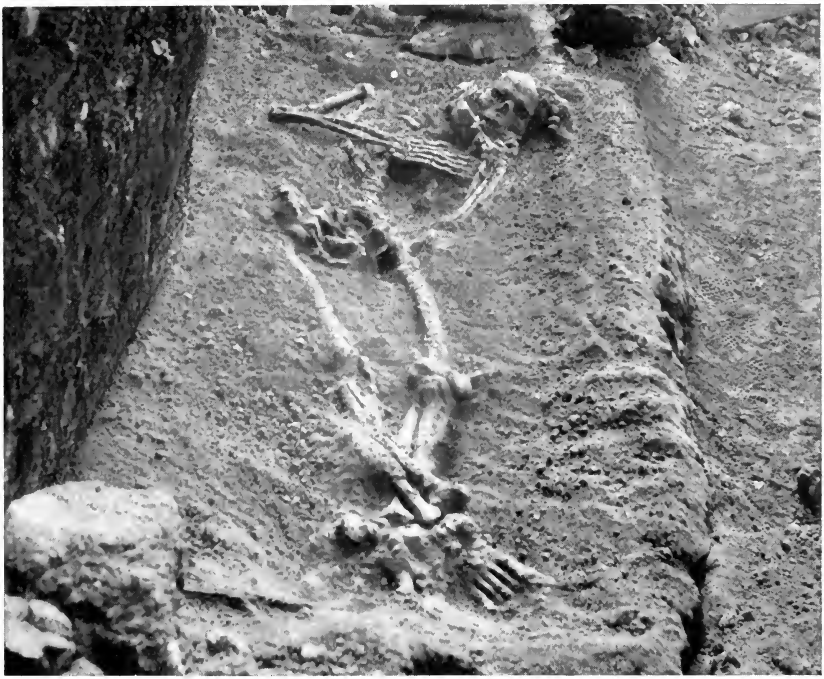
* In a paper of February, 1892, by M. Binet-Heutsch, entitled Nouvelles Découvertes aux Grottes de Menton, we find mention of a skeleton that was found in the same cave by M. Rivière in the following year (1873), far less well preserved than the first. It was of enormous size, and was more than two metres in height; the skull was damaged during the excavation. Possibly this may be one of the skeletons that we have mentioned, on the excellent authority of one who was present with M. Rivière at the time, as having been discovered with the 1872 skeleton. Mention, however, is made by M. Rivière of three skeletons, that he found, in a brochure entitled Découverte d'un second Squelette humain de l'Époque Paléolithique dans les Cavernes de Baoussé-Roussé, Nice, 1873. With the measurements given of these last three skeletons by M. Rivière, M. Adolphe Mégret (by his method of multiplying the length of the phalangine of the medial finger by sixty-four), in his Étude de Mensurations sur l'Homme préhistorique, calculates their living heights to have been respectively 1·984, 1·920, and 2·048 metre.

† An amusing Box and Cox episode recalls to our mind the name of Mr. Moggeridge, a gentleman who many years ago lived at Mentone, and who published an excellent outline panorama of all the mountains as seen from the Borrigo Valley bridge, and who had scientifically studied the exact maximum and minimum temperature at the top of each summit. This gentleman, being equally persuaded that he would find human bones beneath the other remains of extinct animals and flint instruments, used to work at the cave during hours when it was deserted, leaving the soil somewhat disturbed, to the bewilderment of M. Rivière on his return the next day. It fell, however, to the lot of the Frenchman to remove the last layers of earth, and, therefore, to have gained the sole honor of being the discoverer.

‡ Among other names, M. Rivière, in his monograph published in 1873, Découverte d'un Squelette Humain de l'Epoque Paléolithique dans les Cavernes des Baoussé-Roussé dites Grottes de Menton, gave that of "*bâton de commandement*" to a small bone, *un métacarpien principal gauche, appartenant à l'Equus cavallus* (a chief left metacarpal of a horse), which is 0·21 metre in length, or about eight inches. It is pierced by a hole, and he re-

bone instruments that were found beside it, and we come to the skeletons discovered in cave No. 5 by M. Bonfils, curator of the Mentone Museum, in February of 1884. Again three were found together. Owing to the stupidity and jealousy of the actual owner of the land, an Italian peasant of the name of Abbo, they were much broken; but neither of these skulls, which M. Bonfils has shown to us, seems to be quite of the same formation as those of 1892, though the peculiar, somewhat quadrangular shape of



Photograph of the Palæolithic Skeleton discovered in the Fifth Cave in the Rochers Rouges, near Mentone, on January 12, 1894. Reproduced by the kind permission of M. Bertrand, Mentone.

the orbital cavities, turning up at the outer corners; is very similar. Prof. Boyd Dawkins believed these 1884 skeletons to be of "doubtful antiquity." They, however, appear more ancient than those found in 1872; and the male skeleton was of gigantic size, being six feet nine and a half inches in height, from top of head to heel, according to M. Bonfils. The latter also discovered with

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marks "devait être porte suspendu au cou comme insigne. Il ne porte aucun dessin, ni gravure, ni entaille" ("was probably worn suspended from the neck as an *insignium*. It bears no drawing, or engraving, or carving"). We may here add that if what he here describes is in any way like what we have referred to under the skeleton of 1892, it is probably a roughly formed totem for veneration.

this last specimen several flint blades, one on each shoulder and one resting on the top of the head. It was 8·40 metres below the original floor.

Of the three skeletons discovered in February, 1892, Mr. Vaughan Jennings gave a description in an article to which we will refer later on. They also were found in the fifth cave, but a very little further within its depths than those of 1884, and were first noticed by workmen who were blasting and hewing the face of the cliff for stone. During this work they gradually destroyed the sides of the high cleft or cave, and in removing the hard earth that filled its floor to some eight or ten feet in depth, at the distance of about twenty-five metres from its original entrance, they came upon a skull which, unfortunately, was broken by the blow from a man's pickaxe, or, as some say, by the energetic digging of one of Abbo's young sons with the iron instrument used for sinking holes for blasting. From that moment, but not with sufficient care, the skeletons, lying side by side, were unearthed and rapidly robbed of the flints and ornaments found about them, with the result that none can be certain in what position Abbo found them. At first only two were entirely visible—those of a man and a woman—but soon a third, that of a youth, lying between the two, came to light. They lay seven metres and a half below the original floor. All are of great size; the skulls being broken and the skeletons half in the earth, exact measurement of the height was very difficult at the time; but both then and since the skulls have been pieced together we have managed to take some sort of measurement, showing the biggest skeleton, from the crown of the skull to the heel, to be six feet ten inches and a half,* and the other two about six feet six inches and a half. If, then, we allow for the shrinking of the tendons and for the flesh on the heels and head, the man must have stood about seven feet four inches, and the others, to whom the remaining skeletons belonged, about seven feet and half an inch at most. No child was found, as was erroneously stated by a newspaper. The skulls are of unusual size and thickness, the frontal bone being at least a quarter of an inch thick, and the parietal and occipital bones fully three quarters of an inch. The occiput in one of them is enormous, and is very much larger and out of proportion to the rest of the cranium, being expanded lengthwise, while in another it is the parietal bones which exhibit excessive extension. The orbital cavities are unusually large and curiously curved up at the outer corners. The bones, too, are of great thickness; they are, however, most friable; to the slightest touch many of them will crumble, and all

* M. Adolphe Mégret, by his usual calculation, makes the height of the living man to have been 2·144 metres, or about seven feet and half an inch.

of them are covered with a red sort of rust, while they lie in a sepia-colored earth softer than that which is immediately above and around them in the cave. M. Bonfils explains this rusty color by the fact that lumps of red ocher have been found near the skeletons, probably having been obtained from some rocks that exist not far off; with this the bodies most probably had been covered, and the flesh having disappeared, the ocher had settled and remained on the bones. It is said that around the head of the man was a circlet of carved reindeer teeth and a chaplet of shells, and around the necks of all were found necklaces, of course long since fallen to pieces, formed from the backbones of fish; these latter have been strung together on wire. But so many people claim to have seen the skeletons first and dispute each other's assertions with regard to these relics found with them that we only refer to them for what they are worth: certain it is that circlets of carved reindeer teeth and other objects have been found in these caves; all that has been found we have ourself seen, but, unfortunately, no authoritative person was able to reach the caves in time to ascertain in exactly what positions these chaplets, knives, and other objects were found by the peasant Abbo and his wife, to whose house, not far from the caves, the articles were at once transported, to be placed with many others which have from time to time been discovered. These bones and other objects are here and there tinged with the same ocher rust with which the skeletons themselves are covered. The outermost skeleton, that of the man, was lying on its back, the knees slightly bent toward its left, its arms stretched out by its side. In the left hand was found a flint blade exactly nine inches long, held loosely, which proves that once there was a handle of some perishable material. The woman and the youth had been buried lying on their left sides, the legs bent slightly at the knee; the former held in her left hand, raised beside her face, a smooth, wide, and hollow-curved blade of flint that lay under the head as if it had been placed there for it to rest on, while in the right hands of both these smaller skeletons were said to have been found flint knives, as in that of the bigger one. Their right arms were bent so that the hand reached the shoulder. The third, buried between the man and woman, and whose skull is missing, we have taken to be that of a tall youth. From the appearance of these skeletons they seem to have been buried rather than to have been overcome by some sudden catastrophe, as has sometimes been supposed of that of 1872, which was very much bent up and leaning on its left side. Around them, above and below, were the bones of many extinct species of mammalia—huge teeth, teeth of reindeer and of the *Bos primigenius* and the horse, together with many small flint instruments; but these would merely seem to indicate that they had been buried in the cave in which, during their lifetime, they had lived and consumed these animals whose remains we find.

M. Adolphe Mégret suggests that, in the position in which all the skeletons that have as yet been discovered were found to have been buried, we are "in the presence of a funeral and religious rite that was perpetuated." Here we would further draw attention to the little bone objects of various dimensions, but always of the same shape, that have each time been found with the

PHOTOGRAPH OF THE PALÆOLITHIC SKELETONS DISCOVERED IN THE FIFTH CAVE IN THE ROCHERS ROUGES, NEAR MENTONE, IN FEBRUARY, 1892. Reproduced by the kind permission of M. Bertrand, Mentone.

ornaments that are supposed to have been around the heads or necks; we refer to the pieces of bone that measure from about one inch and a half to three inches in length, cut in the center so as to form two ovals joined together; they are slightly ribbed longitudinally; these were supposed to have united the ends of the necklaces of deer's teeth or shells and thus been suspended in a prominent position; they probably were roughly cut "totems" or objects of veneration of their "religious" instinct. Even the same shaped "totems" have been found elsewhere. For further and fuller explanation of a meaning that we can not express here, see a note in our Facts about Pompeii, published by Messrs. Hazell, Watson & Viney, London.

Mr. A. Vaughan Jennings, as we have said, in 1892 had an article in the June number of Natural Science concerning The Cave Men of Mentone, which was so peculiarly inaccurate in its facts as to merit a few lines of criticism. First of all he refers to M. Rivière's skeleton of 1872 as if discovered in 1873. It was M. Rivière's monograph that appeared in 1873. Knowing the place, as we have all our life, we can say that he is correct when he affirms that "the east side of the cavern No. 4* has been a good deal cut back by quarrying," although he omits to mention that both sides of the cavern—indeed, the whole face of the cliff—some twenty years ago came to within a couple of yards of the rocks that break the force of the sea. Mr. Jennings, from his statement, shows that he did not see the remains till the 15th of March, and that by that date they were considerably modified, the skull and arms having been removed. We saw the skeletons on March 18th, and according to notes we made at the time the arms were still there; however, we had the opportunity of seeing them on the 23d of February in a very complete state. We also saw the left arm of the third skeleton, that of the woman, bent up, which Mr. Vaughan Jennings particularly says was not the case. In a footnote on M. Rivière's measurements and those mentioned by the papers, Mr. Vaughan Jennings regrets that "the exact measure will probably never be known, as the neck and shoulder region is now destroyed." We are happy to have been able to supply this necessary information, from measurements that we took at the time on the spot, before the skeletons were removed from the earth in which they were imbedded. Later on Mr. Hanbury, of Mortola, very generously bought the skeletons from Abbo and placed them in the latter's cottage with the other remains; this has saved them from further destruction. Mr. Jennings places the 1892 skeletons between the palæolithic and neolithic periods of man, and very rightly deprecates the habit of speaking of these periods with sharp distinctions; thus it is possible that an intermediate race existed, while it is only natural to understand that the formation of neolithic man was merely a series of progressions from earlier forms. On the other hand, the period of time between the existence of palæolithic and neolithic man may not have been so great as has been supposed.

PART II. MAN, THE FLOOD, AND THE GLACIAL PERIOD.

Flint instruments, the product of man, for a long time have been often found in many places. It is merely necessary here to

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* M. Rivière's No. 5.

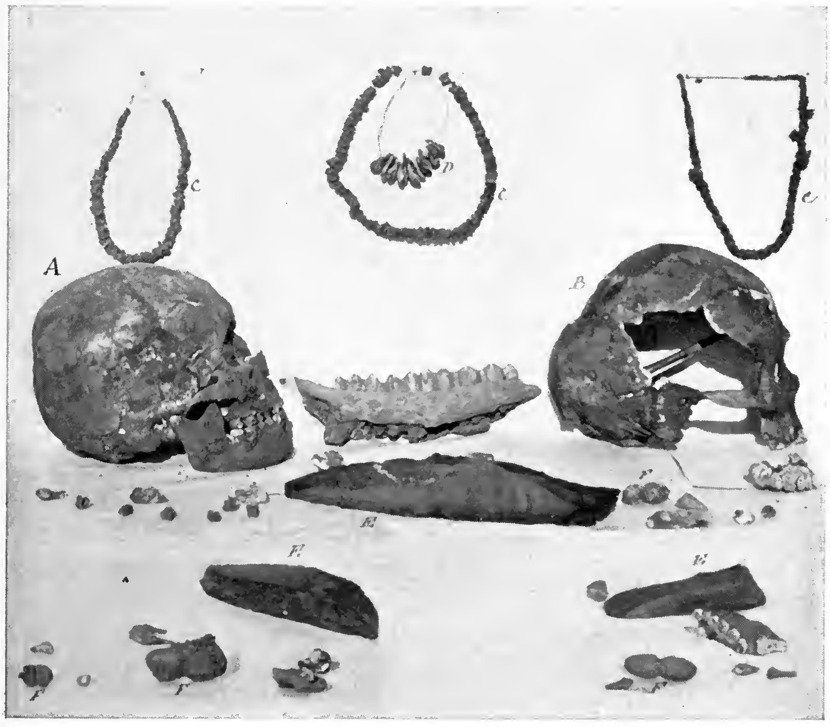
mention a few instances. In 1715 a flint knife, now in the British Museum, was found imbedded in gravel with the tooth of an extinct species of elephant, near Gray's Inn Lane, London, thus marking the extreme antiquity of flint instruments. In 1797 flint hatchets were found in Suffolk, and in 1847 flint instruments at Abbeville. In 1858 Sir Charles Lyell found others in the valley of Somme in Picardy. Flint instruments have been found in caves all over the earth, mixed with bones of animals that lived before, during, and after the Glacial period. They can be more or less classified according to their form and finish.* We believe that in all instances flint instruments have been found with what are supposed to be the earliest skeletons of mankind; moreover, the oldest type of flint instrument has been found with the skeleton of man.†

The difficulty now is to assign a period to the earliest type of flint instrument. If this can be done, the period in which man first appeared on the earth can be more precisely ascertained, and this in two ways—either by finding these flint instruments beneath certain strata which can be assigned to certain periods by geologists, or by finding them with the bones of certain animals the period of whose extinction is also approximately known. This only is certain: that the bones of extinct species of animals, extinct yet still represented by later races, have been found in these and other caverns with those of man and with flint instruments. These bones are those of mammalia of the Miocene, Pliocene, and Pleistocene periods. Secondly, the caverns in which these human bones have often been found have, we believe, been always in the Secondary and Lower Cretaceous rocks, though this does not, of course, show that man was in existence immediately after the formation of these rocks, but merely that they were the most accessible and convenient for him in which to live or be buried, for many of the skeletons that have been discovered seem to have been carefully buried by others. The alluvial deposits, formed by the action of water, which actually contain man's remains, belong to a more modern era than the newest stage of the Tertiary epoch and are within the Post-tertiary series, in the Pleistocene, Glacial, or Bowlderdrift period, as it is variously

* M. Bonfils, curator of the Mentone Museum, in order to prove how rapidly these flint knives, hatchets, spearheads, daggers, fishing weights, etc., could be made, has himself made many with the aid of only stones with which to commence, and later on with the help of the instruments thus formed. And thus he has found that they only took from five hours to nine days to make, according to the quality of the flint or agate and the form of the instrument.

† Previous to flint, man must have used wood, breaking boughs from off the trees and making them into the form of stout staves and clubs, and later into that of wooden spears, bows, and arrows, of which perishable materials naturally no traces can be found.

called. But then we must remember that this may not have been the original soil in which they first lay, for the very reason that it is alluvial and could have been formed afterward. In 1852 human bones were found in a cave at Aurignac, near the foot of the Pyrenees. In caves in the valley of the Meuse, near Liège, three human skeletons with flint knives and a mammoth's tooth were found. In 1858 human bones were found in Brixham cave



Photograph of some of the Palæolithic Remains discovered in the Caves near Mentone, in February, 1892. A, B, skulls of two of the three skeletons; C, chains formed of fish bones strung together by the holes with which they were found to have been pierced; D, carved reindeer teeth strung together by the holes with which they were found to have been pierced; E, flint knives, etc.; F, carved bones, shaped as if to be tied round the middle by a string, and possibly worn round the neck or wrist as an ornament or "totem." (See note, page 12, Facts about Pompeii; Hazell, Watson & Viney, London.) Reproduced by the kind permission of M. Bertrand, Mentone.

near Torquay. In 1863 a human tooth and jawbone with flint instruments and the bones of extinct animals were found in a gravel pit at Montin-Guignon. In North America human bones have been found in the caverns of Kentucky, and in South America in caverns in Brazil. In the Dordogne caves in central France were found perforated teeth, vertebræ, and shells of Cypræa, and still more important the bones of mammoth and reindeer on which were etched the figures of mastodons, deer, and horses. Caves in Saxony, Gibraltar, Austria, and many other places have been discovered containing human bones. The human skeletons discovered in a modern limestone formation at Guadaloupe, in the Windward Islands, are possibly of a later period and are not even fossilized, though imbedded in compact stone. In August, 1894, Herr Mascha, director of the Grammar School at Predmost in Bohemia, who has for many years made discoveries in that neighborhood and has found hundreds of mammoth skeletons, has unearthed a family of six people—a man of enormous size and a woman and her children—near to the remains of mammoths; this is said to be the furthest northeast that primeval man has been discovered with the bones of antediluvian animals. It is a pity that more exact information upon certain interesting points has not come to hand. It is equally a pity that all such treasures of the ancestry of our race should not be preserved and indeed systematically sought for by professional scientists and archæologists, for we know how those at Mentone have been ruined and altered and their ornaments removed by the peasant Abbo and his workmen before competent judges have had any chance of observing the several different points of interest that seem to require even more than the knowledge of the anatomist and osteologist. These remains at Predmost and the men whose bones have been discovered at Mentone must have been coëval with the animals of either the Miocene, Pliocene, or Glacial periods. But as late as the Glacial period the bones have been discovered of mammoth and of extinct species of lions, bears, rhinoceros, hyenas, reindeer, Irish elk, and of the *Bos primigenius*, animals that had also existed in the two earlier periods, and with whose bones flint instruments have been in different places discovered in fluviatile gravels and in caves. This, however, only proves that man lived either during or just previous to the Glacial period, the latest at which these animals existed. Till, however, the bones of man or his flint instruments can be found with the bones of some animal that became extinct before the Glacial period, we can not place him at any earlier date.

If, however, man existed before or during the Glacial period, it is strange that there should be no tradition of such a change taking place on the earth's surface. It may be that the alteration in temperature was so gradual, and extended over such a great length of time, that the generations of men who succeeded each other were unaware of it; perhaps, too, almost imperceptibly to themselves, the then existing races of men moved gradually to warmer regions, keeping pace with the advance of cold, which we must, in reasoning thus, suppose to have been so gradual that at any rate nomadic races would not have noticed it by their traditions. But such a change in one portion of the earth would not be likely to take place without a coincident change everywhere else. While ice lay over a great portion of the earth, the rest of its surface may have possessed a temperate or almost semitropical climate, of peculiarly equable character the whole year round. The race of men born in such a zone would probably be hardy and strong, and this is precisely what we suppose our first ancestors to have been. But, though in what appear such favored conditions, they have left to us, in nearly all the races that have sprung from them over the whole world, a tradition of a great catastrophe—a flood. The chiefs of the then world, it seems, were saved, and, whether in one ark, or in several strangely and wonderfully built vessels, were preserved to again spread the human race. But how came this flood, and when ? And why should immense quantities of rain descend, and why should the seas rise in every direction ? If we refer to the probable cause of the Glacial period, we shall also see the origin of the flood. It is, we believe, an accepted theory that the mountain ranges of the globe were formed by the shrinking of the earth's crust. This was caused by the diminishing lava or molten earth within having contracted at length to such an extent as to have been often removed during the globe's rotation on its axis far away from the still self-supporting crust, till a stage was at length reached when the outer crust became so cold that ice gradually formed over all those parts that were furthest from the molten liquid. At the two poles—that is, furthest from the greatest sunshine, as also from the lava (since the latter would be naturally drawn round with the velocity of the equator, and therefore would be furthest from the poles and nearest to the equator)—there was the greatest abundance of ice. After many centuries of this there came a time when the crust could no longer support itself; the strain of the internal lava beating loosely within was too great at times; great convulsions shook the earth's surface, the crust breaking in long lines, and forcing up huge mountain ridges covered with gigantic blocks of ice that rose thousands of feet high. The crust, diminished in extent, again touched the molten lava, the ice melted, volcanoes arose, steam escaped from the cracks, the whole range of the Andes poured forth clouds of steam, the earth again became warm. But what then happened ? The water that was formed by the melting ice, that had not risen in steam to the clouds, spread at once over the lessened area of the earth's surface; the seas rose in every direction and chilled the air; and thus the earth's outermost surface also once more cooling somewhat, the vapor or clouds dispersed around descended again in torrents to add to the great sea already spreading between the newly raised and the ancient mountain ranges of the earth. This, then, is the connection between the Glacial period and the flood, and the probable reason why no tradition has descended to us of the former; first, because man was born during its epoch and was formed by it and accustomed to it, and living in the one temperate zone on the equator saw nothing strange in his surroundings, and, secondly, because the only change that man saw was the sudden accumulation of waters descending from the earthquake-riven and colder portions of his then unexplored globe.

Thus, man's remains have been found with those of the mammoth—a mammal of the warm, subtropical Pliocene period, that lived on into the cold Pleistocene epoch. Probably his origin was previous to that of man; but man may not have appeared until the end of the Pliocene period and the commencement of the cold, which, in all likelihood, gradually and surely came on, as the interior of the globe shrank farther and farther away from contact with the easily chilled outer crust, which it left to fields of ice bordering a narrow temperate zone; the ice reaching from the north pole as far south possibly as 50° north of the equator, and from the south pole as far north as 40° south of the equator; thus the present temperate zones became arctic, and the tropical zone became almost unvaryingly temperate. Man probably in his first ages had spread far and wide north and south of the equator, but not so far as at present we find ourselves; he had been gradually driven back by the advancing cold, yet so slowly that the change did not make itself noticeable to him, and as his civilization advanced to the time when he began to build and to establish great cities he found himself settled near the equator, even further south than ancient Thebes, and probably where the great deserts of Arabia, Nubia, and those of the Sahara stretch their vast plains of sands, and perchance now cover works even older than the stepped pyramid of Ata. However long, therefore, these periods of change may have been, it seems very probable that man first appeared in a fresh, temperate climate, the only proof of which is that he has several times been found with the remains of the mammoth, an animal that outlived the primal warm periods. Probably no preglacial period existed for man. As for the length of time that must have elapsed between the first appearance of vegetation upon the earth until the time that the climax of the Glacial period arrived, when the flood took place, ten thousand years need not be too much. Midst the surroundings of that Glacial period, however, man's remains have been found, but not in those of the preglacial ages that lead back to the ichthyosaurus, plesiosaurus, and other monsters of the deep, or of the age of gigantic flora, huge pine trees, and enormous ferns.

If the flood, then, as some have calculated, was only five or six thousand years ago, then the coldest period of the Glacial age can not have been very far removed, and not much further off than five or six thousand years from the present date; and those skeletons found near Mentone may be those of men who lived eight or nine thousand years ago, before the coldest epoch had gradually driven them further south, near the completion of the evolution of the race, and its consolidation into the perfect form of man, whose intelligence lives and breathes as much as does his more visible and wonderfully formed body.

RECENT TENDENCIES IN THE EDUCATION OF WOMEN.

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THE first women who asked admission to colleges which offered a higher education to men were those whose strong individuality and distinctive intellectual bent demanded some other outlet than housekeeping for their energies. They wished to teach in the higher schools, or to enter the professions of literature, law, or medicine. That competition with men in these lines required better training than was afforded by the "female seminary" was obvious, and they naturally inferred that it was only to be had by means of the same curriculum as that which men pursued. These first women, therefore, applied themselves to mathematics, Greek, and Latin, and found in them satisfaction for hungry minds, if not a perfect equipment for their business in life. Although many of them afterward married, their strong intellectuality is clearly shown by the mark which they have left on their generation in some lines of professional labor.

At that time women were not prepared to question the methods of education; in such matters they were accustomed to be led by men, and what seemed good to men seemed doubly good to those to whom it was newly opened. Indeed, before the middle of this century it had not occurred to many minds that anything else than the classical curriculum could be the basis of a truly high education. What wonder, then, that women should eagerly seek that which men valued most?

When it had once been granted by even a small number of intelligent people that it might be desirable for *some* women to seek a higher education, the door was practically open to any ambitious girl who had the will-power to overcome prejudice at home and the pluck to endure the opposition and scorn of men at college. Coeducation was the outcome of this tendency to demand for women precisely the same kind of education as that which was offered to men. It is a significant fact that the early objections to it were primarily women's supposed physical inability and the danger to womanly character. The traditional curriculum was as well adapted to the needs of women as to the needs of men in nonprofessional occupations. It was rightly felt that there is a virtue in culture, irrespective of the aims of the individual.

By the Morrill Land Grant of 1862 coeducation was assured, potentially at least, in one institution in every State. The other provisions of the act, compelling the teaching of agriculture and the mechanic arts, also indicated the rise of a new and broader idea in education. The colleges thus founded were not intended primarily for rich men's children, but for the sons and daughters of the great middle class. Coeducation seems to have been a concession to the American sense of fairness. If the farmer's boy should have a school, then the farmer's girl must have a school too; it was obviously cheaper to educate them together, while social tradition, less developed among the farming classes and in the States west of New England, offered no obstacle to this purpose. While, therefore in New England coeducation was still mentioned with horror as an impropriety,* in the more crude and democratic West it was having a natural and wholesome growth.

The logical consequences of coeducation in these institutions were evidently not anticipated. The boy who went to the State college took lectures in scientific agriculture or mechanical engineering, with so many hours a day on the farm or in the shop, under a trained instructor; the girl who went to college took whatever was considered strictly ornamental in the course—French, literature, ancient history, rhetoric, with a certain number of hours per day of domestic work. But the hours of sweeping, bed-making, and dish-washing were illuminated by no application of scientific principles from the mind of a trained instructor. In fact, nobody knew very well what she was there for; it seemed only fair that she should "have a chance too," but a chance for what? Why, to marry, of course! But nobody ever said that aloud, and nobody thought of adapting her training to her probable and desirable business in life.

The West had solved the problem of woman's education by offering her the same curriculum under essentially the same conditions of life and discipline as those of men. The disasters to coeducation which had been prophesied had not occurred. Girls

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* Young men and young women have been taught together in the Maine Wesleyan Seminary, Kent's Hill, Maine, one of the best known classical and preparatory schools in New England, since at least 1828, and in the seminary at Cazenovia, N. Y., since 1830.—Editor *Popular Science Monthly.*

showed no physical or mental inability to endure the strain of college life, and apparently lost none of the precious bloom of true womanliness. But no sooner had the system become thoroughly established than a whole world of new social problems was discovered in connection with it. The primeval attraction of men and women for each other was not obliterated by the higher education. Conventionality stood aghast at the primitive and unrefined social life sometimes found within college walls. The social tone of these new colleges could not be much higher than that of the rural communities from which it came. It was not to be expected that students from progressive but uncultured communities should at once be transformed into dignified, self-restrained, conventionally proper young men and women.

Eastern scholars and teachers who went West to fill chairs in these colleges were shocked at the crudity which they met; in their eyes and in the eyes of the cultured New Englander all improprieties, unconventionalities, and crudities were the offspring of the vicious principle, coeducation. In New England, consequently, the pressure of social conservatism compelled a less radical solution of the impending problem of woman's education.

Following the type of Vassar, Wellesley, and Smith were founded still with the curriculum based on the old classical model of Harvard and Yale, but with living conditions and social restraints especially intended to preserve and develop womanliness. A liberal allowance of the classics, a little harmless inorganic science, some music or art by way of sweetening, and domestic labor as a reminder of housewifely occupations, constituted the regimen of the typical woman's college. No inducements or opportunities were offered for young women to enter any professions except literature and teaching. Curiously enough, few women could be found prepared to fill the professorships except those who had been coeducated at Oberlin, Michigan, and Cornell, and to them was set the task of preserving femininity by a harmlessly miscellaneous culture.

Meanwhile the great tide of scientific education had risen; the evolutionary theory had been proposed, attacked, accepted by the greater scientists. New fields were thus opened to men, which women as yet could not enter. That which they had supposed would insure to them the highest intellectual life no longer sufficed. In the larger coeducational colleges, laboratories and elaborate scientific equipments were rapidly acquired. Women, more conservative and true to the traditions of higher education, continued to choose classical courses long after science had become the most prominent feature of the younger institutions. Slowly the women's colleges were compelled to add zoölogy and physiology, laboratories and apparatus to their meager courses in science.

In 1886 two thirds of the senior class at Wellesley graduated from the classical course; in 1890 more than one half took the degree of Bachelor of Science.

Competition with coeducational colleges made it evident that the women's colleges were offering almost no facilities for specialization and graduate study. To meet this deficiency, and yet to preserve the distinctive ideals of separate education, a new combination was devised. Bryn Mawr proposed to offer opportunities for advanced study similar to those afforded at Johns Hopkins and Cornell, but under social conditions and restraints such as characterized the women's colleges, thus securing womanliness at no cost of intellectual development. Harvard Annex offered approximately the same courses under the same professors as Harvard itself, but with meager equipment and social isolation. Barnard College, and recently the Yale graduate department, have recognized the principle of coeducation in a restricted form.

The tendency to provide the same kind of education for women as for men, and the desire to preserve that intangible quality, womanliness, were constantly at variance in all these different methods, producing some unexpected results. Here and there women who were coeducated specialized. Perhaps Ph. D.'s of Zurich, after a short and brilliant career, fell in love in a hopelessly feminine manner, married, and apparently wasted all their intellectual achievements in cuddling babies and training the immigrant domestic; all this without any sign of discontent or domestic tragedy. On the other hand, as many sweet, feminine, docile creatures from the women's colleges, whose femininity had been preserved to ideal sweetness, went into law or medicine, declined to marry at all, and lived happy, unregretful lives.

The same contradictions were to be found among educated men. The farmer's boy who had taken a course in scientific agriculture refused to farm and went into journalism; the college professor's son failed in the classics, but made a fortune on a Western cattle ranch; the orthodox became the heterodox, and, behold, everything was topsy-turvy! Given a boy, a girl, and a curriculum—results: The boy a poet, the girl a lawyer, and the curriculum something which had somehow missed fire! No anxious parent or zealous professor could be sure of the effect of a given training.

Into the midst of this uncertainty the elective system was projected by one of the most conservative of Eastern colleges; it said, "Let him follow his bent." The thought spread like contagion to the coeducational colleges, where traditions were less fixed, and gradually to the older men's colleges as well; but not to the women's colleges. If a girl followed her bent, who knew what might happen? She might become too "learned for the common uses of life." The fear that she will not marry was less alarming than the thought "men will not marry her." The elective system meant freedom of choice, the inevitable result of which is freedom of life. Intelligent men saw clearly that an intelligent, highly-educated woman might possibly hesitate to sacrifice the pure delights of scientific learning for the pettiness of domestic routine and the satisfactions of burden-bearing motherhood. Therefore she must not be *too* highly educated, lest freedom turn her from her proper sphere.

In our day the cry of alarm has again been raised; more and more women are coming up to the doors of the colleges; if intelligent women do not marry, the future of this race is uncertain, and civilization itself is in danger. Some would even make this question the test of the varied systems of education for women, in the hope of finding one which may be labeled, "Warranted not to divert women from marriage!" But the problem is neither so imminent nor so serious as many suppose. Two thirds of all women graduates marry; the one third who do not are an infinitesimal part of the thirty million five hundred thousand women in the whole United States. The one third in our day have, on the whole, as good a chance to obtain a suitable training as men in the same lines. They specialize and find growth and contentment in the sense of power and usefulness. It is not their destiny which should concern us, but rather the destiny of the other two thirds who do marry. The question arises, Does their college training bear so definite and satisfactory a relation to their after-lives? I fear not. It is constantly impressed upon a boy during these four years that he must find out what he is good for; he must either be fit or ready to be fitted to do something which will have a definite market value. But the destiny of the girl who goes to college is carefully concealed from her. During these four years, who says to her: If you marry, you will need biology, the sciences of life and reproduction; hygiene, the wisdom to attain and preserve health; sociology, the laws which govern individuals in society; chemistry, physics, economics, all the sciences which may help to solve the problems which the housewife must meet; literature and language, the vehicles of poetry and inspiration? No one has the courage to suggest any of these as suitable—nay, absolutely essential—to the successful fulfillment of her probable vocation in life. Young women are turned blindly adrift among a mass of subjects, with no guide but a perverted instinct, and with many a hindrance in the shape of tradition and ridicule. In all ages men have united in adoration of the dignity of domesticity and the sacredness of motherhood, yet any loving, foolish, untrained, inefficient creature has been held good enough to be a wife and mother. We do not expect a man to become a distinguished engineer or a professor of Latin by studying a little literature, history, music, and language; yet we expect a woman to undertake an occupation for which, in this age at least, a certain definite kind of training is necessary, without anything more applicable than "general culture."

The want of co-ordination between training and the needs of life in the education of women has repeatedly brought into question the desirability of the higher education at all for a woman who is to return to the home. As a result, there is a distinct tendency to demand a differentiation in the education of women. The recent proposal of a new type of woman's college is, in fact, a demand for a separate technical school in which there shall be a liberal scientific training with special reference to their domestic occupations and functions.

This is, however, not a new idea. In all those State colleges in which agriculture and the mechanic arts are taught a similar problem and a like solution were presented. The farmers demanded that the agricultural colleges teach how to plow, sow, and reap, rather than how to think; as a result, many of these institutions are to-day little more than high schools, with manual training added. In others it was perceived that, to make a successful farmer or engineer, a man must have the power to think clearly, accurately, effectively on any subject. The best agricultural colleges give little beyond what may be called laboratory demonstrations in field and barn, while the most progressive engineering schools no longer attempt to turn out skilled mechanics. Teachers of these subjects prophesy the complete elimination of shop work and practical farm operations from university courses, and their relegation to the position of entrance requirements.

Shall, then, the woman's college be a technical school, where she may learn all the practical details of housekeeping and sanitary science? It is the same problem, and must also be answered in the negative. Technical schools, wherever outside the university atmosphere, show a fatal lack of breadth. Physicians with only the training of the medical school, engineers with no ideas beyond their own specialty, farmers who despise *pure* science, housewives who are only perfect housekeepers, are the inevitable product of a purely technical education.

While such propositions as this are being widely discussed, the true solution is coming by a natural process. Within the boundaries of the new universities a few courses are offered to meet the specific needs of women's occupations. What women need is not to know how to cook, and wash, and lay a table, but how to think out clearly, accurately, and effectively any problem which they may meet in every-day life. As the numbers of women in the universities increase, and the influence of educated wives and mothers is more widely felt, there will be an adaptation of university work to the needs of women as well as of men. The now scarcely perceptible tendency to emphasize the profession of wifehood and motherhood in its proper relations will be increasingly controlling in all education of women. Surrounded by the atmosphere of generous culture, molded by men and women of varied abilities, guided in the special preparation for her future, the young woman will soon be able to obtain as broad and as specialized a training as her profession shall require—a training which shall put her in touch with the best of the world for the benefit of her home and her children.

CONSUMPTION CONSIDERED AS A CONTAGIOUS DISEASE.

By A. L. BENEDICT, M. D.

A FEW years ago the newspapers were discussing rumors of the advent of leprosy in this country. Many were apprehensive of an epidemic of this disease, whose very name suggests all that is unclean, horrible, and loathsome. Although official reports made it certain that the lepers who had reached our shores were few, and that comparatively simple precautions could prevent the spread of the disease, public sentiment demanded the most rigorous quarantine and the sending back of those lepers who had already landed.

But there is in our midst another leprosy whose victims we meet, not outside the city wall warning us of their presence with the cry "Unclean! unclean!" but who walk the public streets, whom we meet in our places of business and amusement, in social gatherings, and, too frequently, in our very homes. It is doubtless a surprise that consumption should be mentioned in terms applicable to leprosy, but investigation shows that a close analogy may be drawn between the two diseases. Consumption or phthisis, as either word implies, is a consuming or wasting disease, characterized by a progressive failure of strength and an almost certain tendency toward death. Although the exact lesions differ in different cases, the essential nature of consumption is in inflammation, excited by a small germ which, magnified five hundred times, is just visible as a minute hyphen, usually tilted up at one end.

The same germ—the *Bacillus tuberculosis*—may lodge in bones, joints, the intestines, the membranes of the brain, and, in fact, in almost any part of the body. Thus, consumption is only a special manifestation of the general disease—tuberculosis. The germs are not merely thorns in the flesh, producing a local inflammation, but they are plants which multiply rapidly, and form in their growth poisons as dangerous to life as if they were elaborated in one large plant instead of millions of small ones.

The germ of leprosy is very like that of tuberculosis. In both diseases, little masses of inflammatory tissue form around the bacilli, and then, not having the vitality of normal structures, these break down, involving other parts in their own destruction. Leprosy attacks chiefly those parts of the body which are exposed, like the hands, feet, arms, and legs, though it occasionally invades the mucous membranes, and it is seen in the nose, mouth, and throat. Tuberculosis, on the other hand, seeks the deeply seated organs by preference, though it, too, may affect the throat; and many of the so-called scrofulous sores are tubercular. Leprosy thrusts out its hideous deformities and disgusting ulcers to the gaze of the passer-by; tuberculosis hides its devastations beneath an exterior which may be even beautiful. The greater sufferer from fever, lassitude, and pain is the consumptive. So, too, is his mental suffering greater, since the leper is usually a person who has lived in filth and squalor, while the tubercular patient is more likely than not to be one who has worked hard to gratify some ambition and who feels more keenly than bodily pain the necessity of abandoning active life. Leprosy is not a rapidly fatal disease, usually lasting from nine to twenty years after its recognition. Consumption fortunately does not allow its victims to linger so long, but kills in from one to four years in the great majority of cases.

In order to see how formidable an enemy we have in tuberculosis, let us contrast it with some other diseases which are even more dreaded. Leprosy is rare in most civilized countries; even in Asia Minor it causes less than one per cent of the total death rate. Typhoid and scarlet fevers are each held responsible for three per cent; diphtheria and pneumonia, for five per cent each. The deaths from consumption alone, omitting such tubercular troubles as hip-joint disease, Pott's disease of the spine, some forms of meningitis, intestinal marasmus, caries of bone, and many abscesses, make up, according to one authority, about twenty per cent of the total death rate of this country. It is estimated that one third of all deaths occurring in the medical wards of hospitals are due to tuberculosis, and that a fifth of all surgical cases treated—many of which are cured—are tubercular. We may bring these statistics home by saying that you and I were born with one chance in five of dying of some form of tuberculosis. If our chance of being instantaneously and decently killed by an electric shock were one in five hundred, we would turn the wheels of progress back twenty years rather than allow an electric light or a trolley car to threaten our safety. No pains and no expense are thought too great in maintaining a quarantine against cholera, smallpox—which the sensible part of the community is already vaccinated against—diphtheria, and the like. Large appropriations are made that there may be tried a yet unproved defense against diphtheria, but to the insidious enemy that numbers its dead by hundreds where these other open foes count theirs by scores we are blind. It is time that the veil should be drawn from the loathsomeness of "the great white scourge," that the false sentiment which poetry and prose have thrown over infection, blood poisoning, suppuration, and decay should be dissipated.

In the case of a disease so fatal and so general as tuberculosis, the considerations of cause and prevention become all-important, especially since few cases are curable. The most sanguine authority on the subject—a New York physician whose patients can command every means of relief, and who usually seek medical advice at the first suspicion of illness—claims to cure only one consumptive out of six. Most physicians would consider this an extremely high proportion, while with regard to well-established cases there is no question that all or nearly all end in death.

It has been demonstrated by the experimental inoculation of guinea-pigs and other animals that the tubercle bacillus needs no dormant period outside the body—such as is requisite for certain other germs—but that the disease is directly transmissible. There are two factors in the establishment of any disease—the presence of the germ and a certain predisposition. It is not a metaphor but a plain statement of fact to compare the former to the planting of a vegetable, the latter to the adaptability of the soil. Some germs will thrive only under the most favorable conditions, others will grow in almost any person. In other words, some diseases are liable to occur only under definite circumstances of predisposition, and these may be readily prevented, while others are virulent, attacking whole communities at once. Fortunately, the latter usually "exhaust the soil," so that if the patient recovers from one attack he is not liable to a second, though there are exceptions to all such rules. Measles, scarlet fever, smallpox—in fact, nearly all the eruptive fevers—find the proper soil in almost every body, but the something on which they thrive is exhausted, so that thereafter an immunity exists. Tuberculosis never "exhausts the soil." Even if the patient recovers—as not infrequently happens in surgical cases, hip-joint disease, inflammation of bones, etc.—he is always liable to a subsequent attack of tubercular disease, not necessarily in the same organ. On the face of the matter it would seem that a germ that kills a fifth—or, to give the lowest estimate, a tenth—of the civilized human race is not very exacting as to the soil afforded. Yet until recently consumption has not been recognized as a contagious disease, and the factor of predisposition, as determined by heredity, lack of proper air and exercise, failure of vital strength, impoverished blood, "weak lungs," etc., has been considered paramount. It is certainly true that a robust person may be placed in the most intimate contact with the germs of tuberculosis and throw them off or inclose them as inert foreign bodies in his tissues; on the other hand, nearly every one is at one time or another susceptible to tuberculosis and escapes or becomes a victim according as he is free from or is exposed to contagious influences. A mother and her baby, for instance, both die of consumption and heredity is blamed. But does the child inherit the bacilli, or does it imbibe them in the milk—where they have been repeatedly found—or are they inhaled as the mother bends over the child and smothers it with kisses? Again, brothers and sisters drop off one after another, and it is said that "consumption runs in the family"; but we would seek another explanation if the same succession of deaths were due to scarlet fever. Tubercle bacilli have been found in the dust on the top of the door and window casings, in carpets, bedding, and wall paper. Is it not rational to suppose that these foci of infection have more to do with the death of successive members of the family than a hereditary taint? When we note that members of the family who leave home escape the disease and that other persons occupying the same house later contract it, is not the evidence tolerably clear? Are not husbands and wives, roommates, and other persons intimately associated almost as likely to follow one another with consumption as if there were a blood relationship? Such questions can only be fully answered by a careful collection of statistics, taking advantage of the experiments of chance; enough evidence has been already gathered to warrant the adoption of the contagiousness of tuberculosis as a practical basis for preventive measures.

The predisposing tendencies to tuberculosis may be modified, often absolutely removed, by hygienic and tonic treatment. If, however, any systematic attempt is to be made to stamp out the disease, such an attempt as has been eminently successful in the case of cholera and smallpox, it must depend upon isolation and disinfection. We may logically hope to be able to vaccinate against any disease which occurs but once in a lifetime—that is to say, we may dwarf the germs so that their growth will occasion no dangerous symptoms while they will still "exhaust the soil" so as to prevent a subsequent development of the corresponding unmitigated germs. This hope has been realized only in the case of smallpox, but it is quite likely that the bacteriological horticulturist may learn to dwarf the germs of scarlet fever, typhoid, and similar diseases. Diseases, on the other hand, which are essentially chronic, which remain or recur without a tendency to self-limitation, must be attacked in another manner. The failure of Koch's tuberculin was simply an illustration of this general principle.

At present the main obstacle to the carrying out of measures of quarantine against tuberculosis is public sentiment. Public sentiment requires all smallpox patients to be sent to a pest house, though, with rare exceptions, such patients can be of danger only to the ignorant who have refused vaccination. Public sentiment kept a poor Chinese leper confined in a bare stone cell with almost the same neglect of humanity as characterized the treatment of prisoners in the dark ages. Public sentiment checked immigration and commerce in the effort to quarantine against cholera. Yet this same public sentiment would characterize as barbarous the isolation of consumptives, with every provision for their comfort, in hospitals so arranged as not only to prevent the spread of the disease, but to afford every possible chance for the relief or cure of their inmates.

While yielding to the inevitable, something may still be done to limit the spread of tubercular disease without removing the consumptive from his customary associations. Barring surgical tuberculosis, in which the ordinary antiseptic dressings and the destruction of old bandages by fire will suffice, we have to contend against the dissemination of germs by the various excretions of the body. Fortunately, in the vast majority of instances we can restrict our attention to the expectorated matter. Few germs are exhaled in the breath, yet it is unwise for any one with a severe cold or bronchitis to be in the same room with a consumptive, and no one should sleep night after night in the same bed. If it is absolutely necessary for an attendant to sleep in the same room, the freest ventilation should be insisted on.

Our sleeping cars are, I believe, a positive source of infection. A considerable proportion of travelers are consumptives seeking warmer or drier climates. An almost equal number are persons predisposed to the disease, but not yet infected, going to the same resorts to escape our northern winters. Imagine such a person passing three or four days in the confined air of a palace car, with several consumptives sleeping in a berth whose hangings have been infected from the exhalations of consumptives on previous trips, and, on reaching his destination, spending a number of months at a hotel which is practically a hospital for consumptives! In many instances public hospitals are breeding places for tuberculosis, patients with various depressing ailments, including those that render the lungs particularly vulnerable, being assigned to wards occupied also by consumptives. Such instances are more often due to lack of funds than to a failure to appreciate the danger.

The idea is apparently widely entertained that sidewalks and the floors of public conveyances and buildings are a sort of ever-ready cuspidor. The habit of ubiquitous expectoration—always disgusting and unnecessary in health—becomes dangerous when practiced by consumptives. Sweeping trains catch a surprising amount of filth, and tubercle bacilli as well as other germs have been found in the skirts of ladies' dresses, whence they may be introduced into houses. How often do we see a consumptive shivering over a register and dropping the scourings of the cavities in his lungs down the hot-air pipe, to be dried and disseminated throughout the building! An apparatus, differing only in detail from the ordinary register, is used in laboratories for the experimental inoculation of guinea-pigs with tuberculosis.

On the other hand, the consumptive must not swallow the infectious material raised from the lungs, for, by so doing, he might set up tubercular inflammation of the stomach and intestine. The expectoration should take place into a cup that can be readily disinfected, or into a waterproof-paper receptacle that can be burned. For disinfection, strong carbolic acid or a solution of zinc chloride may be used, and the disinfectant must remain in contact with the sputum for a long time; preferably the cup should always contain some of the solution. For use away from home, pocket cuspidors, or those fitted into canes, may be used. The sputum should never be allowed to dry. Handkerchiefs, sheets, etc., should be boiled for at least half an hour—so resistant are the tiny plants that cause the trouble—apart from other clothing.

The communication of tuberculosis through cow's milk is at length obtaining the attention that it deserves. Milk once infected can not be made safe except by such treatment as will seriously interfere with its nutritious qualities. Ordinary germs of putrefaction may be killed by boiling, or even by letting the milk stand in water previously brought to the boiling point, but the only satisfactory dealing with tuberculous milk is destruction at the hands of Government inspectors.

So long as tubercular patients are allowed the freedom of social intercourse they must be held to the moral obligation of certain restrictions. Kissing has been called an elegant method of transmitting disease. Consumptives must hold their affection in check; above all, they must not kiss little children, whose resistance to disease is slight. They must recognize the necessity, if they are not to be isolated from their surroundings, of isolating from themselves children and those at all inclined to tubercular trouble. Cleanliness of habit and thorough disinfection of sputum must largely depend upon the conscientiousness of consumptives themselves. All these precautions involve a great amount of self-sacrifice on the part of those affected with this terrible disease; they necessitate the realization of certain facts which we would gladly keep from the sufferer; they demand a sacrifice of sentiment on the part of those near and dear to the patient. To this extent the attempt to exterminate the greatest plague of civilization is cold-blooded. But a worse alternative confronts us. So long as we neglect to consider tuberculosis as a contagious disease, though not so conspicuously so as the eruptive fevers; so long as we occupy homes in which the germs of this disease linger, neglecting to disinfect, repaint, and repaper; so long as sick and well mingle without an effort to destroy the virus, so long will the great white scourge shorten valuable lives and bring mourning on millions. Because its foulness is concealed, because it strikes painlessly and its wound is not felt for weeks or months, because it does not mark its victims in letters of red or choke them in a week with a visible mass of poison, shall we ignore the fact that this insidious, relentless foe is the chief lieutenant of Death?

THE PAST AND FUTURE OF GOLD.

By CHARLES S. ASHLEY.

IT is, I think, universally claimed by advocates of the free coinage of silver that the so-called demonetization of silver has led to an appreciation in the value of gold; and that this appreciation has worked grievous hardship to the debtor, or, what is largely the same, the producing classes, who are thus obliged to pay in a more valuable currency than that in which their debts were contracted. The claim is that, by an artificial change in the value of the dollar, the farmer has to produce twice or three times as many bushels of wheat as formerly to pay off his mortgage. The resulting embarrassment of the debtor classes has, in this view, spread among other classes, and has led to panics and long-continued depression in business. Aside from the natural desire of the silver miners to have their product doubled in debt-paying power, this is the whole basis of the silver agitation.

If one were to say that for this theory, upon which an international agitation has been built, and which is countenanced by a large number who have given the matter considerable investigation, some of whom are generally reputed to be competent for the purpose, there is absolutely no foundation in fact, and that, so far from there having been a rise in the value of gold, there has been an appreciable fall, he might be thought to take an extreme position. To that position, however, a careful examination of the facts has led me; and this article is written to present the evidence on the question.*

To ascertain the value of gold, two sources of inquiry are open: First, what is the comparative standing of gold in the mass of commodities, such as labor, land, agricultural products, manufactured products, etc.? Second, what are the influences directly affecting the value of gold, such as rate of production and relative demand for its use? In considering the evidence on the first point we must be careful to bear in mind what our silver friends generally, if not always, ignore—i. e., the influence of railways and inventions in cheapening products. Kerosene sold at Toledo forty years ago for seventy-five cents a gallon; recently as low as five cents. If, then, we ignored all other commodities and the influence of discovery, we might reach the absurd conclusion that gold had appreciated fifteen times and silver seven and a half times in forty years. So with the value of wheat and cotton in Liverpool. Improvements have cheapened transportation so vastly that, though the Ohio farmer now gets more for his wheat and corn than he did in the "forties," those products sell in Liverpool for one third the former price. So this low price in Liverpool does not mean that gold, as compared with wheat and corn, has risen. It merely registers the force of other circumstances. In using this method of comparison, therefore, we must be careful to consider not simply present as compared with former prices, but also other matters affecting market values; and it is best, whenever possible, to make comparison with commodities where the methods of production and transportation are comparatively unchanged.

I. For the purpose of comparison we shall go back a period of fifty years, and by observing the change in price-level of a given amount of gold we shall have pretty clear evidence of its rise or fall. Such a method ought to meet with acceptance by the silver men, because they are, I think, universally fond of asserting that for hundreds of years the "bimetallic standard" provided a good currency, free from all objections, and that our great

* Never until the past few months have the "gold" men seemed to put forth their case in public argument. Their feeling seemed to be that the silver agitation was a piece of childish folly which required simply a little soothing talk about international bimetallism and "increased use of silver," and other Utopian schemes. Accordingly, the silver men have really had the field to themselves, and have filled the air with talk about the "appreciation" of gold, "the crime of '73," etc., almost without contradiction; so that the public mind has given far more credit to these fairy tales than could otherwise have happened.

object is to reverse the current of events and return to the practice of the past, from which the nations have one by one unfortunately departed. The "bimetallic standard" was in force in the United States fifty years since—so it is claimed—although the actual standard of the country after 1834 was gold, and less silver was then coined in a year than has been issued of late years in a month or even in a week, because the gold constituting a dollar could be bought slightly cheaper than the silver in a silver dollar, and therefore, though the coinage of silver was nominally "free," it had really ceased to be "basic money" long before the "crime of 1873" had been thought of.* If, now, the evidence shows that the existing standard of value, or "basic money," has lost instead of gained in value since the days of the "bimetallic standard" of glorious memory, then the complaints and theories of the free-silver men are without any solid foundation; and the existing agitation is like all agitations destitute of justice, simply a hindrance to the establishment of firm confidence and prosperity, and, in short, an unmitigated nuisance with which no compromise should be made.

It is a singular fact that the method of showing that the general level of prices has greatly fallen, and that therefore the gold dollar has risen, is to take the statistics of prices in great centers as a final basis. Wheat is cheaper in London in 1895 than it was in 1845—much cheaper; so is cotton, so is corn—the three great staples. Therefore, say our friends, gold has risen, and the debtor, the farmer, and the producer are robbed! This, with a little bogy-talk about Shylocks, England, and Wall Street, is all there is of their argument.

Now, if we ask what the Ohio farmer received fifty years ago for his wheat and corn, we come upon the fact—which must be a disagreeable one for the cheap-money men—that he did not get as much then as he does to-day. No books of statistics take any account of the prices obtained by the Ohio farmer in 1845; and our statistical friends, overlooking (or "remembering to forget") the difference in transportation and other conditions then and now, conveniently assume that because wheat was higher in London in 1845 than now, the Ohio farmer must have been rolling in wealth. In the forties, the Ohio farmer seldom got twenty cents a bushel for his corn, and frequently burned it up; and men still living can remember how, in those

* This fact, which must be well known to men like Senators Teller, Jones, and Stewart, renders it difficult to acquit the leading advocates of free coinage of deliberate hypocrisy, when they so loudly declaim about "the crime of 1873" (which Senator Stewart himself voted to enact), and the "dollar of our daddies," which was practically non-existent.

glorious bimetallic days, the farmer got but twenty-five cents a bushel for his wheat. In those times the western farmer lived chiefly by consuming his own products, buying almost nothing. It is too clear for argument or dispute that it has been railroads, telegraphs, produce exchanges, and such-like means of facilitating exchange, and not gold or silver, that have caused the fall of the great staples in commercial centers—a fact easily verifiable by any western man who will consult the oldest residents of his town.

In a late number of The Forum, that excellent statistician, Mr. Edward Atkinson, has given a most interesting table which, in the present connection, I can not do better than copy. The table was constructed to show at a glance the variations in price of the principal commodities as expressed in gold.*

Prices, Wages, Purchasing Power.

	1845.	1860.	1865.	1870.	1880.	1890.
Meat	79·4	100	197·0	174·3	103·6	99·6
Other food	82·8	100	240·3	146·3	116·9	103·5
Cloths and clothing	97·1	100	299·2	139·4	104·5	82·4
Fuel and lighting	......	100	237·8	196·5	100·2	92·5
Metals and implements	110·8	100	191·4	127·8	96·3	73·2
Lumber and building material	106·7	100	182·1	148·3	130·9	123·7
Drugs and chemicals	121·0	100	271·6	149·6	113·1	87·9
House furnishings	102·3	100	181·1	121·6	85·2	69·5
Miscellaneous	114·8	100	202·8	148·7	109·8	89·7
Average of all prices	102·8	100	216·8	142·3	106·9	92·3
Average of all wages	86·8	100	143·1	162·2	141·5	158·9
Average wages by importance	85·7	100	148·6	167·1	143·0	168·2
Salaries of city teachers	74·8	100	134·7	186·3	182·8	186·3
Paper money	100·0	100	49·5	81·1	100·0	100·0
Gold price of silver bullion in London	95·3	100	99·0	98·2	84·7	77·4
Purchasing power of wages	84·4	100	66·0	114·1	132·3	172·1

In brief, the table shows that the prices of many commodities rose very much between 1845 and 1865, and afterward fell a little lower than the 1845 level; while wages, on the contrary, not only did not recede, but continued to advance after 1865. It shows another interesting fact—*that* 1865 *is the date when prices began to fall, and not* 1873; and thus discloses the purely artificial nature of the effort to make the era of cheap prices coincide with the "demonetization of silver" in that year.

In Mulhall's History of Prices (page 7) the author brings together in a short comparison a statement of the views of various authorities on the subject of the rise and fall of prices.

* For the excellent discussion as to the price variations of the different commodities, the reader must be referred to the article itself, which is a good antidote for the reckless assertions and hasty theories current on this subject.

YEARS.	Soetbeer.	Jevons.	Laspeyre.	"Economist."	Mulhall.	Medium.
1845 to 1850	100	100	100	100	100	100
1851 to 1855	114	107	111	...	104	109
1856 to 1860	125	120	122	127	105	120
1861 to 1865	127	120	123	...	110	121
1866 to 1870	125	121	...	140	111	124
1871 to 1875	136	...	...	127	112	125
1876 to 1880	127	...	...	115	99	114
1881 to 1884	124	...	...	105	92	107

A study of any of these tables will convince one that there is an enormous exaggeration in the way the cheap-money men talk about the fall of prices. While there has been to some extent a fall in the price of most products in centers of trade, it is by no means very extensive or portentous.

According to Mulhall (History of Prices, page 7), cotton in the United States averages thirty-three per cent higher in 1881–'83 than in 1841–'50; and wheat two per cent higher. Owing, however, to the great fall in transportation, and to improvements in agricultural machinery, the farmers' increased remuneration is by no means expressed by these figures. For corn the showing is still better, probably amounting to something like one hundred per cent for the average American farmer. During the same period pork has risen fifty-six per cent; tobacco, forty-four per cent; butter, forty-five per cent, and cheese eighty per cent—all in centers of distribution, while they have risen still more in the hands of the producer. If my personal recollection is at all reliable, we pay in Toledo, Ohio, to-day more for eggs, chickens, potatoes, and fruits than twenty years ago in greenbacks. Thus, by a little discrimination, we see that the "great fall in prices," so often and so lugubriously spoken of, is in the great centers where the consumers and not where the producers live. Instead, therefore, of being a calamity, this fall in prices has been an unmixed blessing. The farmer gets more for his product; the city man pays less. Such has been the result of the construction of railroads, the most beneficent and far-reaching of all practical inventions. And yet, with locomotive whistles reaching well-nigh every ear in the country, from lines of railroads having a mileage of nearly one hundred and seventy thousand in the United States, our free-silver friends ignore their existence, and, on the basis of London prices in former times, build up a purely imaginary farmers' paradise in contemporary America.

The evidence afforded by wages shows either that the money standard has not risen, as claimed, or that the working classes have received an astounding increase of wages. Take the trades in which the conditions are wholly or comparatively unchanged by modern inventions, and in a country where no economic revolution has occurred—England: *

Year.	Shillings per week.		
	Blacksmith.	Mason.	Carpenter.
1740	16	16	15
1840	21	23	20
1880	32	35	30

Thus wages are seen to have advanced about twice as much in the forty years, 1840 to 1880, as in the previous century. In the United States Mulhall gives tables (Dictionary of Statistics, page 463) showing that operatives' wages have risen from two hundred and fifty to three hundred dollars per annum in the thirty years beginning with 1850. Even during the last few years, in spite of the depression prevailing, I very much doubt if wages and salaries have, taken as a whole, declined at all, or at any rate so much as is usually supposed. Only a few days since I read in a newspaper of the city in which I live a table showing that the salaries of teachers in the public schools had had a steady average increase during the past four years; and the increase was not confined to any one year, but continued gradually through the whole period. However this may be, we can not turn to any reputable authority which does not show that a large increase of wages has occurred during the past fifty years in every civilized country. If, therefore, "gold has risen fifty per cent" in value, the working classes have had a far more wonderful advance than they or any one else supposed.

Again, real estate is one of the greatest of commodities, and if the dollar has increased in value it ought to be reflected in the fall of real estate. No such fall has, however, taken place. Farms in the United States, irrespective of cattle, implements, etc., rose from two hundred and fifty dollars per inhabitant to two hundred and eighty dollars per inhabitant during the thirty years ending in 1880 †—a fine increase, considering the accompanying increase of population.

Another consideration is of far greater weight than any derived from a single commodity. If land rises in value, the rent increases; if money rises in value by reason of scarcity, the rate of interest advances. If, then, the combined Shylocks of the world, together with the banks, England, and Wall Street, have "demonetized silver" in order to "corner money" and boom the rate of interest, there ought to be traces of it. Singular as it may be to our silver friends, there seem to be none. In fifty years the

* Mulhall, Dictionary of Statistics, p. 461.

† Ibid., p. 9.

average rate of interest in the United States has been about cut in two. The best railroad bonds formerly bore seven and ten per cent interest; now they bear four and five per cent. The same proportion holds good of United States bonds and of municipal indebtedness. Every decade has seen a great decline in the rate of interest. If, now, money is getting scarce, and if, as our silver friends claim, the quantity of money regulates its value, then interest should be three or four times as high as we find it. While I do not claim that the fall of interest, which has taken place in Europe as well as America, absolutely proves that the value of money has not risen, I do think it very good evidence of the fact; and it certainly shows that the "bankers' conspiracy" theory of the free-silver men is one of the wildest ideas ever put forth by men outside of insane asylums.

II. Having briefly considered what may be called the direct evidence bearing on the subject, it remains to consider the indirect—the circumstances occurring during this half century which would naturally have an influence on the value of gold money. One of the most prominent of these is the growth of banks and the popularization of checks. The first English bank was established just two hundred years ago. "Since 1840 the banking of the world has increased about eleven fold—that is, three times as fast as commerce, or thirty times faster than population."

In 1870 the Bank of Germany did about seventy-five times the business it transacted in 1820. A like state of affairs prevails in the United States. A very large proportion—some say ninety-five per cent—of the country's business in done by checks which supply the place of currency, and diminish to their extent the necessity of the use of gold. Fifty years since comparatively little business was done through banks. In this way the currency, while maintaining its quality, has been vastly expanded; so that the actual currency (counting checks) circulating in the United States to-day is perhaps one hundred times what it was in 1845. Banks and the use of checks also save the loss of gold arising from shipwreck and other accident, and, by storing it quietly in vaults, save the loss by abrasion which would occur if it were actually used in business.

A great economy in the use of gold has been made by modern electroplating inventions. Few things are now made of solid gold. Solid gold watch cases are superseded by "filled," which are stronger and wear sufficiently well. Plate, too, has largely gone out of style, a circumstance which is a principal cause in the decline of silver. "Official returns of silver stamped in Great Britain for plate and ornament show an annual average of 1,091,-

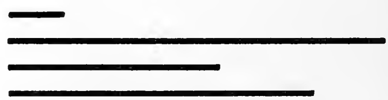
000 ounces in the years 1821–'50, and only 790,000 ounces in the decade ending 1880." *

But the most tangible and solid evidence that can be found on the subject lies probably in the history of the production of gold. On page 174 of the Report of the Director of the Mint for 1894 is a table giving a statement of the annual product of gold from the discovery of America. It may be summarized as follows:

Periods.	Average annual product.
1493 to 1520	$3,855,000
1701 to 1720	8,520,000
1801 to 1810	11,815,000
1850 to 1855	132,513,000
1890	118,849,000
1893	157,222,000

Prior to the Californian period the average product for three hundred and fifty years was about $8,794,000. Before 1493 it was still less. The value of gold therefore—its standing relatively to other commodities—may be said to have been determined by this long-continued rate of production. Then almost in the twinkling of an eye came the Californian and Australian discoveries. The annual product of gold became nearly twenty times what it had been: and this rate of production has not only been substantially maintained, but is now showing a rapid increase. The extraordinary contrast between the annual product of gold prior to and after 1850 deserves a diagram:

World's annual product of gold, 1493 to 1850.
World's annual product of gold, 1850 to 1893.
Total product, 1493 to 1850, $3,158,233,000.
Total product, 1850 to 1893, $5,240,878,000.



It is therefore difficult to imagine that gold has appreciated fifty per cent, or to any other extent, in the face of this wonderful and continuous production.† The facts above stated—its standing relative to labor, land, and commodities not greatly affected by modern conditions, the economy in its use effected by banks and checks, and its novel rate of production—lead me, on the contrary, to think that since 1845 gold has suffered a slight decline, some-

* Mulhall, History of Prices, p. 11. "Notwithstanding the great increase which has taken place in the means of all classes during the interval, the average Englishman of the present day consumes less gold than the Englishman of fifty years back." (J. E. Cairnes, Essays, p. 134.) M. Chevalier likewise finds a decrease in the consumption of gold for tableware purposes during the present century, both in England and France.

† J. E. Cairnes (Essays, p. 115) states the gold production of the three hundred and fifty-six years from 1492 to 1848 to have been, in round numbers, £400,000,000—an amount nearly supplied, as he states, every decade at the present rate of production.

thing like twenty-five per cent.* The decline was much discussed and feared about 1855, owing to the then novel rate of production; but men get used to all wonderful things, and cease to consider what they get used to. Nevertheless, the force of vast production continues to operate year after year.†

So much for the past of gold; now for its future. In 1877 Dr. Suess, of Austria, an eminent geologist, startled the economic and financial world by proving to his own satisfaction that the world's production of gold was destined to decrease and in no very long time to become insignificant. His theory was based on the fact that gold, being one of the heaviest metals, would naturally, during the molten period of the earth, have sunk very far from the surface—too far to be mined successfully. This theory, though not corroborated by any direct or historical evidence, obtained considerable currency, and was an important factor in promoting the sentiment for bimetallism.

Like the other scientific theory that no man could ride a two-wheeled vehicle because of the perpetual tendency to fall over, and another, supposed to be based on the laws of motion, that a ball-pitcher could not "curve" a baseball, this theory has proved to have no foundation in fact. It is now evident that the production of gold for the next fifty years will be altogether unprecedented. This production has been vigorously stimulated by fresh discoveries of mines, by new and cheap mining processes, and by the fall of silver, leading miners to pay greater attention to the other metal. The operation of the latter factor is best seen in

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* M. Chevalier, in his once celebrated book on the Depreciation of Gold, says that since 1492 silver has fallen in the ratio of six to one and gold four to one—i. e., that gold is worth only twenty-five per cent what it was in 1492.

† In volume clviii of the North American Review, p. 464 (April, 1894), President E. B. Andrews, of Brown University, asserts that "it is universally admitted that since 1873 there has been an extraordinary appreciation of gold." This is a very easy way to settle a question. For my part I do not think there is much more evidence of a rise since 1873 than since 1845. Land has risen, wages have risen, cheese, butter, eggs, beef, and many other commodities have risen, and interest has fallen—all going to show that gold has continued to fall. The only commodities which have fallen greatly are those like iron, in which great inventions have been made, tending to reduce the cost of production, or, like coal, where the extension and improvement of railways, canals, and telegraphs have quickened and cheapened transportation. The Suez Canal, Indian railways, and western railroad building in the United States have naturally had a profound effect on the prices of wheat, corn, and cotton. In Mr. Atkinson's article, above referred to, this claim of an appreciation of gold since 1873 is not admitted, but controverted. Instead of being "universally admitted," this alleged appreciation is, in my opinion, generally denied by the best authorities on the subject, among whom Mr. Atkinson stands high. It is true, however, that gold has not depreciated since 1873 so fast as in the fifties. The reason is not far to seek. The production of the Californian period was extremely sensational, so long as it was new, and led men to fear that gold would be a drug in the market—thus "bearing" the price of gold.

Colorado, where the production of gold rose from $5,300,000 in 1892 to $7,527,000 in 1893, and to about $12,000,000 in 1894. The production for 1895 in Colorado is confidently expected to reach $20,000,000. The Director of the Mint is of opinion that the production of the United States rose from $33,014,981 in 1892 to about $39,500,000 in 1894, while other good authorities put the production for 1894 at $50,000,000. The annual product of other great producing countries shows a large increase of late years. In his notable article in the North American Review,* Mr. Preston states that the world's production of gold for 1893 was "the largest in history, amounting in round numbers to $155,522,000." The product for 1894, however, very largely exceeded—probably by twenty-five per cent—the product of 1893. There is scarcely any assignable limit to the gold known to exist in the world or even in the United States. It is said that simply by the removal of the restrictions on hydraulic mining California can produce half a billion of gold. The quantity easily obtainable in Colorado is stupendous. Other parts of the United States are also rich, while Australia and Russia probably possess a stock equal to our own, and are increasing the annual output every year.

But the most surprising and, so to speak, revolutionary facts regarding gold that have recently come to light are those concerning the great Witwatersrandt mines of South Africa. There gold is found in enormous quantities and in a cheaply workable form in a new geological situation—"in strata the component parts of which are pieces of quartz held together by a clayey cement." A part of this tract—about one fifth of the whole—has been separately explored by a mining expert sent by the German Government and by a distinguished American mining engineer, Mr. Hamilton Smith. Each of these gentlemen concluded that the minimum amount of gold obtainable from the tract surveyed was upward of a billion dollars. These mines began production in 1887, when their product was about $500,000. In 1893 it was nearly $30,000,000. It is therefore not hazardous to predict that from this one mine will come in the near future enough gold to double the total existing stock of about $4,000,000,000.

There is therefore, in my opinion, not the slightest fear of an appreciation of gold arising from its scarcity. It is as certain as anything can well be that the abundance of gold will be such as not only to prevent a rise in its value, but materially to accelerate its fall. It is not probable that the increased production will be relatively as great as that of the Californian period; but the absolute increase may well be larger, and it would not be surprising to see an annual production of $300,000,000 worth of gold by the

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* January, 1895, p. 46.

end of this century. The real danger is that gold will fall so much as to cause a contraction of credits; for no one will voluntarily give credit in a falling commodity or depreciating money standard. As the greater part of the world's business is done on credit, this possibility is most serious. It would be difficult to borrow large sums on long time for the construction of railways and other great works if capitalists were convinced that after ten or twenty years they would receive in full payment of a dollar of the present value of one hundred cents a dollar of the value of seventy-five cents.

Probably, however, the world will soon get used to the great increase in gold production, and cease to pay any attention to it, as was the case in the Californian period. Now, as then, we may expect that the vast gold production now going on will result in a rise of the general price level, in wages, and in the great relief of the debtor class. Barring the possibility of foolish experiments in currency legislation, which, in spite of much noise in irresponsible quarters, is but small, we are entering on an era of great prosperity, where all business will sail along triumphantly on an ever-rising tide of gold.

PROFESSIONAL INSTITUTIONS.

VII.—JUDGE AND LAWYER.

By HERBERT SPENCER.

IN the preceding division of this work, and more particularly in § 529, it was shown that in early societies such regulation of conduct as is effected by custom, and afterward by that hardened form of custom called law, originates in the expressed or implied wills of ancestors—primarily those of the undistinguished dead, and secondarily those of the distinguished dead. Regard for the wishes of deceased relatives greatly influences actions among ourselves, and it influences them far more among savage and semi-civilized peoples; because such peoples think that the spirits of the deceased are either constantly at hand or occasionally return, and in either case will, if made angry, punish the survivors by disease or misfortune. When, in the course of social development, there arise chiefs of unusual power, or conquering kings, the belief that their ghosts will wreak terrible vengeance on those who disregard their injunctions becomes a still more potent controlling agency; so that to regulation of conduct by customs inherited from ancestors at large, and ordinarily enforced by the living ruler, there comes to be added regulation by the transmitted commands of the dead ruler.

Hence originates that early conception of law which long continues with slowly increasing modification, and which, in our day, still survives in those who hold that Right means "that which is ordered"—firstly, by a revelation from God, and secondly by god-appointed or god-approved kings. For the theological view implies that governments in general exist by divine permission, and that their dictates have consequently a divine sanction. In the absence of a utilitarian justification which only gradually emerges in the minds of thinking men, there of course exists for law no other justification than that of being supernaturally derived—first of all directly and afterward indirectly.

It follows, therefore, that primitive law, formed out of transmitted injunctions, partly of ancestry at large and partly of the distinguished ancestor or deceased ruler, comes usually to be enunciated by those who were in contact with the ruler—those who, first of all as attendants communicated his commands to his subjects, and who afterward, ministering to his apotheosized ghost, became (some of them) his priests. Naturally these last, carrying on the worship of him in successive generations, grow into exponents of his will; both as depositories of his original commands and as mouth-pieces through whom the commands of his spirit are communicated. By necessity, then, the primitive priests are distinguished as those who above all others know what the law is, and as those to whom, therefore, all questions about transgressions are referred—the judges.

In small rude societies judicial systems have not arisen, and hence there is little evidence. Still we read that among the Guiana Indians the Pe-i-men are at once priests, sorcerers, doctors, and judges. Concerning the Kalmucks, who are more advanced, Pallas tells us that the highest judicial council consisted partly of priests, and also that one of the high-priests of the community was head-judge.

Though among the semi-civilized Negro races of Africa, theological development has usually not gone far enough to establish the cult of a great god or gods, yet among them may be traced the belief that conduct is to be regulated by the wills of supernatural beings, who are originally the ghosts of the distinguished dead; and in pursuance of this belief the ministrants of such ghosts come to be the oracles. Thus Lander tells us that "in Badagry the fetich-priests are the sole judges of the people." Cameron describes a sitting of Mganga, chief medicine man at Kowédi. After the chief's wife had made presents and received replies to her inquiries others inquired.

Questions were "put by the public, some of which were quickly disposed of, while others evidently raised knotty points, resulting in much gesticulation and oratory. When the Waganga [apparently the plural of Mganga] pretended they could not find an answer the idols were consulted, and one of the fetich men who was a clever ventriloquist made the necessary reply, the poor dupes believing it to be spoken by the idol."

Of ancient historic evidence readers will at once recall that which the Hebrews yield.

There is in the Bible clear proof that the ideas of law and of divine will were equivalents. Their equivalence is shown alike in the bringing down of the tables from Sinai and in the elaborate code of regulations for life contained in *Leviticus*; where the rules even for diet, agricultural operations, and commercial transactions, are set down as prescribed by God. Still more specific evidence, elucidating both the general theory of law and the functions of the priestly class, is supplied by the following passages from *Deuteronomy*:—

"If there arise a matter too hard for thee in judgment, between blood and blood, between plea and plea, and between stroke and stroke, being matters of controversy within thy gates: then shalt thou arise, and get thee up into the place which the Lord thy God shall choose; and thou shalt come unto the priests the Levites, and unto the judge that shall be in those days, and inquire; and they shall shew thee the sentence of judgment; and thou shalt do according to the sentence, which they of that place which the Lord shall choose shall shew thee."

Moreover, beyond the often recurring injunction to "inquire of the Lord," we have the example furnished by the authority and actions of Samuel, who, dedicated to him from childhood was a "prophet of the Lord," who as a priest built an altar, and, as we see in the case of Agag, was the medium through whom God conveyed his commands, and who played the part of both judge and executioner.

Of course we may expect that Egypt with its long history furnishes good evidence, and we find it. Here are relative facts from three authorities—Bunsen, Brugsch, and Erman.

"That the oldest laws were ascribed to Hermes, implies however nothing more than that the first germ of the civil law sprung from the Sacred Books, and that it was based in part upon the religious tenets which they contained."

Mentu-hotep, a priest and official of the 12th dyn., on his tomb, "prides himself on having been 'a man learned in the law, a legislator.'"

"The chief judge was always of highest degree; if he was not one of the king's own sons, he was chief priest of one of the great gods, an hereditary prince."

"All the judges of higher rank served Mo'at, the goddess of Truth, as priests, and the chief judge wore a small figure of this goddess as a badge round his neck."

A court which held a sitting in the 46 of Ramses II consisted of 9 priests (prophets and priests) and one lay member, the registrar. But in another case (Ramses IX) the lay element preponderated.

Which last statement implies a step toward differentiation of the secular from the sacred in local administration.

To the circumstance that the Greek States did not become fully united has already been ascribed the fact that the Greek priesthood never became a hierarchy. Says Thirlwall—"the Greek priests never formed one organized body . . . even within the same State they were not incorporated." Hence the normal development of sundry professions is less distinctly to be traced. Nevertheless the relation between the priestly and the judicial functions is visible in a rudimentary, if not in a developed, form. Among the Greeks, as among the Hebrews, it was the habit in cases of doubt to "inquire of the Lord"; and the oracular utterance embodying the will of a god was made by a priest or priestess. Moreover, the circumstance that Greek laws were called themistes or utterances of the goddess Themis, as the mouthpiece of Zeus, shows that among the early Greeks, as among other peoples, a law and a divine fiat were the same thing. That systems of law were regarded as of supernatural origin, is also evidenced by the code of Lycurgus. Says Hase:—"The origin of his code was religious. A declaration of the Delphic god contains the fundamental principles of the measures by which he reconciled the rival claims" [of the Spartans]. That the non-development of a legal class out of a priestly class followed from the lack of development of the priestly class itself, seems in some measure implied by the following extract from Thirlwall:—

"The priestly office in itself involved no civil exemptions or disabilities, and was not thought to unfit the person who filled it for discharging the duties of a senator, a judge, or a warrior. . . . But the care of a temple often required the continual residence and presence of its ministers."

Possibly the rise of priest-lawyers, impeded by this local fixity and by want of co-operative organization among priests, may have been also impeded by the independence of the Greek nature; which, unlike Oriental natures, did not readily submit to the extension of sacerdotal control over civil affairs.

How priestly and legal functions were mingled among the early Romans is shown by the two following extracts from Duruy:—

The patricians "held the priesthood and the auspices; they were priests, augurs, and judges, and they carefully hid from the eyes of the people the mysterious formulæ of public worship and of jurisprudence."

The "servile attachment to legal forms [which characterized the early Romans] came from the religious character of the law and from the belief imposed by the doctrine of augury, that the least inadvertence in the accomplishment of rites was sufficient to alienate the goodwill of the gods."

It seems probable, indeed, that legal procedure consisted in part of ceremonies originally devotional, by which the god Numa was to be propitiated, and that the complex symbolic actions used were superposed. For of the judges, who "sat only on days fixed by the secret calendar of the pontiffs," it is said that "they did not admit the litigants to set forth simply the matters in dispute; mysterious formulæ, gestures, and actions were necessary." In further evidence of this priestly character of the judicial administration is the following statement of Professor W. A. Hunter:—

"Pomponius, in his brief account of the history of Roman Law, informs us that the custody of the XII Tables, the exclusive knowledge of the forms of procedure (*legis actiones*), and the right of interpreting the law, belonged to the College of Pontiffs."

And Mommsen tells us in other words the same thing.

But while we here see, as we saw in the cases of other early peoples, that the priest, intimately acquainted with the injunctions of the god, and able to get further intimations of his will, consequently became the fountain of law, and therefore the judge respecting breaches of law, we do not find evidence that in ancient Rome, any more than in Greece, Egypt, or Palestine, the advocate was of priestly origin. Contrariwise we find evidence that among these early civilized peoples, as at the present time among some peoples who have become civilized enough to have legal procedures, the advocate is of lay origin. Marsden says that in Sumatra—

"the plaintiff and defendant usually plead their own cause, but if circumstances render them unequal to it, they are allowed to *pinjam mulut* (borrow a mouth). Their advocate may be a *proattin*, or other person indifferently; nor is there any stated compensation for the assistance, though if the cause be gained, a gratuity is generally given."

So, too, from Parkyns we learn that the Abyssinians have a sort of lawyers—merely "an ordinary man with an extraordinary gift of the gab. These men are sometimes employed by the disputants in serious cases, but not invariably." Indeed, it must everywhere have happened in early stages when litigants usually stated their respective cases, that sometimes one or other of them asked a friend to state his case for him; and a spokesman who became noted for skill in doing this would be employed by others, and eventually a present to him would become a fee. It was thus among the Romans. After knowledge of the Twelve Tables had been diffused, and after the secrets of legal procedure had been disclosed by a secretary of Appius Claudius, there grew up a class of men, the *jurisconsulti*, learned in the law, who gave their advice, and also, later, advocates distinguished by their oratorical powers, who, as among ourselves, were furnished with materials and suggestions by lawyers of lower grade.

The superposing of civilizations and of religions throughout Northern Europe after Roman days, complicated the relations between religion and law, and between those who administered them. Nevertheless, the evidence everywhere points to the conclusion we have already reached.

Beginning with heathen times there may be put first the facts which Sir George Dasent gives us respecting the ancient Norse. He writes:—

The priest "was the only civil, just as he was the only religious authority—minister and magistrate in one."

"In trials . . . it fell on him [the priest] to name the judges, and to superintend the proceedings."

But it seems that even in those rude days there had come into existence non-clerical advocates.

"There were the lawmen or lawyers (lögmenn), a class which we shall find still flourishing in the time of which our Saga tells. They were private persons, invested with no official character." "They seem to have been simply law-skilled men, 'counsel' to whom men in need of advice betook themselves."

In harmony with these statements are those made by an authority respecting Old-English institutions, Mr. Gomme. He says—

"We learn from the historians of Saxony that the 'Frey Feldgericht' of Corbey was, in pagan times, under the supremacy of the priests of the Eresburgh."

"There can be little doubt that the church or temple of primitive society was the self-same spot as the assembly-place of the people and the court of justice."

In support of this last conclusion it may be remarked that as in early times gatherings for worship afforded occasions for trading, so they also afforded occasions for legal settlements of disputes; and further that the use of the sacred edifice for this purpose (as among the Babylonians) was congruous with the conception, everywhere anciently entertained, that legal proceedings tacitly or avowedly invoked divine interposition—tacitly in the taking of an oath and avowedly in trial by judicial combat.

The conquest of northern heathenism by Christianity gradually led to subjugation of the heathen system of law by the system of law the Church imposed—partly its own, the canon law, and partly that inherited from Roman civilization, the civil law. The rules of conduct which, transmitted from the heathen priesthood, had become the common law, were in large measure overridden by the rules of conduct which the Christian priesthood either enacted or adopted. In early English days lay and clerical magnates co-operated in the local courts: laws derived from the old religion and from the new religion were jointly enforced.

"The clergy, in particular, as they then engrossed almost every other branch of learning, so (like their predecessors, the British Druids), they were peculiarly remarkable for their proficiency in the study of the law. . . . The judges therefore were usually created out of the sacred order, as was likewise the case among the Normans; and all the inferior offices were supplied by the lower clergy, which has occasioned their successors to be denominated *clerks* to this day."

But with the growth of papal power a change began. As writes the author just quoted, Stephen—

"It soon became an established maxim in the papal system of policy, that all ecclesiastical persons, and all ecclesiastical causes, should be solely and entirely subject to ecclesiastical jurisdiction only."

After the conquest, when shoals of foreign clergy came over, and when they and the pre-existing monastic clergy were bribed by endowments to support the Conqueror, the papal policy prevailed so far as to separate the ecclesiastical court from the civil court; after which "the Saxon laws were soon overborne by the Norman justiciaries." In subsequent reigns, according to Hallam—

"the clergy combined its study [*i. e.*, the Roman law] with that of their own canons; it was a maxim that every canonist must be a civilian, and that no one could be a good civilian unless he were also a canonist."

Along with acceptance of the doctrine that the Christian high priest, the pope, was an oracle through whom God spoke, there was established in Christendom a theory of law like that held by ancient peoples: laws were divine *dicta* and priests divinely authorized interpreters of them. Under these circumstances the ecclesiastical courts extended their jurisdiction to secular causes; until, gradually, the secular courts were almost deprived of power: the removal of criminal clerics from secular jurisdiction and the penalty of excommunication on those who in any serious way opposed the clerical power, being of course efficient weapons. The condition of things then existing is well shown by the following statement of Prof. Maitland :—

"If we look back to Richard I.'s reign we may see, as the highest temporal court of the realm, a court chiefly composed of ecclesiastics, presided over by an archbishop, who is also Chief Justiciar; he will have at his side two or three bishops, two or three archdeacons, and but two or three laymen. The greatest judges even of Henry III.'s reign are ecclesiastics, though by this time it has become scandalous for a bishop to do much secular justice."

Not only were priests the judges and the interpreters of law, but they at one time discharged subordinate legal functions. In Germany, according to Stolzel, the notarial profession was in the hands of ecclesiastics. France, during the 13th century, furnished like evidence. Clerics played the parts of *procureurs* or attorneys, according to Fournier, who says :—

"les ecclésiastiques ne pouvait, en principe, accepter ces fonctions que pour réprésenter les pauvres, les églises, ou dans les causes spirituelles."

So, too, was it with the function of advocate. Sainte Palaye writes—

"Loisel . . . remarks that in the time of Philip [the Fair] and since, the best of them were 'ecclesiastical persons instructed in the Canon and Civil Law, learning practice chiefly by the decretals.'"

However, according to Fournier, this function was limited to certain cases—

"le prêtre ne peut exercer les fonctions d'avocat si ce n'est au profit de son Eglise et des pauvres, et sans recevoir de salaire."

But in England, when ecclesiastics had been forbidden by the pope to make their appearance in secular courts, it appears that they evaded the prohibition by disguising themselves.

"Sir H. Spelman conjectures (Glossar. 335), that coifs were introduced to hide the tonsure of such renegade clerks, as were still tempted to remain in the secular courts in the quality of advocates or judges, notwithstanding their prohibition by canon."

From which it would seem that the "renegade clerks" became barristers who personally received the profits of their advocacy.

By what steps the complete secularization of the legal class was effected in England, it does not here concern us to ascertain. It suffices to observe the state of things now arrived at.

So long have our judges ceased to display any clerical attributes, that now, to the ordinary citizen, the statement that they were once priests is surprising. If there remains any trace of the original condition of things, it is only in such a fact as that the Archbishop of Canterbury retains the power of conferring the degree of Doctor of Civil Law; which degree, however, is one covering only a restricted sphere of practice. But, while, save perhaps in observance of certain ceremonies and seasons, separation of judicial functionaries from clerical functionaries has long been complete, separation of certain areas of jurisdiction has taken place quite recently. Until some five and thirty years ago ecclesiastical courts still had jurisdiction over some secular matters—testamentary and matrimonial; but they were then deprived of this jurisdiction, and retained none save over affairs within the Church itself.

In conformity with the usual course of things, while the legal profession has been differentiating from the ecclesiastical, there have been going on differentiations within the legal profession itself. Originally, beyond the judge and the two suitors there occasionally existed only the advocate—a functionary who, becoming established, presently rendered his services to defendants as well as to plaintiffs. Gradually these ancillary agencies have complicated; until now there are various classes and sub-classes of those who conduct legal proceedings.

The original body of them has separated itself primarily into two great divisions—those directly concerned in carrying on causes in law-courts and those indirectly concerned who prepare the cases, collect evidence, summon witnesses, etc. Within the first of these classes has arisen a partial distinction between those whose business is mainly in courts and those whose business is mainly in chambers; and there are further segregations determined by the different courts in which the pleadings are carried on. To which add the cross-division of this class into Queen's Counsel or leaders, and ordinary barristers or juniors. Then in the accessory class—lawyers commonly so-called—we have the distinction, once well recognised, between attorneys and solicitors, arising from the separate divisions of jurisprudence with which they were concerned, but which has now lapsed. And we have various miscellaneous subdivisions partially established, as of those mainly concerned with litigious matter and those mainly concerned with non-litigious matter; of those who transact business directly and of those who act for others; those who are parliamentary agents; and so on.

In their general character, if not in their details, the facts now to be named will be anticipated by the reader. He will look for illustrations of the integrating tendency, and he will not be mistaken in so doing.

Very soon after the divergence of the legal class from the clerical class had commenced, there arose some union among members of the legal class. Thus we read that in France—

"En 1274, le concile de Lyon, dans quelques dispositions relatives aux procureurs, les met à peu près sur le même pied que les avocats. C'est que dès lors les procureurs forment une corporation qui se gouverne sous l'autorité des Juges d'Eglise."

In England also it appears that the two processes began almost simultaneously. When the deputies of the king in his judicial capacity ceased to be wholly nomadic, and fixed courts of justice were established at Westminster, the advocates, who were before dispersed about the kingdom, began to aggregate in London, where, as Stephen says, they "naturally fell into a kind of collegiate order." Hence resulted the Inns of Court, in which lectures were read and eventually degrees given: the keeping of terms being for a long time the only requirement, and the passing of an examination having but recently become a needful qualification for a call to the bar. Within this aggregate, constituting the collegiate body, we have minor divisions—the benchers who are its governors, the barristers, and the students. This process of incorporation began before the reign of Edward I; and while certain of the inns, devoted to that kind of law which has now ceased to be marked off, have dwindled away, the others still form the centres of integration for the higher members of the legal profession.

Then we come to the lower members, who in early days became incorporated.

"It was ordained by stat. 4 Henry IV. c. 18, that all attornies should be examined by the justices, and by their discretions their names should be put in a roll: they were to be *good and virtuous*, and *of good fame*."

Other groupings of more modern and less coherent kinds have to be named. There is the Bar Committee, serving as an organ for the practising barristers; and there are the relatively vague unions of barristers who go the same circuits. For solicitors there is in London a central Law Society, along with which may be named Law Societies in leading provincial districts; and there are also various benevolent associations formed within these larger bodies.

Nor let us omit to notice how in this case, as in all cases, the process of integration has been accompanied by progress in definiteness. Early in its history the body of barristers separated itself by its regulations from the trading community; and then, more recently, it has increased its distinctness of demarcation by excluding those not adequately instructed. So too, with the body of solicitors. This has fenced itself round by certain regulations respecting admission, conduct, and practice, in such wise that by striking off the rolls those who have not conformed to the rules complete precision is given to the limits of the body.

And then, as serving to hold together these larger and smaller definitely consolidated aggregates, we have various periodicals—several weekly law-journals, and now also a law-quarterly.

A CURIOUS case of dual consciousness is recorded in the English journal Brain, by Dr. Lewis C. Bruce, late of the Derby Borough Lunatic Asylum. Deterioration is going on in the brain of the patient, but at different rates in the two lobes. Sometimes the right side alone acts; and then the patient talks Welsh, takes little interest in life, does not care for money or tobacco or for anything but his food, is left-handed, and is almost idiotic. When that side of the brain is inert and the left side is acting, the patient speaks chiefly English, is eager for money and tobacco, being even almost ready to steal them, and is right-handed. For a short interval between these two conditions, he mingles Welsh and English words, uses both hands, and is about halfway active. Of specimens of his handwriting in both stages, the Welsh can hardly be read and goes from right to left, while the English is legible, from left to right, and is generally normal. In either stage he seems to have no knowledge of what has passed in the other. The case seems to suggest that the two sides of the brain may have action independently of one another, and may be organs of communication with the external world of often very different degrees of power.

THE AIMS OF ANTHROPOLOGY.*

By DANIEL G. BRINTON.

A MODERN philosopher has advanced the maxim that what is first in thought is last in expression, illustrating it by the rules of grammar, which are present even in unwritten languages, whose speakers have no idea of syntax or parts of speech.

It may be that this is the reason why man, who has ever been the most important creature to himself in existence, has never seriously and to the best of his abilities made a study of his own nature, its wants and its weaknesses, and how best he could satisfy the one and amend the other.

The branch of human learning which undertakes to do this is one of the newest of the sciences; in fact, it has scarcely yet gained admission as a science at all, and is rather looked upon as a *dilettante* occupation, suited to persons of elegant leisure and retired old gentlemen, and without any very direct or visible practical applications or concern with the daily affairs of life.

It is with the intention of correcting this prevalent impression that I address you to-day. My endeavor will be to point out both the immediate and remote aims of the science of anthropology, and to illustrate by some examples the bearings they have, or surely soon will have, on the thoughts and acts of civilized communities and intelligent individuals.

It is well at the outset to say that I use the term anthropology in the sense in which it has been adopted by this association—that is, to include the study of the whole of man, his psychical as well as his physical nature, and the products of all his activities, whether in the past or in the present. By some writers, especially on the Continent of Europe, the term anthropology is restricted to what we call physical anthropology or somatology, a limitation of the generic term which we can not but deplore. Others again, and some of worthy note, would exclude from it the realm of history, confining it in time to the research of prehistoric epochs, and in extent, to the investigation of savage nations.

I can not too positively protest against such opinions. Thus "cabined, cribbed, confined," it could never soar to that lofty eminence whence it could survey the whole course of the life of the species, note the development of its inborn tendencies, and mark the lines along which it has been moving since the first

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* Address of the retiring president of the American Association for the Advancement of Science, delivered at Springfield, Mass., August 29, 1895.

syllables of recorded time; for this, and nothing less than this, is the bold ambition toward which aspires this crowning bough of the tree of human knowledge.

You will readily understand from this the magnitude of the material which anthropology includes within its domain. First, it investigates the physical life of man in all its stages and in every direction. While he is still folded in the womb, it watches his embryonic progress through those lower forms, which seem the reminiscences of far-off stages of the evolution of the species, until the child is born into the world, endowed with the heritage transmitted from innumerable ancestors and already rich in personal experiences from its prenatal life. These combined decide the individual's race and strain, and potently incline, if they do not absolutely coerce, his tastes and ambitions, his fears and hopes, his failure or success.

On the differences thus brought about, and later nourished by the environment, biology, as applied to the human species, is based; and on them as expressed in aggregates, ethnography, the separation of the species into its subspecies and smaller groups, is founded. It has been observed that numerous and persistent although often slight differences arose in remote times, independently, on each of the great continental areas, sufficient to characterize with accuracy these subspecies. We therefore give to such the terms "races" or "varieties" of man.

All these are the physical traits of men. They are studied by the anatomist, the embryologist, the physician; and the closest attention to them is indispensable if we would attain a correct understanding of the creature man and his position in the chain of organic life.

But there is another vast field of study wholly apart from this and even more fruitful in revelations. It illustrates man's mental or psychical nature, his passions and instincts, his emotions and thoughts, his powers of ratiocination, volition, and expression. These are preserved and displayed subjectively in his governments and religions, his laws and his languages, his words and his writings, and, objectively, in his manufactures and structures, in the environment which he himself creates—in other words, in all that which we call the arts, be they "hooked to some useful end" or designed to give pleasure only.

It is not sufficient to study these as we find them in the present. We should learn little by such a procedure. What we are especially seeking is to discover their laws of growth, and this can only be done by tracing these outward expressions of the inward faculties step by step back to their incipiency. This leads us inevitably to that branch of learning which is known as archæology, "the study of ancient things," and more and more to that part of archæology called prehistoric, for that concerns itself with the most ancient; and the most ancient is the simplest, and the simplest is the most transparent, and therefore the most instructive.

Prehistoric archæology is a new science. I can remember when neither its name nor its methods were known to the most learned anthropologists. But it has already taught us by incontrovertible arguments a wonderful truth—a truth opposing and reducing to naught many teachings of the sages and seers of past generations. They imagined that the primal man had fallen from some high estate; that he had forfeited by his own falseness, or been driven by some hard fate, from a pristine paradise, an Eden garden, an Arcadia; that his ancestors were demigods and heroes, himself their degenerate descendant.

How has prehistoric archæology reversed this picture? We know beyond cavil or question that the earliest was also the lowest man, the most ignorant, the most brutish, naked, homeless, half speechless. But the gloom surrounding this distant background of the race is relieved by rays of glory, for with knowledge not less positive are we assured that through all hither time, through seeming retrogressions and darkened epochs, the advance of the race in the main toward a condition better by every standard has been certain and steady, "ne'er known retiring ebb, but kept due on."

Archæology, however, is, after all, a dealing with dry bones, a series of inferences from inanimate objects. The color and the warmth of life it never has. How can we divine the real meaning of the fragments and ruins, the forgotten symbols and the perished gods, it shows us?

The means has been found, and this through a discovery little less than marvelous, the most pregnant of all that anthropology has yet offered, not yet appreciated even by the learned. This discovery is that of the physical unity of man, the parallelism of his development everywhere and in all time; any, more, the nigh absolute uniformity of his thoughts and actions, his aims and methods, when in the same degree of development, no matter where he is or in what epoch living. Scarcely anything but his geographical environment, using that term in its larger sense, seems to modify the monotonous sameness of his creations.

I shall refer more than once to this discovery, for its full recognition is the corner stone of true anthropology. In this connection I refer to it for its application to archæology. It teaches us this: That when we find a living nation of low culture we are safe in taking its modes of thought and feeling as analogous to those of extinct tribes whose remains show them to have been in about the same stage of culture.

This emphasizes the importance of a prolonged and profound investigation of the few savage tribes who still exist, for, although none of them is as rude or as brutelike as primitive man, they stand nearest to his condition, and, moreover, so rapid nowadays is the extension of culture that probably not one of them will remain untouched by its presence another score of years.

Another discovery, also very recent, has enabled us to throw light on the prehistoric or forgotten past. We have found that much of it, thought to be long since dead, is still alive and in our midst, under forms easily enough recognized when our attention is directed to them. This branch of anthropology is known as folklore. It investigates the stories, the superstitions, the beliefs, and customs which prevail among the unlettered, the isolated, and the young; for these are nothing less than survivals of the mythologies, the legal usages, and the sacred rites of earlier generations. It is surprising to observe how much of the past we have been able to reconstruct from this humble and long-neglected material.

From what I have already said, you will understand some of the aims of anthropology, those which I will call its "immediate" aims. They are embraced in the collection of accurate information about man and men, about the individual and the group, as they exist now and as they have existed at any and all times in the past, here where we are and on every continent and island of the globe.

We desire to know about a man his weight and his measure, the shape of his head, the color of his skin, and the curl of his hair; we would pry into all his secrets and his habits, discover his deficiencies and debilities, learn his language, and inquire about his politics and his religion—yes, probe those recesses of his body and his soul which he conceals from wife and brother. This we would do with every man and every woman, and, not content with the doing it, we would register all these facts in tables and columns, so that they should become perpetual records, to which we give the name "vital statistics."

The generations of the past escape such personal investigation, but not our pursuit. We rifle their graves, measure their skulls, and analyze their bones; we carry to our museums the utensils and weapons, the gods and jewels, which sad and loving hands laid beside them; we dig up the foundations of their houses and cart off the monuments which their proud kings set up. Nothing is sacred to us; and yet nothing to us is vile or worthless. The broken potsherd, with half-gnawed bone, cast on the refuse heap, conveys a message to us more pregnant with meaning, more indicative of what the people were, than the boastful inscription which their king caused to be engraved on royal marble.

This gleaning and gathering, this collecting and storing of facts about man from all quarters of the world and all epochs of his existence, is the first and indispensable aim of anthropologic science. It is pressing and urgent beyond all other aims at this period of its existence as a science, for here more than elsewhere we feel the force of the Hippocratic warning that the time is short and the opportunity fleeting. Every day there perish priceless relics of the past, every year the languages, the habits, and the modes of thought of the surviving tribes which represent the earlier condition of the whole species are increasingly transformed and lost through the extension of civilization. It devolves on the scholars of this generation to be up and doing in these fields of research, for those of the next will find many a chance lost forever of which we can avail ourselves.

And here let me insert a few much-needed words of counsel on this portion of my theme. Why is it that even in scientific circles so little attention is paid to the proper training of observers and collectors in anthropology ?

We erect stately museums, we purchase costly specimens, we send out expensive expeditions; but where are the universities, the institutions of higher education, that train young men how to observe, how to explore and collect in this branch ? As an eminent ethnologist has remarked, in any other department of science—in that, for instance, which deals with flowers or with butterflies—no institution would dream of sending a collector into the field who lacked all preliminary training in the line or knowledge of it; but in anthropology the opinion seems universal that such preparation is quite needless. Carlyle used to say that every man feels himself competent to be a gentleman farmer or a crown prince; our institutions seem to think that every man is competent to be an anthropologist and archæologist; and let a plausible explorer present himself, the last question put to him will be whether he has any fitness for the job.

Hence our museums are crammed with doubtful specimens, vaguely located, and our volumes of travel with incomplete or wholly incorrect statements, worse than purely fictitious ones, because we know them to be the fruit of honest intentions, and therefore give them credit.

But you will naturally ask, To what end this accumulating and collecting, this filling of museums with the art products of savages and the ghastly contents of charnel houses ? Why write down their stupid stories and make notes of their obscene rites ? When it shall be done, or as good as done, what use can be made of them beyond satisfying a profitless curiosity ?

This leads me to explain another branch of anthropology to which I have not yet alluded—one which introduces us to other aims of this science quite distinct from those I have mentioned. That branch is ethnology.

Ethnology in its true sense represents the application of the principles of inductive philosophy to the products of man's faculties. You are aware that that philosophy proceeds from observed facts alone; it discards all preconceived opinions concerning these facts; it renounces all allegiance to dogma, or doctrine, or intuition; in short, to every form of statement that is not capable of verification. Its method of procedure is by comparison—that is, by the logical equations of similarity and diversity, of identity and difference; and on these it bases those generalizations which range the isolated fact under the general law, of which it is at once the exponent and the proof.

By such comparisons ethnology aims to define in clear terms the influence which the geographical and other environment exercises on the individual, the social group, and the race; and, conversely, how much in each remains unaltered by the external forces, and what residual elements are left, defiant of surroundings, wholly personal, purely human. Thus, rising to wider and wider circles of observation and generalization, it will be able at last to offer a conclusive and exhaustive connotation of what man is—a necessary preliminary, mark you, to that other question, so often and so ignorantly answered in the past, as to what he should be.

Ethnology, however, does not and should not concern itself with this latter inquiry. Its own field is broad enough and the harvest offered is rich enough. Its materials are drawn from the whole of history and from pre-history. Those writers who limit its scope to the explanation of the phenomena of primitive social life only have so done because these phenomena are simpler in such conditions, not that the methods of ethnology are applicable only to such. On the contrary, they are not merely suitable, they are necessary to all the facts of history, if we would learn their true meaning and import. The time will come, and that soon, when sound historians will adopt as their guide the principles and methods of ethnologic science, because by these alone can they assign to the isolated fact its right place in the vast structure of human development.

In the past, histories have told of little but of kings and their wars; some writers of recent date have remembered that there is such a thing as the people, and have essayed to present its humble annals; but how few have even attempted to avail themselves of the myriad of sidelights which ethnology can throw on the motives and the manners of a people, its impulses and acquisitions!

It is the constant aim of ethnology to present its results free from bias. It deprecates alike enthusiasm and antipathy. Like Spinoza's god, *nullum amat, nullum odit.* Its aim is to compare dispassionately all the acts and arts of man, his philosophies and religions, his social schemes and personal plans, weighing and analyzing them, separating the local and temporal in them from the permanent and general, explaining the former by the conditions of time and place, referring the latter to the category of qualities which make up the oneness of humanity, the solid ground on which he who hereafter builds "will build for aye."

This, then, briefly stated, is the aim of that department of anthropology which we call ethnology. In yet fewer words, its mission is "to define the universal in humanity," as distinguished from all those traits which are the products of fluctuating environments.

This universal, however, is to be discovered, not assumed. The fatal flaw in the arguments of most philosophers is that they frame a theory of what man is and what are the laws of his growth, and pile up proofs of these, neglecting the counter-evidence, and passing in silence what contradicts their hypotheses.

Take, for instance, the doctrine of evolution as applied to man. It is not only a doctrine but a dogma with many scientists. They look with theological ire on any one who questions it. I have already said that in the long run and the general average it has been true of man. But that we have any certainty that it will continue true is a mistake; or that it has been true of the vast majority of individuals or ethnic groups is another mistake. As the basis for a boastful and confident optimism it is as shaky as sand. Taken at its real value, as the provisional and partial result of our observations, it is a useful guide; but swallowed with unquestioning faith as a final law of the universe, it is not a whit more inspiring than the narrowest dogma of religious bigotry.

We have no right, indeed, to assume that there is anything universal in humanity until we have proved it. But this has been done. Its demonstration is the last and greatest conquest of ethnology, and it is so complete as to be bewildering. It has been brought about by the careful study of what are called "ethnographic parallels"—that is, similarities or identities of laws, games, customs, myths, arts, etc., in primitive tribes located far asunder on the earth's surface. Able students, such as Bastian, Andree, Post, Steinmetz, and others have collected so many of these parallels, often of seemingly the most artificial and capricious character, extending into such minute and apparently accidental details from tribes almost antipodal to each other on the globe, that Dr. Post does not hesitate to say: "Such results leave no room for doubt that the psychical faculties of the individual as soon as they reach outward expression fall under the control of natural laws as fixed as those of inorganic nature."

As the endless variety of arts and events in the culture history of different tribes in different places, or of the same tribe at different epochs, illustrates the variables in anthropologic science, so these independent parallelisms prove beyond cavil the ever-present constant in the problem—to wit, the one and unvarying psychical nature of man, guided by the same reason, swept by the same storms of passion and emotion, directed by the same will toward the same goals, availing itself of the same means when they are within reach, finding its pleasure in the same actions, lulling its fears with the same sedatives.

The anthropologist of to-day who, like a late distinguished scholar among ourselves, would claim that because the rather complex social system of the Iroquois had a close parallel among the Munda tribes of the Punjab, therefore the ancestors of each must have come from a common culture center; or who, like an eminent living English ethnologist, sees a proof of Asiatic relations in American culture because the Aztec game of *patolli* is like the East Indian game of *parchesi*—such an ethnologist, I say, may have contributed ably to his science in the past, but he does not know where it stands to-day. Its true position on this crucial question is thus tersely and admirably stated by Dr. Steinmetz: "The various customs, institutions, thoughts, etc., of different peoples are to be regarded either as the expressions of the different stadia of culture of our common humanity or as different reactions of that common humanity under varying conditions and circumstances. The one does not exclude the other. Therefore the concordance of two peoples in a custom, etc., should be explained by borrowing or by derivation from a common source only when there are special known and controlling reasons indicating this; and when these are absent, the explanation should be either because the two peoples are on the same plane of culture or because their surroundings are similar."

This is true not only of the articles intended for use, to supply the necessities of existence, as weapons and huts and boats—we might anticipate that they would be something similar, otherwise they would not serve the purpose everywhere in view; but the analogies are, if anything, still more close and striking when we come to compare pure products of the fancy, creations of the imagination or the emotions, such as stories, myths, and motives of decorative art.

It has proved very difficult for the comparative mythologist or the folklorist of the old school to learn that the same stories—for instance, of the four rivers of Paradise, the flood, the ark, and the patriarch who is saved in it—arose independently in western Asia, in Mexico, and in South America, as well as in many intervening places, alike even in details, and yet neither borrowed one from the other nor yet drawn from a common source. But until he understands this he has not caught up with the progress of ethnologic science.

So it is also with the motives of primitive art, be they symbolic or merely decorative. How many volumes have been written tracing the migrations and connections of nations by the distribution of some art motive, say the *svastika*, the *meander*, or the cross! And how little of value is left in all such speculations by the rigid analysis of primitive arts that we see in such works as Dr. Grosse's Anfänge der Kunst, or Dr. Haddon's attractive monograph on the Decorative Art of British New Guinea, published last year! The latter sums up in these few and decisive words the result of such researches pursued on strictly inductive lines: "The same processes operate on the art of decoration, whatever the subject, wherever the country, whenever the age." This is equally true of the myth and the folk tale, of the symbol and the legend, of the religious ritual and the musical scale.

I have even attempted, I hope not rashly, to show that there are quite a number of important words, in languages nowise related by origin and contact, which are phonetically the same or similar, not of the mimetic class, but arising from certain common relations of the physiological function of language; and I have urged that words of this class should not be accounted of value in studying the affiliations of language.

And I have also endeavored to demonstrate that the sacredness which we observe attached to certain numbers, and the same numbers, in so many mythologies and customs the world over, is neither fortuitous nor borrowed the one from the other, but depends on fixed relations which the human body bears to its surroundings, and the human mind to the laws of its own activity; and therefore that all such coincidences and their consequences —and it is surprising how far-reaching these are—do not belong to the similarities which reveal contact, but only to those which testify to psychical unity.

So numerous and so amazing have these examples of culture identities become of late years that they have led more than one student of ethnology into a denial of the freedom of the human will under any of the definitions of voluntary action. But the aims of ethnology are not so aspiring. It is strictly a natural science, dealing with outward things—to wit, the expressions of man's psychical life, endeavoring to ascertain the conditions of their appearance and disappearance, the organic laws of their birth, growth, and decay. These laws must undoubtedly be correlated with certain mental traits, but it is not the business of the ethnologist to pursue them to their last analysis in the realm of metaphysics. For instance, we may trace all forms of punishment back to the individual's passion for revenge, or we may analyze all systems of religion until we find the common source of all to be man's dread of the unknown, and these will be sufficient ethnologic explanations of both these phenomena, but not a final analysis of the emotion of dread or the thirst for vengeance. Ethnology declines to enter these realms of abstraction.

I repeat that to define "the universal in humanity" is the aim of ethnology—that is, the universal soul or psyche of humanity.

But let me not be understood as speaking of this as of some entity, like the *ame humaine* of the Comtists. That were sophistical word-mongering in the style of ancient scholasticism. There is no such entity as humanity, or race, or people, or nation. There is nothing but the individual man or woman, the "single, separate person," as Walt Whitman says. Hence some of the most advanced ethnologists are ready to give up the *ethnos* itself as a subject of study. Those terms so popular a few years ago, *Völkerpsychologie*, *Völkergedanken*, racial psychology, ethnic sentiments, and the like, are looked upon with distrust. The external proofs of the psychical unity of the whole species have multiplied so abundantly that some maintain strenuously that it is not ethnic or racial peculiarities, but solely external conditions on the one hand and individual faculties on the other, which are the factors of culture evolution.

While I admit that this question is still *sub judice*, I add that the position just stated seems to be erroneous. All members of the species have common human mental traits; that goes without saying; and in addition it seems to me that each of the great races, each ethnic group, has its own added special powers and special limitations compared with the others; and that these ethnic and racial psychic peculiarities attached to all or nearly all members of the group are tremendously potent in deciding the result of its struggle for existence.

I must still deny that all races are equally endowed, or that the position with reference to civilization which the various ethnic groups hold to-day is one merely of opportunity and externalities. I must still claim that the definition of the *ethnos* is one of the chief aims of ethnology; and that the terms of this definition are not satisfied by geographic explanations. Let me, with utmost brevity, name a few other connotations, prepotent, I believe, in the future fate of nations and races.

None, I maintain, can escape the mental correlations of its physical structure. The black, the brown, and the red races differ anatomically so much from the white, especially in their splanchnic organs, that even with equal cerebral capacity they never could rival its results by equal efforts.

Again, there is in some stocks and some smaller ethnic groups a peculiar mental temperament, which has become hereditary and general, of a nature to disqualify them for the atmosphere of modern enlightenment. Dr. Von Buschan has recently pointed out this as distinctly and racially pathologic; an inborn morbid tendency, constitutionally recreant to the codes of civilization, and therefore technically criminal.

Once more, one can not but acknowledge that the relations of the emotional to the intellectual nature vary considerably and permanently in different ethnic groups. Nothing is more incorrect than the statement so often repeated by physicians that the modern civilized man has a more sensitive emotional system than the savage. The reverse is the case. Since the dark ages, Europe has not witnessed epidemic neuroses so violent as those still prevalent among rude tribes.

These and a number of similar traits separate races and peoples from each other by well-marked idiosyncrasies, extending to the vast majority of their members and pregnant with power for weal or woe on their present fortunes and ultimate destinies. The patient and thorough investigations of these peculiarities is therefore one of the most apposite aims of modern ethnology.

In this sense we can speak of the *Volksgeist* and *Völkergedanken*, a racial mind, or the temperament of a people, with as much propriety and accuracy as we can of any of the physical traits which distinguish it from other peoples or races.

For the branch of anthropology which has for its field the investigation of these general mental traits the Germans have proposed the name "Characterology" (*Karakterologie*). Its aim is to examine the collective mental conditions and expressions of ethnic groups, and to point out where they differ from other groups and from humanity at large; also to find through what causes these peculiarities came about, the genetic laws of their appearance, and the consequences to which they have given rise.

This branch of anthropology is that which offers a positive basis for legislation, politics, and education as applied to a given ethnic group; and it is only through its careful study and application that the best results of these can be attained, and not by the indiscriminate enforcement of general prescriptions, as has hitherto been the custom of governments.

The development of humanity as a whole has arisen from the differences of its component social parts, its races, nations, tribes. Their specific peculiarities have brought about the struggles which in the main have resulted in an advance. These peculiarities, as ascertained by objective investigation, supply the only sure foundation for legislation; not *a priori* notions of the rights of man, nor abstract theories of what should constitute a perfect state, as was the fashion with the older philosophies and still is with the modern social reformers. The aim of the anthropologist in this practical field is to ascertain in all their details, such as religions, language, social life, notions of right and wrong, etc., wherein lie the idiosyncrasies of a given group, and frame its laws accordingly.

Perhaps what I have said sufficiently explains the aims of ethnology. Some one has pertinently called it "the natural science of social life," because its methods are strictly those of the natural sciences, and its material is supplied by man living in society.

The final arbiter, however, to whom it appeals is, I repeat, not the *ethnos*, not the social group, but the individual. I think it was Goethe who, nearly a century ago, uttered the pithy remark, "Man makes genera and species; Nature makes only individuals." Hence the justification of any result claimed by ethnology must come from the psychology of the individual; in his personal feelings and thoughts will be discovered the final and only complete explanation of the forms of sociology and the events of history. As I have elsewhere urged, man himself, the individual man, is the only final measure of his own activities, in whatever direction they are directed.

On the other hand, the only rational psychology—using that term as a science of the mental processes—must be the outcome of anthropology conducted as a natural science. For thousands of years other plans have been pursued. The philosopher would delve in his "inner consciousness"; the theologian would turn to his revelation; the historian would reason on his undigested facts; but the psychologist of the future, taking nothing for granted, will define the mentality of the race by analyzing each of its lines of action back to the individual feelings which gave them rise.

It is quite likely that some who have heard me thus far, and have agreed with me, are still dissatisfied. On their lips is that question which is so often put to, and which so often puzzles, the student of the sciences, *cui bono*? What practical worth have these analyses and generalizations which have been referred to?

Fortunately, the anthropologist is not puzzled. His science, like others, has its abstract side, seemingly remote from the interests of the workaday world; but it is also and pre-eminently an applied science—one the practicality and immediate pertinence of which to daily affairs render it utilitarian in the highest degree.

Applied anthropology has for its aims to bring to bear on the improvement of the species, regarded on the one hand as groups, and on the other as individuals, the results obtained by ethnography, ethnology, and psychology.

Such an improvement is broadly referred to as an increased or higher civilization; and it is the avowed aim of applied anthropology accurately to ascertain what are the criteria of civilization, what individual or social elements have in the past contributed most to it, how these can be continued and strengthened, and what new forces, if any, may be called in to hasten the progress. Certainly no aims could be more immediately practical than these.

Here, again, anthropology sharply opposes its methods to those of the ideologists, the dogmatists, and the deductive philosophers. It refuses to ask, What *should* improve man? but asks only, What *has* improved him in the past? and it is extremely cautious in its decision as to what "improvement" really means. It certainly does not accept the definition which up to the present the philosophies and theologies have offered any more than it accepts the means by which these claim that our present civilization has been brought about.

This department of anthropology is still in its infancy. We are only beginning to appreciate that, in the future, political economy, like history, will have to be rearranged on lines which this new science dictates. The lessons of the past, their meaning clearly apprehended, will be acknowledged as the sole guides for the future. It may be true, as De Tocqueville said of the United States, that a new world needs a new political science; but the only sure foundation for the new will be the old.

Applied anthropology clearly recognizes that the improvement of humanity depends primarily on the correct adjustment of the group to the individual; and, as in ethnology, its ultimate reference is not to the group, but to the individual. In the words of John Stuart Mill, the first to apply inductive science to social evolution, it is that the individual may become "happier, nobler, wiser," that all social systems have any value.

We may profitably recall what the same profound thinker and logician tells us have been up to the present time the prime movers in human social progress. They are: First, property and its protection; second, knowledge and the opportunity to use it; and third, co-operation, or the application of knowledge and property to the benefit of the many.

But Mill was altogether too acute an observer not to perceive that while these *momenta* have proved powerful stimulants to the group, they have often reacted injuriously on the individual, developing that morbid and remorseless egotism which is so prevalent in modern civilized communities. Nor should I omit to add that the remedy which he urged and believed adequate for this dangerous symptom is one which every anthropologist and every scientist will fully indorse—the general inculcation of the love of truth, scientific, verifiable truth.

It seems clear, therefore, that the teachings of anthropology, whether theoretical or practical, lead us back to the individual as the point of departure and also the goal. The state was made for him, not he for the state; any improvement in the group must start by the improvement of its individual members. This may seem a truism, but how constantly is it overlooked in the most modern legislation and schemes of social amelioration! How many even of such a learned audience as this have carefully considered in what respects the individual man has improved since the beginning of historic time? Is he taller, stronger, more beautiful? Are his senses more acute, his love purer, his memory more retentive, his will firmer, his reason stronger? Can you answer me these questions correctly? I doubt it much. Yet if you can not, what right have you to say that there is any improvement at all?

To be sure there is less physical suffering, less pain. War and famine and bitter cold are not the sleuthhounds that they once were. The dungeons and flames of brutal laws and bigoted religions have mostly passed away. Life is on the average longer, its days of sickness fewer, justice is more within reach, mercy is more bountifully dispensed, the tender eye of pity is ever unscarfed.

But under what difficulties have these results been secured! What floods of tears and blood, what long wails of woe, sound down the centuries of the past, poured forth by humanity in its desperate struggle for a better life—a struggle which was blind, unconscious of its aims, unknowing of the means by which they should be obtained, groping in darkness for the track leading it knew not whither!

Ignorant of his past, ignorant of his real needs, ignorant of himself, man has blundered and stumbled up the thorny path of progress for tens of thousands of years. Mighty states, millions of individuals, have been hurled to destruction in the perilous ascent, mistaking the way, pursuing false paths, following blind guides.

Now anthropology steps in, the new Science of Man, offering the knowledge of what he has been and is, the young but wise teacher, revealing the future by the unwavering light of the past, offering itself as man's trusty mentor and friend, ready to conduct him by sure steps upward and onward to the highest summit which his nature is capable of attaining; and who dares set a limit to that?

This is the final aim of anthropology, the lofty ambition which the student of this science deliberately sets before himself. Who will point to a worthier or a nobler one?

RECENT RECRUDESCENCE OF SUPERSTITION.

By Prof. E. P. EVANS.

[*Concluded.*]

AN article published in the Popular Science Monthly for December, 1892, and entitled Modern Instances of Demoniacal Possession, gives an account of the casting out of a devil from a boy named Michael Zilk, by Father Aurelian, a Capuchin monk, in Wemding, Bavaria. The exorcist accused a Protestant woman, Frau Herz, of having conjured the devil into the boy and denounced her as a witch, and was prosecuted by the woman's husband for defamation. The trial, which took place in November, 1892, resulted in the condemnation of the defendant, who was sentenced to pay a fine of fifty marks, with costs, and, in default of payment, to five days' imprisonment. The case derives its chief interest from the testimony of two ecclesiastical experts, whom Father Aurelian called in for the purpose of proving that he had acted strictly in accordance with the rules and regulations of the Catholic Church. These experts were Dr. J. E. Prunner, provost of the cathedral in Eichstadt, and the cathedral capitular, Dr. Schneidt, both of whom approved of Father Aurelian's method of proceeding. That men may enter into a league with Satan, says Dr. Prunner, is affirmed by Holy Writ and by canon law; both the truth of Scripture and the teachings of the Church establish the possibility and actuality of demoniacal possession beyond a peradventure, which must therefore be accepted as incontestable. As regards Michael Zilk, Father Aurelian was perfectly justified in assuming that he was possessed with a devil, since all the signs favored this presumption, such as sudden paroxysms, abnormal bodily strength, hagiophobia, or strange dread of holy things, and demoniac ecstasy. The demon becomes firmly established in the organism and uses it as a base of operations, causing the individual to curse and rage and foam, using his tongue to speak languages unknown to him, and endowing his muscles with preternatural force. When these manifestations convinced Father Aurelian that the devil was to pay, it was his duty to investigate the matter and to ascertain the *causa possessionis*, and whether it was produced by *ars magica* or witchcraft. "*Maleficium* always presupposes *factum cum dœmone*"; in other words, sorcery implies a compact with Satan. In the course which he pursued, Father Aurelian followed the instructions and obeyed the injunctions of the ritual, even to the assumption that the dried pears given by Frau Herz to the boy had been the means of conveying the demoniac infection, since the ritual expressly enjoins upon the exorcist to pay heed to what the energumen has eaten. He was also right in believing what the devil said on this point, for "if the devil is the father of lies, he can nevertheless be compelled by the Church to tell the truth; that he was forced in this case to bow to ecclesiastical authority, is proved by the result."

Dr. Schneidt indorsed the opinion of his colleague, adding a few remarks from a "philosophical-psychological" point of view and denouncing the scientific materialism of the day, which denies the existence of spirits and their influence on corporeal substances. He admitted that the symptoms of Saint Vitus's dance and hysteria are very similar to those of demoniacal possession, but can be readily distinguished by two tests, both of which were applied by Father Aurelian: the boy Zilk raged and fumed when sprinkled with holy water, but remained quiet if ordinary water was used; the utterance of a benediction in ecclesiastical Latin rendered him extremely violent, whereas he was wholly unaffected by the recitation of a passage from a Latin classic. Dr. Schneidt thought Father Aurelian was right in laying great stress upon these two criteria, and in regarding the manner of their "reaction" as conclusive proof of diabolic agency.

That learned doctors of theology and high Church dignitaries should be willing to appear before a court of justice at the present day with such expert testimony as this, is a curious psychological phenomenon and a remarkable instance of superstitious survival. It would also be a greater miracle than any wrought by the holy coat of Trier, if the inculcation and dissemination of these mediæval notions by the bishops and other clergy should not produce a benighting and degrading effect upon the masses intrusted to their instruction and guidance in spiritual things. A few examples may be cited to show to what extent the popular belief in witchcraft, demoniacal possession, and the efficacy of conjurations still prevails. In the spring of 1894 a Hungarian named Jordan started on a bicycle from Bucharest, with the intention of making a tour through the Balkan peninsula to Constantinople. Not far from Philipoppel, in Roumelia, he was overtaken by night and obliged to stop at a hovel which served as a public house, and after confiding his "wheel" to the care of the innkeeper, who took charge of it with considerable distrust, went to bed. Very soon the news spread abroad that a sorcerer had arrived riding on a magic car drawn by invisible spirits, and a crowd of excited peasants filled the inn under the direction of the pope, or village priest, who sprinkled the bicycle with holy water and adjured the demon to depart. The "magic car" of the itinerant sorcerer was then taken out of doors and demolished. On the next morning, when Mr. Jordan wished to continue his journey, he found his bicycle broken to pieces, and was under the necessity of walking a long distance to the nearest railway station. It was only the fear of his enchantments as a wandering magician that saved him from personal harm.

In October, 1894, a chromolithograph of St. Anna, in a church at Naples, showed suddenly on the breast of the saint a white spot, which in the eyes of her worshipers gradually grew into the form of a lily. The rumor of this wonder caused thousands of people to flock to the sacred shrine, and several miracles were already reported, when the police ordered the print to be taken down and examined. On investigation, the white lily proved to be mold. It is hardly credible that the Neapolitan clergy should not have known the nature of this phenomenon, and yet they did nothing to expose the delusion, but made capital out of it by holding solemn services at the altar in recognition of its supposed miraculous character.

The results of such superstitious notions are not always so harmless as in the cases just cited. Thus, a peasant living at Pontea Ema, about a mile from Florence, in Tuscany, had a daughter who was subject to severe hysterical convulsions; she had also "suffered many things of many physicians," and was thereby "nothing bettered, but rather grew worse"—a result which will not surprise any one who knows what a wretched quacksalver the country doctor is in Italy. The parish priest intimated that the girl was probably possessed with a devil, and one day in February, 1893, the peasant and his daughter, after hearing several masses suitable to the occasion, went to Florence to consult a wise woman famous for sorceries, who informed him that an ordinary conjuration would cost five lire, and might not be effective, whereas the invocation of Beelzebub, which would cost twenty-five lire, would be an infallible remedy. The peasant paid the twenty-five lire and the old witch began her conjurations, dragging herself over the floor on her knees and howling fearfully. Finally she ceased, and declared that the conjuration had been successful. "Now go home," she added, "and heat the oven. The first person who comes to your door will be the one who has caused your daughter's malady; thrust this person into the oven in the presence of your daughter, and there will be no recurrence of the disease." The peasant obeyed these instructions and kept the oven heated all night. Early the next morning there was a rap at the door. "*Chi è?*" (Who's there?) asked the peasant. "For heaven's sake, a piece of bread!" was the reply. The peasant rushed to the door, seized the beggar woman as she stood there pale with hunger and shivering with cold, and without a moment's hesitation put her into the heated oven. Two milkmen passing by heard her cries, and, breaking open the bolted door of the house, rescued her, already half-suffocated, from a horrible death.

About a year ago an old woman named Theresia Kleitsch was crucified at Rekeseley, in Hungary, on suspicion of having bewitched the stalls of her neighbors and thus caused many cattle to die of murrain. Not long since, in a village near Moscow, a woman seventy-three years of age, named Darya, was clubbed and stoned to death by the inhabitants because she was supposed to have an "evil eye," which brought sickness and other misfortunes upon her neighbors. Seven of the chief culprits were sentenced to four years' hard labor in Siberia. When brought to trial they pleaded not guilty, declaring that the old hag was well known to be a witch, and that they were perfectly justified in not suffering her to live.

The measures recently devised to suppress a witch at Lupest, in Hungary, are the more noteworthy because they emanated from the civil authorities. The death of an old woman who had the reputation of being in solemn covenant with the devil was the occasion of public rejoicings. In the midst of the festivities it was announced that a villager's cow had died suddenly and under suspicious circumstances. The common council, after an official investigation, reported that the cow had been bewitched by the deceased beldame, and, in order to prevent her from doing further harm, commanded that a stallion should be brought and made to leap over her grave. The horse, however, showed signs of fright and refused to jump, and this circumstance greatly added to the public excitement. Finally, it was decreed by the common council that the body of the witch should be exhumed and stabbed with red-hot pitchforks. This proceeding proved effective, and the old hag ceased to trouble her former neighbors.

In the little town of Gif, about twelve miles from Paris, was a girl nineteen years of age, who had suffered for several months from an aggravated form of hysteria accompanied by catalepsy. One of the most distinguished Parisian physicians, Dr. Dumontpallier, made a diagnosis of the disease, declared it to be curable, and offered to treat it gratuitously if the parents would send the patient to one of the city hospitals. This generous offer was declined, owing to the intervention of the village priest, who had meanwhile informed the family that it was a clear case of demoniacal possession, with which the Church alone was competent to cope, and had applied to Monseigneur Goux, Bishop of Versailles, for permission to proceed with the exorcism. The right reverend ecclesiastic not only granted this request, but also sent the director of the theological seminary of Versailles to assist him in the conjuration. Both appeared at the bedside of the maiden in full canonicals, each with a crucifix in his hand and attended by their acolytes, and went through with the benedictions, adjurations, and aspersions prescribed by the ritual. No sooner did the girl perceive them than she cried out, "There come the parsons with their hocus-pocus!" and as they recited the litany, instead of responding with *ora pro nobis*, she used the word said to have been uttered by Cambroche at the battle of Waterloo when the Old Guard was summoned to surrender, repeating it three times in an angry tone. This conduct only confirmed the exorcists in their theory of diabolism. Indeed, one young priest recognized the different devils by their accent in speaking, and made a long list of their names: Satan, Lucifer, Beelzebub, Mammon, etc. Thus encouraged, the conjurers continued their efforts with unabated zeal, and finally succeeded, according to their own statement, in casting out all the large demons, and had only twenty-eight lesser demons to expel, when the bishop of Versailles, in view of the scandal which the discussion of the affair by the press threatened to bring on the Church, recalled the director of the seminary, and put an end to the ceremony which he had himself authorized. What became of the residue of devilkins that remained in possession of the maiden we are not informed.

About the same time, in the spring of 1893, in the French hamlet of Cras-Culot, the parents of a small boy who had fallen ill and was assumed to have been bewitched, enticed into their house a woman suspected of having caused the trouble and commanded her to exorcise the victim of her sorceries. On her protesting that she knew nothing of such arts, the parents of the child and their assembled friends began to beat the supposed witch and to stick hairpins into her neck and shoulders, and one of the fanatical crowd expressed his regret that it was no longer possible to burn her publicly at the stake. Perhaps a private *auto da fé* would have been held had she not succeeded finally in escaping and claiming the protection of the police court, which sentenced her principal persecutors each to fourteen days imprisonment and a fine of twenty-six francs.

In June, 1891, a Viennese waitress named Fanny Strobl brought a suit for slander against Maria Wirzar, a servant girl, who had sent the plaintiff several postal cards, addressing her as "cannibal, witch, night hag," and accusing her of coming down the chimney in the dark and sucking all the blood out of her (Maria Wirzar's) veins until she was reduced to skin and bone. The curiosity of the judge was excited, and he requested the defendant to state more clearly what she meant. "Well," she replied, "such a night hag comes over a person when asleep like a current of air, benumbing and stupefying him. If the sleeper is able to rouse himself and cry out 'Jesus! Mary! Joseph!' then the witch desists and departs. This woman (pointing to the plaintiff) is such a night hag. She drives me out of every place, so that I can never stay anywhere more than three weeks. At midnight she comes out from under my bed when I am asleep, sits on me, and sucks the blood out of my breast. I am so weak that I can not work. Formerly I was strong and healthy, now I am lank and lean, because she has drained me of all my blood." Thereupon a woman in the court room exclaimed: "That is true; the witch ought to let her alone. I myself have seen the red spot on her breast and the bites on her arm with the marks of real teeth." The case was then adjourned in order to obtain the opinion of a physician as to the mental condition of the defendant. But if the psychiater declares Maria Wirzar to be crazy, what should he say of the sanity of priests like Dr. Bischofberger, or of the Catholic bishops and other ecclesiastical dignitaries whose teachings are directly responsible for the spread of such gross popular delusions?

Still later, in the autumn of 1892, Victoria Seifritz was charged with having bewitched the stall of the burgomaster of Schapbach, in Baden, and thereby produced an epidemic of hoof disease. As the circulation of this report was injurious to her reputation, and she found it inconvenient to prosecute the burgomaster, with whom it appears to have originated, she published a notice in the local newspaper denying that she ever possessed or exercised any power as a witch. In December of the same year a maid-servant, Elizabeth Hörrath, of Obermichelbach, in Bavaria, was sentenced to ten days' imprisonment for having accused her aunt of being a house witch and her own mother of being a stall witch, asserting that she saw the latter riding on the back of a cow, which immediately afterward went dry. The remarkable thing was, not that an ignorant and malevolent girl should have started such a report, but that many of the neighbors should have believed it and broken off all intercourse with the two satellites of Satan.

In June, 1885, at Kempten, in Bavaria, Xaver Endtes, a professional wizard, was tried and condemned to jail for three weeks because he swindled a peasant named Ostheimer out of seventeen marks under the pretext of casting devils out of cattle. He kindled a fire in the stable and heated two iron bars red hot, then poured on them a quantity of milk, and persuaded Ostheimer that the film of scalded milk that remained was the skin of the witch, who had thus been burned and rendered harmless for the future.

In 1891 a witch conjurer (Hexenbanner), a mason by trade, was arrested by the police at Ulm, where he had established himself as an exorcist, charging twenty-five marks for his services and finding apparently plenty of customers. He was also sentenced to three weeks' imprisonment as a common swindler. The possibility of brazen-faced deceptions of this sort implies a general prevalence of gross superstition in the communities where they are practiced. The first and strongest impulse of the European peasant even in the most enlightened countries is to ascribe all extraordinary good or evil fortune to diabolical agencies. If a man's hens lay more eggs, or his cows give more milk, or his fields yield better crops than those of his neighbors, the latter are pretty sure to attribute his prosperity to witchcraft. Pliny records a case of this kind in which the freedman C. Furius Cresinus was summoned to appear before the ædile Spurius Albinus on the charge of sorcery, because he raised richer harvests on his small farm than others did on their large estates. In his defense he pointed to his well-fed slaves, his superior agricultural implements, and his fat oxen, and exclaimed: "These, O Quirites, are some of my magic arts; but my night-waking and continuous toil I can not show you here on the forum!" Curiously enough, in the early part of the last century precisely the same accusation was brought against a woman who cultivated her own land at Bischofswerder, in west Prussia; and again in November, 1893, at Dresden, a shoemaker named Liebscher instituted a suit against a miner and small innkeeper named Timmel to recover damages for defamation of a like character. Both parties lived in the village of Müdisdorf, not far from Freiberg. It seems that Liebscher's hens and cows supplied him abundantly with eggs and milk, whereas Timmel's were remarkably unproductive. Liebscher was then charged with practicing sorcery, and thereby transferring the eggs and milk from Timmel's poultry and kine to his own. As this report was diligently circulated by the defendant and believed by the great majority of the inhabitants of Müdisdorf and of the surrounding country, it naturally proved to be very injurious to the reputation and the business of the shoemaker, who appears to have been a man of intelligence far superior to that of his neighbors. The testimony taken at the trial revealed the startling fact that nine tenths of the population of this mining district, although good Protestants, hold firmly to the belief in witchcraft and the reality of satanic compacts.

In the summer of 1874 a woman named Frenzel, living at Trulben, in the Bavarian palatinate, consulted a famous wizard at Ixheim, near Zweibrücken, in order to ascertain who had bewitched her child that he should have fallen sick. The wizard placed a key in an open Bible and told Frau Frenzel to lay her finger on it and then to repeat the names of all the people in Trulben. No sooner had she mentioned Margaret Klein than the key turned over. "That is the witch," exclaimed the wizard, who also learned through the movements of the key that she had acquired her knowledge of the magic art from her grandmother, and had the power of transforming herself into a cat or dog at pleasure. When the mother returned home and was washing her child she heard the melancholy mewing of a cat near the house, and was now thoroughly convinced of the truth of the wizard's statements. Margaret Klein, an estimable maiden of twenty-two, was on this account decried and shunned by nearly every person in the village, and was finally compelled, for the sake of her good name, to prosecute Frau Frenzel, who was sent to jail for five days and condemned to pay the costs of the trial.

It is hardly necessary to multiply instances of this kind. They are of constant occurrence and endlessly repetitious, the tautological echo of old superstition, a striking illustration of the persistency of tradition and the poverty of the popular imagination. The question as to when the last witch was burned has been frequently discussed by historians, who differ as to the exact date, but generally agree that it was not later than the second half of the eighteenth century. As a matter of fact, a woman named Agrafena Ignatyeva was burned as a witch by her fellow-countrymen at Vratshevo, in the Russian province of Novgorod, in 1879, if not with the co-operation at least with the collusion of the local authorities, and we have no reason to suppose that she was or will be the last victim of this cruel delusion.

The unpleasant smell of garlic which so often offends the nostrils of travelers in Servia and other countries of eastern and southern Europe is due in a great measure to the notion that witches have a strong aversion to this plant. It is chiefly for this reason that the common people not only eat it, but also rub themselves and their children with it, especially on going to bed, so as not to be visited by any wandering night hag who might otherwise strike the sleeper on his breast with her magic wand, open his side, and devour his heart; the wound would then close up without leaving any scar to show the cause of his death.

In some districts of Dalmatia it is still customary to throw all the women into the water on a specified day to see whether they will sink or swim. A rope is attached to each one in order to save from drowning those who prove their innocence by sinking. The witches who float are also pulled out, and after being rather roughly handled are made to promise to renounce the devil on pain of being stoned. The Dalmatians are evidently of Heine's opinion, that

> "Genau bei Weibern
> Weiss man nicht wo der Engel
> Aufhört und der Teufel anfängt."

Hence they deem it necessary to apply their simple but decisive test occasionally, and the prevalence of an epidemic or epizoöty is pretty sure to be followed by a general immersion of the fairer and frailer sex.

In August, 1893, at Montelepre, in Sicily, a girl of seventeen suffered from a painful malady which her family and kinsmen suspected of being the result of demoniacal possession. This opinion was confirmed by the village *strega* or witch, who gave them full information concerning the name, character, origin, and power of the indwelling demon, and recommended the fifteenth of the month, the Feast of the Assumption of the Virgin, as the fittest time for casting out the evil spirit. On the appointed day the witch prepared a bath of boiling-hot water, into which she threw snail shells, lobsters' claws, nettles, and similar ingredients of a powerful hell-broth, recalling the contents of the caldron over which the three weird sisters in Macbeth muttered their potent charm. The patient was then put into the water and covered with a bed blanket, under which a pound and a half of burning incense was placed. The screams and struggles of the unfortunate girl were of no avail, and not until she fainted away was she taken out in a parboiled condition and laid on a bed, where she soon afterward expired. As she was at the last gasp the witch said, "Now the charm is beginning to work and the demon is about to go out of her."

It is not merely among ignorant and superstitious Sicilians that such things are possible. Not many years ago a young man at Urschütz, near Rosenberg, in Upper Silesia, was treated by a "wise woman" in precisely the same manner and with equally fatal results.

It was recently reported from Catania, in Sicily, that a fiddler named Carmolo had killed twenty-four children and saturated the earth with their blood as a means of finding hidden treasure. A little later the bodies of twenty children were discovered in the woods near the hamlets of Cibali and Santa Sofia; at the same time the parents received anonymous letters, in which the writer told them not to grieve for the dead, since their blood would enable him to unearth an immense amount of money, which he would share with them and thus amply compensate them for their loss.

In March, 1894, a farm laborer, Sier, was sentenced to fourteen months' imprisonment for having exhumed the body of a newly buried child in the graveyard at Moosbach, in Bavaria, and taken out one of its eyes, which, he believed, would render him invisible, like the tarn-helmet of the old German saga, and thus make it possible for him to thieve with impunity. The notion that a bridge will remain firm for all time if a living human being is immured in its foundations is quite prevalent in eastern Europe, and the gypsies are generally suspected of stealing children and selling them for this purpose. Not long since, when a bridge was to be built over the Save, near Breczka, in

Bosnia, the whole population, Christian and Mohammedan, rose up in arms against a band of gypsies who were camping in the neighborhood, and would have put them to death had it not been for the energetic intervention of the authorities. The excitement was caused by a rumor that negotiations were going on between the bridge builders and this vagabond folk for the purchase of a child. There is a popular tradition that a bridal pair were walled up in the old Roman bridge over the Narenta at Mostar, and that the structure owes its strength to this sacrifice. A fresh human liver, especially that of a woman, is supposed to confer magical powers upon him who eats it; and it is highly probable that the desire to become a great magician may explain the many mysterious murders and horrible mutilations of women which have occurred within the past few years, such as the otherwise incomprehensible exploits of Jack the Ripper in London, and similar hideous deeds near Innsbrück, in the Tyrol, and elsewhere. A like exhibition of superstition was recently witnessed in Barcelona at the execution of six anarchists, when old women dipped their handkerchiefs in the blood that flowed from the coffins, making the sign of the cross three times and holding the dirty clouts to their noses. Such a blood-stained cloth is prized as a powerful talisman and carefully preserved.

In some districts on the Rhine the belief that midwives may be in league with the devil and substitute an imp for the newborn infant is not uncommon. Such changelings are called *Kielkröpfe*, and this term would imply that their fiendish origin is indicated by a wen on the throat. It is well known that Luther was firmly convinced of the reality of these substitutions, and urged the Prince of Anhalt to have every hellish succubus or succuba drowned at once; but the sovereign, whose theological education on this point seems to have been neglected, could not be fully persuaded of the existence of such creatures and declined to act upon the reformer's advice.

During the reign of Frederick the Great the statue of a madonna in the Catholic church of a Prussian town was robbed of a costly ornament. A soldier, whose frequent and fervent devotions at this shrine had been remarked, was arrested, and the jewels were found in his possession. He was accordingly tried for church robbery and sacrilege and condemned to be shot. The sentence of the court-martial was submitted to the king for approval, together with the culprit's protest that he had not stolen the precious stones, but that while he was engaged in prayer and laying his necessities before the seat of mercy, the Virgin took the ornament from her neck and gave it to him. One can imagine the malicious pleasure with which the cynical and skeptical monarch referred the whole matter to the Catholic bishop, requesting him to give his official opinion as to the possibility of such a miracle. The bishop was in a quandary. He knew that the soldier's statement was false and absurd, but he could not say so without contradicting the teachings and traditions of the Church and impeaching the testimony of the saints and all the records of hagiology. In his report he was therefore compelled to admit that the prayer may have been answered in the manner described. On the strength of this "expert evidence" Frederick annulled the sentence of the court-martial, but forbade the soldier on penalty of death to offer henceforth petitions of this kind to any image of the Virgin.

One of the most characteristic as well as anachronistic exhibitions of religious folly and frenzy in our day is the *Springprocession*, or procession of jumpers, which takes place yearly at Echternach, in Luxemburg, on the first Tuesday after Whitsunday, and is popularly regarded as a sure cure for epilepsy, St. Vitus's dance, syntexis, murrain, and other maladies of men and cattle. A full description of this performance was given in a book published more than twenty years ago and entitled Die Springprocession und die Wallfahrt zum Grabe des heiligen Willibrord in Echternach (Luxemburg, Brück, 1871), the author of which, J. B. Krier, a priest and religious instructor in the Echternach preparatory school, expresses his firm belief in its therapeutic efficacy and general wonder-working power. "We can not but envy these people," he says, "on account of their living faith, and in our inmost soul praise God, who in our cold and indifferent age has kept alive such a fire in the hearts of our fellowmen." A few Catholics of superior culture, like Prof. Froschammer, of Munich, vigorously protested against the glorification of such crass fanaticism, but it received the approval and encouragement of the episcopate, and, instead of disappearing in the light of the nineteenth century, as one would expect such a survival of mediævalism to do, has been growing stronger ever since. On May 15, 1894, 16,905 persons, including one bishop, 140 clergy, 267 musicians, 2,213 prayers, 2,448 singers, and 11,836 springers, took part in the strange ceremony. This number, which has been derived from official documents, is the largest on record, and furnishes a drastic illustration of the manner in which the patronage of the Church contributes to the promotion of superstition.

The "springprocession" is, in fact, one of the queerest sights that have been witnessed in Christendom since the Flagellants of the thirteenth century made the streets of Italian cities hideous with their scourgings and howlings. The men, women, and children who are to join in the choral dance—which an ancient Greek or Roman, if he should rise from the dead, might easily mistake for a Bacchanalian orgy—assemble on a meadow near the town, where they are arranged in rows or groups, the schoolboys and schoolgirls being in charge of their respective teachers, as if they were going on a picnic. At a given signal the musicians strike up the lively tune known as "Willibrord's Dance," and the saltatory movement begins, the whole mass moving three or four steps forward and one or two steps backward, or four steps to the right and the same number to the left in a diagonal direction, thus advancing, as it were, on the hypothenuse instead of on the perpendicular of a triangle. From a distance, the bobbing and swaying throng resembles the swell and fall of a restless sea, or the bubbling of boiling water in an immense caldron. In this manner the procession moves on for more than two hours through the streets of the town and up the sixty-two steps leading to the parish church, where the dance is kept up for some time around the tomb of St. Willibrord. The dancers join hands, or more frequently hold together by means of a handkerchief, for the sake of greater freedom of motion. Here and there an old man may be seen dragging along an infirm son, who makes desperate attempts to leap with the rest, or a stout woman gasping and sweating under the heavy burden of a paralytic daughter, whom she bears in her arms as she bounds to and fro.

Many legends are afloat concerning the origin of this custom. Thus it is said that in the latter half of the eighth century a sort of epizoötic chorea broke out in the region round about Echternach, and caused all the horses, cows, sheep, and goats to dance in their stalls and to refuse to eat. As no medicine gave relief, the people made a vow that they would dance round the grave of St. Willibrord, and no sooner was this vow fulfilled than the plague ceased, apparently in accordance with the homœopathic principle—*saltus saltibus curantur*. Another tradition connects it with the pestilence known as the black death, which prevailed about the middle of the fourteenth century. In all probability, however, it is a survival of the old pagan feast which was celebrated at the summer solstice in honor of the sun, and changed by Willibrord into a Christian festival. This policy of adopting heathen observances that could not be easily abolished was urged by Pope Gregory the Great as early as the sixth century, in his famous letter to the Benedictine Augustine, first Bishop of Canterbury, and followed by Boniface, Willibrord, and all the other Anglo-Saxon missionaries to the German tribes. It was due to this prudent spirit of compromise that the feast of Ostara, the German goddess of spring, was transformed into Easter, and the nativity of John the Baptist, the herald of the Sun of Righteousness, was placed on June 24th, so as to correspond with the pagan festivities of midsummer.

In Italy the belief in the baneful power of "the evil eye," or *jettatura,* is almost universal among the peasants and common people, and quite prevalent even among the higher and more cultivated classes. Pope Pius IX was generally supposed to be a *jettatore,* and many good Catholics, while kneeling before him for his benediction, were wont slyly to extend toward him their hands doubled into a fist, with the thumb thrust between the index and middle finger as a means of warding off the malign influence. Giovanni Maria Mastai-Ferretti was born with this uncanny gift, and neither his consecration to the priesthood nor his elevation to the papacy sufficed to eradicate it or to suspend its operation. The benignity of aspect which distinguished this kind-hearted successor of St. Peter might conceal, but could not counteract, the fatal fascination that lurked in his "evil eye."

In Germany, it is only in the Tyrol that this superstition appears to prevail, although sporadic cases of it occur in Thuringia, where the witchcraft delusion still has a strong hold on the rural population. The village of Espenfeld, for example, numbers two hundred inhabitants, of whom one half are firmly convinced that the other half are skilled in sorcery; of the latter, several are supposed to have grown rich by paying out money and then conjuring it back into their own coffers. A peasant, who imagined that he had lost considerable money in this way, was advised by a "wise woman" to put the coin thus received into a glass jar and then seal it up. He did so, and soon afterward the coins began to hop and skip as if they wished to get out, but, finding it impossible to escape, gradually grew quiet. By taking this precaution he circumvented the conjurer and saved his money.

In England, men or kine that are supposed to suffer from the witchery of the evil eye are said to be "overlooked." "If a murrain afflicts a farmer's cattle," says the author of a recently published work on this subject (The Evil Eye, by Frederick T. Elworthy; London, Murray, 1895), "he goes off secretly to the 'white witch'—that is, the old witch finder—to ascertain who has 'overlooked his things,' and to learn the best antidote. Only the other day a farmer in North Devon, whose cattle were dying of anthrax, applied, not to a first-class veterinary surgeon, but to a 'white witch,' for a remedy against the pestilence, and as a consequence lost almost his whole herd." The same writer states that a pig's or sheep's heart stuck full of pins is found in many chimneys in old farmhouses as a reprisal against witches. It was believed that the witch, who had "overlooked" the animal and caused its death, would have her own heart pricked and pierced by the pins thrust into the heart of her victim, which had been "ill wisht" by her. This sort of retribution, based upon the principle of sympathy, plays a prominent part in the annals of witchcraft. The Somerset peasant says: "Nif you do meet wi' anybody wi' a north eye, spat dree times." Pliny speaks of spitting in the bosom as a means of inducing the gods to grant any presumptuous desire (*veniam quoque a deis spei alicujus audacioris petimus, in sinum spuendo*), and Juvenal refers to the custom of bespitting the upper folds of the toga (*conspuere sinus*) in order to avert divine wrath provoked by haughtiness of speech; and if we go back nearly four centuries earlier to the Greek poet Theocritus, we find that the remedy prescribed by the English boor for warding off the influence of the evil eye was employed by the rustics of that ancient time for precisely the same purpose. The sixth idyl of this pastoral poet consists of a dialogue between two herdsmen, Daphnis and Demoitas, of whom the latter, in the course of conversation, remarks: "Lest I should be enchanted by the evil eye, I spit three times into my breast" (*ὡ̓ς μὴ βασκανθῶ δέ τρὶς εἴς ἐμὸν ἔ̓πτυσα κόλπον*), and adds that in doing so he had followed the advice of an old wizard.

An ornament in the shape of a crescent moon (*σεληνίς* or *σεληνίσκος*) was worn by the Greeks or placed on the walls of their houses as a *προβασκάνιον* or preservative against the evil eye, and the *lulunæ*, with which Roman women adorned their persons, were also regarded as safeguards against witchcraft. We have a survival of this superstition in the half moons so often seen on harness and occasionally on buildings. Indeed, in Oriental countries all jewels are amulets, and are prized more for their occult virtue than for their superficial beauty. The Romans hung a *fascinum* in the form of a phallus round the necks of children as a preventive against witchcraft, and the pieces of red coral used by our teething infants to facilitate dentition are a reminiscence of this usage connected with the Priapian cult. The *Drudenfuss*, or pentagram (*), which the Tyrolese draws on the threshold of his stable to protect his cattle against enchantment, is a relic of Pythagorean mysticism and mediæval magic.

A dreadful tale of cruelty caused by the witchcraft delusion comes to us from the Emerald Isle. A few months ago, at Ballyvadlea, in the county of Tipperary, a woman named Bridget Cleary had an attack of influenza or grippe, which, as is usually the case with maladies of men and beasts, was ascribed to demoniac influences. Her husband, a cooper by trade, got the notion into his head that she had been "overlooked," and thereby spirited away by a wicked fairy, who had taken possession of her body. He called a family council, consisting of her father, an aunt, four cousins, a couple of neighbors, and the village simplist, who unanimously confirmed his suspicion, and went to work to exorcise and expel the evil spirit, so that the unfortunate woman might return to herself and her friends. The simplist prepared a disgusting decoction, which her husband poured down her throat, exclaiming, "There, take that, thou witch!" He then put this question to her twice: "Art thou Mary Boland, the wife of Michael Cleary? Speak by the Lord!" She replied: "I am Mary Boland, the daughter of Pat Boland, by the Holy Ghost!" It now occurred to one of the neighbors, named Dunin, that if they should put her on the fire, which fairies are notoriously much afraid of, the indwelling spirit would speak the truth, and probably be compelled also to depart. This clever suggestion was at once acted upon. The sick woman was taken out of her bed and held over the flames, while in the midst of her fearful screams her tormentors kept shouting, "Come home, Bridget Boland, come home!" She was again put to bed, and Cleary, who had become greatly excited, continued to cry out, "In the name of God, art thou Bridget Cleary, my wife?" declaring that, if she did not give a satisfactory answer three times, he would burn her up. As she was too exhausted to heed this threat, he threw the petroleum lamp at her and she was soon all ablaze, and, in the words of an eyewitness, "burned like a torch." No voice of compassion responded to her shrieks, which only provoked the harsh command of her husband: "Be still! Troth, I'm not burning Bridget; in a minute, begorrah, you'll see the witch going up the chimney." The charred body was put into a sack and thrown out of the window. There it was found and borne to the graveyard by the constables of the village, but no member of the family of the deceased attended her funeral. They were all scattered about on the neighboring hills, each armed with a sharp knife and awaiting the appearance of Bridget Cleary mounted on a white horse which the fairies had given her. There they watched day and night, firmly believing that if they could only succeed in cutting the reins of the bridle the spell would be broken and the unfortunate woman disenchanted. Instead of the magic steed, they were met by a body of policemen and taken to Dublin, where they are to be tried for murder.

In Ireland the laws against witchcraft were not abolished until 1821; and as the Catholic Church still prescribes formulas and performs rites for the exorcism and expulsion of evil spirits, it is no wonder that the delusion lingers in the minds of the people, and sometimes gives rise to horrible cruelty like that ignorantly inflicted upon Bridget Cleary.

About thirty years ago printed prayers addressed to "the true stature of Jesus," which had been supernaturally revealed to some ecstatic soul, were extensively sold in Bavaria as talismans to prevent and destroy diseases. But superstition, too, is not wholly free from the whims of fashion, and these prayers have now been superseded by another panacea called "Lourdes waffle," a thin piece of pastry in the form of a madonna made of flour and the water of Lourdes by the Order of Redemptorists at Cortona, in Tuscany. Quantities of these new-baked fetiches are manufactured and exported every year with the approval of His Holiness Leo XIII, by whom they are especially commended as a specific for demoniacal infestations.

In 1887, when the phenomena of hypnotism began to excite general interest and to be discussed by the press, La Civittá Cattolica, the official organ of the Vatican, published an article ascribing these strange manifestations to diabolical agencies, and asserting them to be desperate attempts of Satan to recover the sovereignty of this world, which the Church is gradually wresting from his grasp.

Unfortunately for the progress of knowledge and the general diffusion of enlightenment, this explanation of hypnotism is a fair example and illustration of the attitude of the papacy toward every puzzling problem which presents itself to the human mind for investigation. There is only one solution: the devil is to pay. The same opinion is held and taught by the Greek Church, as well as by conservative Lutheranism and many other rigidly orthodox sects of Protestantism. Luther asserted that "if a man loses an eye or hand, falls into the fire and is burned to death, or into the water and is drowned, mounts a ladder and breaks his neck, tumbles down without knowing why or how, or incurs daily unforeseen accidents, all these things are mere tricks and onsets of the devil" (*eitel Teufelswürf' und Schläg'*). If a big bluebottle buzzed about in his study and happened to light on his pen, he was sure that it was an emissary of Satan endeavoring to hinder him in his work. Even the refined and scholarly Melanchthon relates similar experiences: "When I was in Tübingen," he says, "I saw every night flames which burned a long time and then vanished in a dense cloud of smoke. Likewise in Heidelberg, forms like falling stars appeared to me every night. They were undoubtedly devils, which are constantly roving about among men." This belief in the omnipresence of satanic satellites, embodied in animate and inanimate objects, was easily confirmed by the citation and frequent perversion of scriptural texts. Thus the words of the Psalmist, "Set a watch, O Lord, before my mouth: keep the doors of my lips," was interpreted, not as entreaty to be saved from the sin of evil-speaking, but as a prayer for protection against evil spirits, who might take advantage of the act of oscitation to enter into and get possession of the human body. It was formerly believed that the devil drowzed people and thus incited them to yawn for this express purpose; hence the custom, once generally prevalent and still practiced in Spain and Italy, of making the sign of the cross over the mouth in yawning, of which the habit of covering the mouth with the hand when yawning is said to be a survival.

Delusions growing out of the dread of demons die hard, especially when it is in the supposed interest of sacerdotalism to uphold them. Every invasion of the realm of supernaturalism through the progress of science is feared and resented by ecclesiastical organizations, lest it should prove to be an entering wedge destined to destroy the foundations upon which they rest. It is this apprehension that often leads men as a body to sustain and perpetuate beliefs which as individuals they know to be false, boldly asserting and often honestly believing that the overthrow of their own little system of faith would imperil the whole edifice of religion and society, although the existence of such solidarity is shown by all the teachings of history to be utterly illusive. Hierarchical and official Christianity to-day bears about the same relation to contemporary scientific and philosophic culture that paganism did to the best thoughts of the period when Lucretius wrote his didactic poem De Rerum Natura, or when Lucian, more than two centuries later, composed his satirical dialogues.

The Tyrolese Jesuit Tanner had brought himself into grave suspicion by advising inquisitors to proceed with caution in the prosecution and punishment of witches; and when he died, in 1632, he was denied Christian burial, because there was found in his possession a dangerous hairy devil, which, on closer examination, proved to be a flea under a magnifying glass. The Church, however, obstinately refused to recognize its error, and still holds to the legend of the "dangerous hairy devil." Recantation is fatal to the prestige of infallible authority, which is forced by its pretensions to cling to its decisions, however absurd, and to close its mind to all sources of enlightenment. It is in this necessity that the divergence of scientific from theological conceptions of the universe originates and gradually widens into an impassable gulf. A divinely inspired and therefore inerrable record can adapt itself to the progress of human thought only by forced interpretations and positive perversions of its original meaning. Hence the supreme importance which all systems of religion attach to hermeneutics, the science of sciences, as Origen called it, absolutely essential to the evolution of doctrinal theology. It was Samuel Werenfels who said of the Bible:

> "Hic liber est, in quo quisque sua dogmata quærit,
> Invenit et pariter dogmata quisque sua."

The same idea is expressed by Rückert in Die Weisheit des Brahmanen:

> "Des Glaubens Bilder sind unendlich umzudeuten;
> Das macht so brauchbar sie bei so verschiednen Leuten."

This sort of exegetical jugglery, with its allegorical, anagogical, and tropological methods of exposition, is not confined to the Jewish and Christian Scriptures, but extends to the sacred books of all nations. Veda, Avesta, Tripitaka, Taò-tĕ-King, Koziki, Kur'an, Adi Granth, Kurral, and Popol Vuh have all been put to the rack by hermeneutical inquisitors and made to confess whatever doctrines their tormentors wished them to teach. We have a striking illustration of this tendency in recent attempts to deprive the Hebrew cosmogony of its true character as the terse and highly poetical version of an ancient Assyrian creation myth, in order to bring it into harmony with the modern theory of evolution.

The same fatality compels the Church in the nineteenth century to observe the forms of propitiation, incantation, and conjuration which were the natural outgrowth and consistent expression of primitive demonolatry, but are utterly repugnant to all rational conceptions of the constitution of the universe and of the laws that govern it. Some years ago the writer was the guest of a Catholic priest in a remote region of the Tyrol. The house was a massive building of the tenth century, formerly used as a cloister, and still adorned with portraits of the old abbots and distinguished monks who were once its inmates. Attached to it was a spacious chapel which now served as the parish church. One day as a severe storm was gathering the church bells began to ring violently in order to affright and drive away the devils who were supposed to be riding on the tempest as satellites of the "prince of the power of the air," and hurling thunderbolts against the habitations of men. The priest admitted that the custom was a relic of pagan superstition and of no efficacy whatever, denied the demonic origin of meteorological phenomena, and added that the ringing of many large bells, like the firing of cannon, would rather tend to produce storms by agitating the air than to disperse them. "But if I should act according to my own judgment and neglect this time-honored practice," he continued, "I should be held morally responsible for all damage done by lightning within the precincts of my parish." He placed his own person and property under the protection of a lightning-rod, but was constrained by his ecclesiastical affiliations to pander to mediæval tradition, and cause the mountain valley to resound with the devil-defeating clangor of consecrated bells.

In November, 1894, it was reported that a statue of the Virgin Mary at Reggio, in Calabria, had been seen opening her mouth and moving her lips, and this absurd rumor attracted thousands of persons, who came to present offerings and to prostrate themselves before the wonderful image, praying to be delivered from the perils of earthquake and similar calamities. It is not surprising that the ignorant and credulous peasantry of southern Italy should fall into gross fetichism of this sort; the astonishing thing is that the priests of a Church which sends missionaries to Africa should encourage such crass superstition at home, and, instead of seeking to enlighten the minds of the masses, should march in procession to the scene of the supposed miracle with banners and censers, singing hymns and chanting litanies, and displaying all the pomp and paraphernalia of an imposing religious ritual in confirmation of a vulgar delusion.

In August, 1894, the population of one of the suburbs of Vienna was thrown into intense excitement by the rumored apparition of the Virgin Mary, who was said to have been seen at sundry times sitting on the branch of a tree in an old cemetery and holding the child in her arms. The throng became so great as to require the intervention of a squadron of police in order to prevent a complete interruption of the city traffic. Not only was the reality of the supernatural appearance generally believed, but several persons turned it to practical account by noting the exact time of the occurrence, hour, day, month, and year, so as to secure lucky-numbers for the lottery, and even attributed the presence of the police to the anxiety of the Austrian Minister of Finance lest, by a happy combination of these numbers, some one should win a tern and thus deplete the state treasury. A workman from a neighboring factory, who chanced to pass by, endeavored to demonstrate the impossibility of such phenomena, and urged the crowd not to give credence to idle tales of this sort; but this laborer was the only one who acted the part of Paul on Mar's Hill, and reproved the multitude for being "too superstitious." Not a representative of the clergy, from the humblest ecclesiastic to the highest dignitary of the Church, has ever been known to improve occasions of this kind for the religious instruction and intellectual elevation of the people. Indeed, it would be difficult for them to do so, in view of the fact that the literature which the Catholic Church still publishes and disseminates for the promotion of piety consists chiefly of similar legends; and it would not surprise us if a full and authentic account of the Vienna apparition should appear in the columns of the Innsbrück periodical, Monthly Roses to the Honor of the Immaculate Mary, Mother of God, as an incentive to more ardent adoration of the Virgin.

Some years ago, in the month of May, I was walking up the Ludwigstrasse, in Munich, with a German friend well known as a genial poet and earnest Catholic. Just then a procession of maidens dressed in white, with wreaths of flowers on their heads and an image of the Virgin borne aloft, came out of the church and passed through the garden, in which are the stations with Fortner's frescoes representing the life and passion of Christ.

"There is something that appeals to the imagination," remarked the German. "And purely a creation of the imagination, too," was my reply. A conversation ensued, from which it appeared that my friend regarded all religious beliefs, institutions, rites, and ceremonies solely from an æsthetic and poetic point of view. He even declared that it made no difference to him whether such a person as Christ ever lived, and whether the popes were the successors of Peter or not; he should still be a Christian and a Catholic. He admitted that all sacred literatures are more or less mythical, and that our Holy Writ forms no exception to the rule. With the progress of the race the old myths are refined and transformed, both artistically and ethically, and thus adapted to every advance in civilization, but they never die out. "The masses," he added, "are mentally and morally mere children and will probably always remain so, and the most interesting and instructive books for children are *märchen*." Here was a scholarly and thoughtful man who stood wholly out of reach of "the higher criticism," since he was ready to assent to its most radical conclusions without the slightest change in his attitude to the current system of belief.

A mind thus constituted would regret the decay of superstition as a decline of ideality and a limitation of the undefined and unknown regions of the supernatural, in which that errant sprite, the imagination, is free to expatiate and quick to discover wonders more strange than any invented by the Moor of Venice to win the heart of Senator Brabantio's daughter. We fully appreciate the poetical side of popular mythology and the unfading fascination of folklore, and feel the charm that lingers in customs growing out of these survivals of primitive beliefs; but this is another phase of the subject which can not be discussed in the present paper. There are many tourists who remember Rome as it was under papal rule, with its countless beggars and chronic filth and perennial sources of malarial fever, and are fain to lament the disappearance of these picturesque features through the purification and regeneration of the ancient city. It is the same sort of false sentiment that mourns over what the poet calls

> "The fair humanities of old religion,"

the loss of which has been more than made good by the marvelous discoveries of modern science, whose achievements rival the annals of credulity in their appeals to the imagination, and render the visible and invisible forces of Nature, once the terror of man, now tributary to his happiness.

EVOLUTION IN FOLKLORE.

SOME WEST AFRICAN PROTOTYPES OF THE "UNCLE REMUS" STORIES.

By the late Colonel A. B. ELLIS.

IN the process of collecting the folklore of West Africa, but chiefly that of the Gold Coast, I have found several tales which are evidently the West African variants of some of the stories collected in the Southern States by Mr. Joel Chandler Harris, and published under the title of "Uncle Remus," and a comparison of the two sets may be of some interest to American readers, besides affording an example of the extent to which folklore is affected by change of environment.

The rôle of Brer Rabbit is filled on the Gold Coast by the Spider (*Anansi*), and on the Slave Coast by the Tortoise (*Awon*), who is doubtless the prototype of the Terrapin in "Uncle Remus." In both districts the Hare figures in the tales, and possibly Brer Rabbit is the Hare amid new surroundings, but in West Africa "Long Ears" rather takes the place of Brer Fox, as he is usually outwitted by the Spider and the Tortoise.

So large a number of the folklore tales of the Gold Coast have the Spider for their hero that the title *Anansi' sem*, "Spider stories," is now the generic native name for all folklore tales whatever, no matter what the subject may be; and this designation survives in the British West Indies in the name "Nancy stories," which is there applied by the negro to his local folklore. The supply of slaves for the British West Indies was drawn almost exclusively from the Gold Coast, so that all, or almost all, of the existing folklore of those islands is derived direct from the Spider stories, and can be readily traced; but in the Southern States the connection is not always so apparent, for although up to the beginning of the present century Gold Coast negroes formed the bulk of the imported slaves, yet, after about 1810, when the African kingdom of Yoruba broke up, large numbers of Slave Coast negroes were introduced, with the result that the local tales present features peculiar to both districts of West Africa.

The second tale in Mr. Harris's "Uncle Remus" series is entitled The Wonderful Tar-baby, and, briefly, is as follows: Brer Fox makes an effigy of tar, mixed with turpentine, and sets it up by the roadside. Brer Rabbit, coming along the road, sees the tar-baby and bids it "Good morning." The tar-baby makes no reply, upon which Brer Rabbit grows angry and strikes it, with the result that his hand sticks to the effigy. Then he strikes with his other hand, with the same result; then he kicks with his feet, and, finally, butts with his head, until he is completely fixed to the tar-baby. As will be readily seen, this is evidently a variant of the following Gold Coast tale:

SPIDER AND THE FARMER.

There was a famine in Spider's country, and Spider had nothing to eat. Now Spider had a son, named Kwaku Tyom, and Spider's son used to go to a farm not far away and steal cassava. And every day when he brought home the cassava, his father would ask him, "Where dost thou get this cassava?" But Spider's son always made answer that he could not tell him, for if he, Spider, were to go there, some harm might befall him. Spider said, "Oh! my son, did I not beget thee, and yet thou thinkest thyself to be more clever than I? Show me the place, and I will be careful that no one sees me." But Spider's son still refused to show Spider.

Now, whenever Spider's son went to the farm to dig cassava, he used to carry a bag, which he filled with cassava, and so brought home; and Spider played his son Kwaku Tyom a trick, for, when night fell, and Spider's son had laid himself down and was sleeping, Spider put wood ashes into the bag and made a hole in the bottom thereof.

Next morning Spider's son arose, and slung the bag around his neck, and set forth to go to the farm; and as he walked, the ashes fell through the hole in the bag and marked the path. Then Spider came after his son and saw the road, but he did not go to the farm that day; he returned home and said nothing. In the evening Spider's son returned home and brought cassava.

Next morning Spider arose early and followed the track of the ashes to go to the farm; and when he reached the place he saw a something there made of crossed sticks, standing in the midst of the farm, and there were snail shells hanging thereon, which the breeze rattled.*

When Spider saw this he was afraid. He saluted the something, and said, "Good morning, sir"; but the something made him no answer. Then Spider became vexed, and he said, "Oh! oh! dost thou want to shake me by the hand before thou answerest me?" He put out his hand to the something, and his hand became fixed to the sticks so that he could not draw it back.

* What we should call a scarecrow, but on the Gold Coast such things scare people rather than birds, for they are meant to protect crops from thieves, and are believed to possess a latent power, derived from some god, to entrap or bring misfortune upon any one who interferes with what is under their guardianship. The snail shells here mentioned are those of the large edible snail of West Africa.

Then Spider became more vexed, and said, "What sort of manners are these? I was so polite as to come and shake thy hand, and now thou dost hold my hand and will not leave it." He put forth his left hand to the something, and the left hand became fastened also. "Well, well," said Spider, "what is it that thou wishest me to do? Thou hast caught my two hands. Dost want me to embrace thee?" He put his face to the shoulder of the something, and it remained fixed there so that he could not draw it back. He kicked with his two feet at the sticks, and they also were caught and held.

In this wise Spider remained all that day and until the morning of the next day, when the plantation owner came there and saw Spider fastened to the something. And the farmer said: "Hallo, Father Spider, and is it thou who hast been coming to take my cassava all this time? At last I have found thee out!"

Spider's wife and Spider's son Kwaku Tyom knew that Spider had gone to the farm, because they had not seen him in the house all the night.

The farmer said to Spider, "I have lost about two hundred and fifty cassavas from my farm since this began, and unless thou payest me thou wilt not go from here." Then Spider begged for pardon, and prayed the man to release him, saying that he would pay for all, and the farmer released him.

Then Spider said to the man that he must return home with him, and they went together; and when they arrived at Spider's house, they met there Spider's wife and son. The farmer said to Spider's wife: "I saw Spider in my farm this morning, quite fastened up, and, as I have lost about two hundred and fifty cassavas from my farm, I asked Spider concerning them, and he confessed it was he who had taken them, and said he would pay me, so I have come hither with him to receive payment."

Then Spider's son spake to Spider and said: "Father, I told thee not to go to the farm. My mother has told me that, when I was sleeping one night, thou didst put some ashes into my bag, and picked a hole in the bag; but I knew not when I was going next morning that the ashes were falling along the road. Now, father, how art thou going to pay for so much?" Spider answered softly, "Never mind, my son, I will pay him up in the roof."

Then Spider made an excuse to the farmer that he wanted to go into his sleeping room, but the farmer said: "No, I will not let thee do so, for thou art too tricky." But Spider begged the farmer, saying that he only wanted to go into the room to get the money wherewith to pay him, and that he would return at once; and at last, after much talking, the farmer left Spider.

Then, when Spider had moved about three steps from where the farmer was sitting, he cried: "Oh! oh! daddy farmer, I have no money for thee. I will pay thee on the roof top." And he jumped at once into the rafters, where he said, "I shall not come down again."

Since then Spider has not come down from the roof, for he owes the farmer too much, and the farmer is still looking for him.

The eighteenth of Mr. Harris's tales, entitled Mr. Rabbit finds his Match at Last, describes how Brer Rabbit runs a race with the Terrapin, which the Terrapin wins by distributing his wife and children at the different mileposts along the track, and by concealing himself near the winning post, up to which he crawls when Brer Rabbit draws near. In the introduction Mr. Harris mentions a similar tale from the South Atlantic States, where the Terrapin, by the same stratagem, wins a race that he runs against the Deer. In this instance, however, the race is for a bride, who is to marry the winner, and so the tale probably has reference to the once widely distributed marriage custom known as "bride racing." The Gold Coast tale, equally with that of Uncle Remus, has no reference to marriage. It is as follows:

THE FROG AND THE LEOPARD.

One day the Frog challenged the Leopard to run a race with him from Axim to Accra, and the Leopard answered: "This is foolishness. A little slow-moving creature such as thou art could not race with me"; but the Frog said, "Yes, I will, and we will then see who is a man"; so the Leopard agreed, and they fixed a day for the race.

Then the Frog went to Axim, and he placed frogs all along the road from Axim to Accra. He hid them in the bush, putting here five and there ten; and when the time came, the Leopard came and called the Frog to go and race.

When they started, they started together, and the Leopard at once made one leap and came to Shamah, and when he alighted on the ground he called "Frog," and a frog answered "Yaow." The Leopard said: "What! such a little creature as that can beat me in a race? No, it is not possible. I will go on again"; and he skipped from Shamah to Kommenda, and when he alighted he called again, "Frog," and a frog answered "Yaow." Then the Leopard was ready to scream with vexation, he did not know what to do, and it was bitter to think that such a slow creature as a frog could leap as far as he.

The Leopard made another leap, and he leaped from Kommenda to Amkwana, and as he alighted he called "Frog," and a frog answered "Yaow." The Leopard said, "What! art thou here again?" and he was angry, and he made a bound from Amkwana to Simpa, without touching anywhere, and when he came down at Simpa he called "Frog," and a frog said "Yaow." The leopard said: "I am the King of the Bush. Every creature is under me. I am the King, I can cut off heads, and yet a little creature like thee is able to race with me, and now thou seekest to beat me."

Then he leaped at once from Simpa to the Sakum River, and when he came there he thought, "Frog is not here," and he did not call the Frog, but said he would first drink some palm wine, because he was tired. And after he had drunk the palm wine he called "Frog," and a frog answered "Yaow." The Leopard asked, "What! art thou here, Frog?" And the frog again said "Yaow." Then the Leopard made a leap from that place and came to Accra, and called "Frog," and a frog answered "Yaow." At every place to which he came he met the Frog, because a frog was there before he leaped.

At that time the Frog lived in the bush—he lived there with all the other animals; but now the Leopard said to him, "I am the King of the Bush, and after this I will not keep thee there any more. I will put thee down close to the water side."

That is why ye can hear frogs crying by the water side whereever ye go. The Leopard has driven them out of the bush, because the Frog was the only animal that could race with him.

Another Gold Coast tale is:

HOW SPIDER AND KWAKU TSE KILLED THE KING'S COWS AND TOOK HIS WIVES.

There was a certain king who had two fine cows, and these two cows were in the same town with the king. In this town people often could not get meat to eat, but the king always had meat to eat from the two cows, for they used to void meat every morning.

Now, Spider and Kwaku Tse came to that town as strangers,* and when they came the people had no meat to eat; they had nothing but plantains and *dokonno*; † so Spider and Kwaku Tse asked the master of the house in which they lodged, since he had no meat to give them, to show them the house of the king.

Then Spider and Kwaku Tse went to the king, and said to him: "We are strangers who have come to thy town, and to-mor-

* It should perhaps have been stated before that Spider and his family are able to assume the human form at will. When Spider is in human shape he is small, lean, and hairy, and these peculiarities are shared by his children. In the tale of Spider and the Farmer it is to be understood that Spider goes to the farm in human shape and, when in his own house, escapes from the farmer by becoming a spider again and climbing up among the rafters.

† Dokonno—a kind of boiled maize bread.

row we will pass on our way, and we can find no meat to eat, but as we were coming hither to thee we saw two fine cows." The king answered, "The cows are mine, and they are not to kill." Spider asked, "Why should not the cows be to kill?" and the king answered, "They supply me with meat." Then Spider and Kwaku Tse asked the king if he could not give them even a small piece of meat, and the king refused.

They departed from the king and returned to the house in which they were lodging, and they told the owner of the house of all that they had said to the king, and how the king had refused to give them even a small piece of meat. They said to the man: "The king said that his two cows supplied him with beef, and that therefore he could not kill them." Spider said, "My name is Spider, and this man is my namesake Kwaku. Never before have I seen a cow that could supply meat and yet live. I came hither only to pass through and go upon my way, but now I will tarry here and see how it is that these cows can supply the king with meat." The owner of the house answered, "That thou wilt not be able to see, for they do it in the king's private yard." Spider said, "I am he who is called Kwaku Anansi, and anything in this world that I want to see or want to do and that I am not able to see or do, I have not yet found it." He said: "These two cows of the king, I will kill them and I will take their heads. I and my friend will do it; we will each kill one, and as for the heads of the cows, the king will cut them off and give them to us."

When Spider spake thus the owner of the house marveled greatly to hear such words, and he ran and called his neighbor and said to him, "Come and listen, for there is a great trouble which these strangers who have come to lodge with me are about to bring upon me." When the neighbor came the owner of the house told him, in the presence of Spider, what Spider had said, and Spider gave them a proverb, saying, "If the load on thy head is heavy, and it is something to eat, whilst thou art eating it thou art lightening it." Then Kwaku Tse said: "We have spoken this in thy house; it is no concern of any one else."

Then Spider and Kwaku Tse told the owner of the house that they were going out to see if they could not get the heads of the two cows and bring them there. And they departed and went to the king's yard, and it was night time, and they found the place wherein the cows used to sleep. Now they had with them a leaf that, when a person smelled it, it made him sneeze, and they rubbed the leaf upon the noses of the two cows. Then the cows at once looked as if they wanted to sneeze; they opened their mouths wide open, and Spider and Kwaku Tse turned themselves very small and each of them jumped into the mouth of a cow, and the cows swallowed them up. Then they cut meat from the insides of the cows, but the cows did not die.

Next morning the king came to his cows to get meat, and the cows voided meat for the king, but this time the meat was not fresh as it always used to be, because Spider and Kwaku Tse had cut it and left it inside all night. The king said, "I wonder why the meat is not fresh as it always is?" and he sent for a medicine man to see if he could cure the cows, for he thought that they were sick. When the medicine man came, he said that the cows had eaten a bad leaf, and he poured medicine down their throats. Then the medicine purged them and they voided more meat, but it was all stinking.

When the king and the medicine man had gone away, and there was nobody left with the cows, Kwaku Tse came out and went into the cow in which was Spider, and when he came there he found that Spider had done the same as he, Kwaku Tse, had done in the other cow. He said to Spider: "I do not know why we can not make these two cows die. We have cut all the meat inside. I am going back to my cow, and after I have gone inside I will cut its belly right through with a knife." Spider answered: "No, do not do that. When thou goest in, thou must cut neither the belly nor the heart." Kwaku Tse asked, "Why not?" and Spider said, "Because if we kill the cows while we are yet inside, we shall not be able to get out again, and what shall we do then?" Kwaku Tse asked, "Why should we not be able to come out?" Then Spider said, "Is not thy mother dead?" and Kwaku Tse answered, "Yes." Spider said again, "And what caused her death?" and Kwaku Tse answered, "She died by poison." Spider said: "When she was dead, did not a medicine man come and try to make her sneeze or open her mouth, and did he not fail to do it? Thus thou must know that if the cows die while we are yet inside them, we can not get out. But we can hide ourselves, and that is what we will do. The king will rip open their bellies to discover the cause of their death, so thou must chop the meat on one side very small, so that they will think that the cows have received a blow, and have died therefrom. When the king rips open the cow thou must hide in the stomach, and if thou seest that they are about to search there, thou must run into the bowels and hide. When thou goest into thy cow now, after thou hast chopped the side as I told thee, thou must search for the heart and cut it down. When thou hast cut the heart down the cow will die, and then thou must be careful where thou hidest, so as to escape the knife with which they will open the belly. But before thou doest this, first run to the man in whose house we lodge and tell him that we are going to the water side to wash." Then Kwaku Tse went to the house-master and told him, and returned into the belly of the cow, and chopped the side and cut the heart down, and the cow died. And Spider did the same in his cow, and both cows were dead.

When the king came and saw that his cows were dead, he ordered his people to go and bring the medicine man who had physicked the cows, and when the medicine man came he said that if the king would allow it he would rip open the cows' bellies. The king consented, and they ripped open the cows, and the medicine man said that something had struck the cows a blow in the side and that that was the cause of their death. The king asked the medicine man if the cows were still good to eat, and the medicine man said that they were. Then the king said: "When thou camest first to the cows thou didst say that they had eaten a bad leaf. How, then, can their flesh now be good to eat?" The medicine man answered that at first he thought the cows had eaten a bad leaf and were sick therefrom, but now he found that a blow had been struck them, and therefore the flesh would be good to eat. He said that the people must cut up the cows and carry the paunches to the water side and wash them.

Then the king had the cows cut up, and he ordered two of his slaves to carry the paunches to the water side; and when they went there they threw them down in the water. When the paunches fell into the water Spider and Kwaku Tse broke forth from their hiding places and changed themselves at once, and looked up at the two slaves and cried unto them: "See how ye have acted to us! see how ye have acted to us! We were bathing here in this water and ye came and cast cows' paunches upon us."

The two slaves were frightened, and they left the paunches and ran away and returned to the king and told him: "When we carried the cow paunches to the stream and cast them into the water, two men arose and said we had cast the cow paunches upon them. The king asked, "And did ye throw the paunches upon them?" The slaves answered: "We saw them not; but when they jumped up before us they were covered with the filth from the cow paunches." The king asked, "How deep was the place?" and the slaves answered that it was about the depth of a man's knees. Then the king said, "If it were only of that depth ye must have seen the men when ye cast in the cow paunches."

The king called two elders and sent them to the water side to see the two men, and when the elders came they found Spider and his friend covered with filth and the cow paunches in the water. Spider said to them: "That which these two slaves have done to us, if we were not strangers here in the town, we would deal with them for it. We asked if we might come here and wash before we came here." The elders said, "This is the place where we always are used to wash. The slaves have done wrong, but they are the king's slaves, therefore we beg thee to let the matter rest." Spider answered: "Ye are begging us while the filth is still upon us. Ye can not beg us so with empty hands. If the cows have been killed 'twill not be so grave a matter, but if they have died our medicine will be spoiled, therefore we will go with ye and see the cows. When first we came to this town we could get no meat. We went to the king and told him we were strangers and had no meat to eat, and he told us he had no meat to give us."

While they were still talking by the water side, the son of the man in whose house Spider and Kwaku Tse were lodging came there and saw them with the elders, and he ran home and told his father. Then the father came to see what was the matter, but when he came he did not find the two strangers, for they had already departed with the elders to go to the king's house. Then he went to the king's house, and when he reached there the strangers and the two elders had not yet arrived. When the man came, the king asked him what he came for, and he answered: "Two strangers came to me three days past and lodged in my house. They went out this morning, and after a time one of them returned to me and told me they were going to the water side to wash. Afterward my son came and told me he had seen them at the water side talking with two elders. So I have come hither to learn what the matter is." The king asked: "What strangers are they? Whence do they come?" and the man answered: "King, thou knowest them. They are the two young men who came to thee and asked for meat, because they were strangers." Then the king said, "Ah! I know them now." He said: "When thou doest good for a man it is good for thyself.* These young men came and asked me for meat, and I said I had none to give them. Now my cows are dead, and the slaves whom I sent to wash the paunches at the water side have cast them upon the young men. I have sent two elders to go and soothe them, but they have not yet returned."

While the king was speaking, Spider and Kwaku Tse and the two elders came, and with them the slaves bearing the paunches of the cows, and Spider and Kwaku Tse were still covered with the dirt from the paunches. The king asked the elders: "The place where these slaves cast down the paunches, if any persons were there, could they see them?" The elders answered that the slaves could not fail to see them. Then the king said, "Then the slaves must have done this thing purposely," and the elders answered, "Thou hast said it." Spider said: "If thou art a stranger and thou goest to another country, they treat thee like a stranger, in truth. The slaves, when they saw my small body, they thought

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* A proverb.

I was a young boy, or else they would not have done such a thing." The king said: "Thou must not say so. I am here for all people, for the townfolk and for strangers also, to protect them and be a father to them." Kwaku Tse answered: "How canst thou say thou art a father to the stranger? Did not we come and ask thee for meat, and didst not thou tell us that thou hadst only meat for thine own household?" Spider said: "In this world in which we live it is not everybody that likes everybody, so it behooves every man to keep a little medicine * to guide him. If the cows died of sickness then our medicine is spoiled, but if the cows were killed no great harm was done." The king said that the cows had died, and then Spider sang:

> "My namesake, Kwaku, we are wearied, we are wearied,
> We are wearied without cause."

The king asked what this song might mean, and Spider said that the little medicine which they possessed was a medicine which forbade them even to pass by dead animals, and now the flesh of animals that had died had been thrown upon them. He said: "Had these two slaves killed one of us, instead of throwing the paunches upon us, it would have been better, because the one who lived would have mourned for the other, and that is something. As we are standing before thee now, O king, if war came upon thee we are thy men. And if war did come upon thee now, we should be the first to die in battle on account of what thy slaves have done." He said, "No son can be older than his father." Then the king asked what this proverb might mean, and Spider and Kwaku Tse showed each a medicine that was upon their loins, and said: "This medicine, when we were born it was not upon us. After we were born we made it, and if thou wilt help us we will make fresh medicine again, and let this matter rest, for thy sake." The king said, "Whatever it is ye want, say it," and they answered, "That which we want, perchance thou thyself will want it also." The king said, "As ye are strangers, ask for what ye wish, and, even though I want it, ye shall have it." Then they said that they wanted the two heads and the two hearts of the very cows whose paunches had spoiled their medicine, and hair from two of the king's own wives. The king answered that he would give them the cows' heads and the two hearts, but as for his wives' hair, that was too much to ask. Spider said, "If the cows were not thine own it would be different, but as the cows were thine own we must ask for the hair." Then the king said he would give them the hair according to their wish, but only a little; and Spider and Kwaku Tse said that a little would suffice.

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* I. e., an amulet or charm.

Then the king called two of his wives, and when they came he was ashamed to tell them what he wanted, so he said to them that their hair had grown too much, and that they must cut it down. Then the two women went into their own room and cut the hair, and the king came behind them and gathered some of it and gave it to Spider and Kwaku Tse, together with the two heads and the two hearts of the cows.

Spider and Kwaku Tse departed from the king and carried all the things to the house wherein they lodged, and they told the house-master that they wished to marry and to give a wedding feast. The house-master said that there was no meat in the town, and though people passed by driving cows to other towns yet they would not sell them. Then Spider and Kwaku Tse took the two cows' heads, and went into the road where the people used to pass driving their cows, and there was much mire at a certain part of the road, and they took the two heads and planted them in the mire so that the severed necks were hidden.

By and by some people came driving cows, and Spider and Kwaku Tse called to them, and said: "We were passing here with our cows, and lo! this mire has swallowed them up, and we can not draw them out. Can ye take them out for us?" The people said "Yes"; and they left their own cows, and went and laid hold of the horns of the cows' heads that were in the mire, and pulled hard to pull the cows out, and when they pulled the two heads came up out of the mire. Then Spider and Kwaku Tse cried aloud and said: "See what ye have done! See what ye have done! Ye have pulled the heads off our cows and left the bodies still in the mire. Ye must pay us for our two cows." Then the people were obliged to give them two of their own cows, and they took the two heads and cast them among the bushes.

Spider and Kwaku Tse take the heads from the bushes and play the same trick upon some other passers-by, after which they make a medicine with the hair of the king's wives, and by means of it compel the two wives to come to them at night, and in the end deprive the king of his wives altogether.

This tale furnishes the material for two of the stories of Uncle Remus. The notion of entering a cow and cutting meat from its inside is to be found in No. XXXIV—The Sad Fate of Mr. Fox. Brer Rabbit and Brer Fox enter a cow and cut meat, and Brer Rabbit, through disregarding Brer Fox's injunction and cutting into the "haslet," kills the cow, so that they can not make their way out again. Then one hides in the maul and the other in the gall when the cow is cut open. The trick of planting the cows' heads in the mire and pretending that the animals had foundered appears in No. XX—How Mr. Rabbit saved his Meat—where Brer Rabbit plants a cow's tail in the earth and tells Brer Fox that the cow has sunk into the ground. They both pull at the tail, and when it comes out Brer Rabbit winks his eye and says, "Dar! de tail done pull out en de cow gone."

No. XXXIII, Why the Negro is Black, is practically the same as the Gold Coast tale, Why Some People are Black and Some White. In the Uncle Remus variant there is a pool of water in which those who wash become white; but the water is soon used up, and the last comers only find enough to whiten the palms of their hands and the soles of their feet. In the Gold Coast tale the change of color is brought about by means of the blood of a handsome boy, who has committed suicide by casting himself down from a tree.

No. VI, Mr. Rabbit Grossly deceives Mr. Fox, which describes how Brer Rabbit, by a trick, rides Brer Fox to Miss Meadows's house, is like the Slave Coast tale, How the Tortoise rode the Elephant to Town, and the stratagem by which the Tortoise escapes being killed by the Elephant is similar to that employed by Brer Rabbit when Brer Fox is about to kill him (No. IV, How Mr. Rabbit was too Sharp for Mr. Fox), and also by the Terrapin when in the same dilemma (No. XII, Mr. Fox tackles Old Man Tarrypin). In the first case Brer Rabbit says, "I don't keer w'at you do wid me, Brer Fox, so you don't fling me in dat brier patch," and in the second the Terrapin begs Brer Fox not to drown him, but to burn him. In the Slave Coast tale, the Tortoise begs the Elephant to dash him down upon the stones, but not to throw him into the swamp, as the water and mire would drown him.

In No. XVII—Mr. Rabbit Nibbles up the Butter—where Brer Rabbit rubs the butter upon the mouth of the sleeping Opossum, and causes him to be thought guilty of the offense, we find a more delicate version of an incident in the Gold Coast tale—How the Cat got the Better of Spider—but as this paper has already reached sufficient length, this and the other stories above mentioned can not be given in detail.

Prof. Angelo Heilprin points out as a field where thorough geographical explorations may be made with profit and additions to knowledge, the regions of the North Pacific uniting North America—by stepping stones—with Asia: the Aleutian Islands and peninsula, Bering Sea and Strait, and the peninsula of Kamchatka. "Where two continents approach one another so closely and give evidence of having been united at seemingly no very ancient date; where a connecting land-bridge could not but most effectually influence the distribution of life—human, animal, and vegetable—upon two hemispheres; there, manifestly, the harvest of exploration must be great, for bound in with the research are problems of deep significance, touching alike the sciences of physical geography, ethnology, geology, and botany."

STUDIES OF CHILDHOOD.

XII.—UNDER LAW.

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(a) THE STRUGGLE WITH LAW.

IN the last chapter we tried to get at those tendencies of child-nature which, though they have a certain moral significance, may in a manner be called spontaneous and independent of the institution of moral training. We will now examine the child's attitude toward the moral government with which he finds himself confronted.

Here, again, we meet with opposite views. Children, say some, are essentially disobedient and lawbreaking. A child as such is a rebel, delighting in nothing so much as in evading and dodging the rule which he finds imposed by others.

The view that children are instinctively obedient and law-abiding has not, I think, been very boldly insisted on. A follower of Rousseau at least, who sees only clumsy interference with natural development in our attempts to govern children, would say that child-nature must resist the artificial and cramping system which the disciplinarian imposes.

It seems, however, to be allowed by some that a certain number of children are docile and disposed to accept authority with its commands. According to them, children are either obedient or disobedient. This is probably the view of many mothers and pedagogues.

Here, too, it is probable that we try to make nature too simple. Even the latter view, in spite of its apparent wish to be discriminating, does not allow for the many-sidedness of the child and for the many different ways in which the instincts of child-nature may vary.

Now it is worth asking whether, if the child were naturally disposed to look on authority as something wholly hostile, he would get morally trained at all. Physically mastered and morally cowed he might, of course, become; but this is not the same thing as being morally induced into a habit of accepting law and obeying it.

In inquiring into this matter we must begin by drawing a distinction. There is first the attitude of a child toward the governor, the parent, or other ruler, and there is his attitude toward law as such. These are by no means the same thing, and a child of three or four begins to illustrate the distinction. He may seem to be lawless, opposed to the very idea of government, when, in reality, he is merely objecting to a particular ruler and the kind of rule (or, as the child would say, misrule) which he is carrying out.

Let us look a little into the noncompliant, disobedient attitude of children. As we have seen, the very liveliness of a child, the abundance of his vigorous impulses, brings him into conflict with others' wills. The ruler, more particularly, is a great and continual source of crossings and checkings. The child has his natural wishes and propensities. He is full of fun, bent on his harmless tricks, and the mother has to talk seriously to him about being naughty. How can we wonder at his disliking the constraint? He has a number of inconvenient active impulses, such as putting things in disorder, playing with water, and so forth. As we all know, he has a ducklike fondness for dirty puddles. Civilization, which wills that a child should be nicely dressed and clean, intervenes in the shape of the nurse and soon puts a stop to this mode of diversion. The tyro in submission, if sound and robust, kicks against the restraint, yells, slaps the nurse, and so forth.

Such collisions are perfectly normal in the first years of life. We should not care to see a child give up his inclinations at another's bidding without some little show of resistance. These conflicts are frequent and sharp in proportion to the sanity and vigor of the child. The best children, best from a biological point of view, have, I think, most of the rebel in them. Not infrequently these resistances of young will to old will are accompanied by more emphatic protests in the shape of slapping, pushing, and even biting. The ridiculous inequality in bodily power, however, saves, or ought to save, the contest from becoming a serious physical struggle. The resistance where superior force is used can only resolve itself into a helpless protest, a vain yelling, or other utterance of baffled impulse.

If, instead of physical compulsion, authority is asserted in the shape of a highly disagreeable command, a child, before obedience has grown into a habit, will be likely to disobey. If the nurse, instead of pulling the mite away from the puddle, bids him come away, he may assert his self in an eloquent "I won't," or, less bluntly, "I can't come yet." If he is very much in love with the puddle and has a stout heart, he probably embarks in a tussle of words; "I won't," or, as the child will significantly put it, "I mus'n't," being bandied with "You must," until the nurse has to abandon the "moral" method and to resort, after all, to physical compulsion.

Our sample child has not, we will assume, yet got so far as to recognize and defer to a general rule about cleanliness. Hence it may be said that his opposition is directed against the nurse, as propounding a particular command, and one which at the moment is excessively unpleasant. It is as yet not resistance to law as such, but rather to one specific interference of another's will.

At the same time we may detect in some of this early resistance to authority something of the true rebel nature—that is to say, the love of lawlessness, and, what is worse perhaps, the obstinate recklessness of the lawbreaker. The very behavior of a child when another will crosses and blocks the line of his activity is suggestive of this. The yelling and other disorderly proceedings, do not they speak of the temper of the rioter, of the rowdy? And then, the fierce persistence in disobedience under rebuke, and the wild, wicked determination to face everything rather than obey, are not these marks of an almost Satanic fierceness of revolt? The thoroughly naughty child sticks at nothing. Thus a little offender of four, when he was reminded by his sister, two years older, that he would be shut out from heaven, retorted impiously, "I don't care," adding, "Uncle won't go; I'll stay with him." *

The fierce and noisy utterance of the disobedient and law-resisting temper is eminently impressive. Yet it is not the only utterance. If we observe children who may be said to show, on the whole, an outward submission to authority we shall discover signs of secret dissatisfaction and antagonism. The conflict with rule has not wholly ceased; it has simply changed its manner of proceeding, physical assault and riotous shouts of defiance being now exchanged for dialectic attack.

A curious chapter in the psychology of the child which still has to be written is the account of the various devices by which the astute little novice called upon to wear the yoke of authority seeks to smooth its chafing asperities. These devices may, perhaps, be summed up under the head of "trying it on."

One of the simplest and most obvious of these contrivances is the extempore invention of an excuse for not instantly obeying a particular command. A child soon finds out that to say "I won't," when he is bidden to do something, is indiscreet as well as vulgar. He wants to have his own way without resorting to a gross breach of good manners, so he replies insinuatingly, "I's very sorry, but I's so busy," or in some such conciliatory words. This field of invention offers a fine opportunity for the imaginative child. A small boy of three years and nine months received from his nurse the familiar order, "Come here!" He at once replied, "I can't, nurse; I's looking for a flea," and he pretended to be much engrossed in the momentous business of hunting for this quarry in the blanket of his cot. The little trickster is such

* My correspondent, discreetly perhaps, does not explain why the uncle was selected as fellow-outcast.

a lover of fun that he is pretty certain to betray his ruse in a case like this, and our small flea-catcher, we are told, laughed mischievously as he proffered his excuse. Such sly fabrications may be just as naughty as the uninspired excuses of a stupidly sulky child, but it is hard to be quite as much put out by them.

These excuses often show a fine range of inventive activity. How manifold, for example, are the reasons, more or less fictitious, which a boy, when told to make less noise, is able to urge in favor of noncompliance! Here, of course, all the great matters of the play world, the need of getting his "gee-gee" on, of giving his orders to his soldiers, and so forth, come in between the prohibition and compliance. And disobedience in such cases has its excuses; for to the child his play-world, even though in a manner modeled on the pattern of our common world, is apart and sacred; and the conventional restraints as to noise and such like, borrowed from the every-day world, seem to him to be quite out of place in this free and private domain of his own.

We all know the child's aptness in "easing" the pressure of commands and prohibitions. If, for example, he is told to keep perfectly quiet because mother or father wants to sleep, he will prettily plead for the reservation of whispering ever so softly. If he is bidden not to ask for things at the table, he will resort to sly indirect reminders of what he wants, as when a boy of five years and a half whispered audibly, "I hope somebody will offer me some more soup," or when a girl of three years and a half, with still greater childish tact, observed on seeing the elder folk eating cake, "I not asking." This last may be compared with a story told by Rousseau of a little girl of six years who, having eaten of all the dishes but one, artfully indicated the fact by pointing in turn to all the dishes, saying, "I have eaten that," but carefully passing by the untasted one.*

When more difficult duties come to be enforced and the neophyte in the higher morality is bidden to be considerate for others, and even to sacrifice his own comfort for theirs, he is apt to manifest a good deal of skill in adjusting the counsel of perfection to young weakness. Here is an amusing example: A little boy, Edgar by name, aged five years and three quarters, was going out to take tea with some little girls. The mother, as is usual on such occasions, primed him with special directions as to behavior, saying, "Remember to give way to them, like father does to me." To which Edgar, after thinking a brief instant replied; "Oh, but *not* all at *once*. *You* have to *persuade* him."

A like astuteness will show itself in meeting accusation. The

* Émile, livre v, quoted by Perez, L'Art et la Poesie chez l'Enfant, p. 127. Rousseau uses this story in order to show that girls are more artful than boys.

various ways in which a child will seek to evade the point in such cases are truly marvelous, and show the childish intelligence at its ablest.

Sometimes the dreary "talking to," with its well-known deep accusatory tone, its familiar pleadings, "How can you be so naughty?" and the rest, is daringly ignored. After keeping up an excellent appearance of listening, the small culprit proceeds in the most artless way to talk about something more agreeable. This is trying, but is not the worst. The deepest depth of maternal humiliation is reached when a carefully prepared and solemnly delivered homily is rewarded by a *tu quoque* in the shape of a correction of something in the delivery which offends the child's sense of propriety. This befell one mother who, after talking seriously to her little boy about some fault, was met with this remark: "Mamma, when you talk you don't move your upper jaw."

It is, of course, difficult to say how far a child's interruptions, and what look like turnings of the conversation when receiving rebuke, are the result of deliberate plotting. We know it is hard to hold the young thoughts long on any subject, and the homily makes a heavy demand in this respect, and its theme is apt to seem dull to a child's lively brain. The thoughts will be sure to wander then, and the rude interruptions and digressions may, after all, be but the natural play of the young mind. I fear, however, that design often has a hand here. The first digression to which the weak disciplinarian succumbed may have been the result of a spontaneous movement of child-thought; but its success enables the observant child to try it on a second time with artful aim.

In cases in which no attempt is made to ignore the accusation, the small wits are busy discovering palliatives and exculpations. Here we have the many ruses, often crude enough, by which the little culprit tries to shake off moral responsibility, to deny the authorship of the action found fault with. The blame is put on anybody or anything. When he breaks something, say a cup, and is scolded, he saves himself by saying it was because the cup wasn't made strong enough, or because the maid put it too near the edge of the table. There are clear indications of fatalistic thought in these childish disclaimers. Things were so conditioned that he could not help doing what he did. This fatalism betrays itself in the childish ruses already referred to by which the *ego* tries to screen itself shabbily by throwing responsibility on to the bodily agents. This device is sometimes hit upon very early. A wee child of two, when told not to cry, gasped out, "Elsie cry—*not* Elsie cry—tears cry—naughty tears." This, it must be allowed, is more plausible than C——'s lame attempt to put off responsibility on his hands; for our tears are in a sense apart from us, and in the first years are wholly beyond control.

The fatalistic form of exculpation meets us later on under the familiar form, "God made me like that." A boy of three was blamed for leaving his crusts, and his conduct contrasted with that of his model papa. Whereupon he observed with a touch of metaphysical precocity, "Yes, but papa you see God had made you and me different."

These denials of authorship occur when a charge is brought home and no clear justification of the action is forthcoming. In many cases the shrewd intelligence of the child, which is never so acute as in this art of moral self-defense, discovers justificatory reasons. In such a case the attitude is a very different one. It is no longer the helpless hand-lifted attitude of the irresponsible one, but the bold, steady-eyed attitude of one who is prepared to defend his action.

Sometimes these justifications are pitiful examples of quibbling. A boy has been rough with his baby brother. His mother chides him, telling him he might hurt baby. He then asks his mother, "Isn't he my own brother?" and on his mother admitting so incontestable a proposition, exclaims triumphantly, "Well, you said I could do what I liked with *my own* things." The idea of the precious baby being a boy's own to do what he likes with is so remote from older people's conceptions that it is hard for us to credit the boy with misunderstanding. We ought, perhaps, to set him down as a depraved little sophist, and destined— But predictions happily lie outside our *métier*.

In some cases these justifications have a dreadful look of being after-thoughts invented for the express purpose of self-protection and knowingly put forward as fibs. Yet there is need of a wise discrimination here. Take, for example, the following from the Worcester Collection: A boy of three was told by his mother to stay and mind his baby sister while she went downstairs. On going up again some time after, she met him on the stairs. Being asked why he had left the baby, he said there was a bumblebee in the room, and he was afraid he would get stung if he stayed there. His mother asked him if he wasn't afraid his little sister would get stung. He said "Yes," but added that if he stayed in the room the bee might sting them both, and then she would have two to take care of. Now, with every wish to be charitable I can not bring myself to think that this small boy had really gone through that subtle process of disinterested calculation before vacating the room in favor of the bumblebee—if indeed there was a bumblebee. To be caught in the act and questioned is, I suspect, a situation particularly productive of such specious fibbing.

One other illustration of this keen childish dialectic when face to face with the accuser deserves to be touched on. The sharp little wits have something of a lawyer's quickness in detecting a flaw in the indictment. Any exaggeration into which a feeling of indignation happens to betray the accuser is instantly pounced upon. If, for example, a child is scolded for pulling kitty's ears and making her cry, it is enough for the little stickler for accuracy to be able to say: "I wasn't pulling kitty's *ears*, I was only pulling *one* of her ears." This ability to deny the charge in its initial form gives the child a great advantage, and robs the accusation in its amended form of much of its sting. Whence, by the way, one may infer that wisdom in managing children shows itself in nothing more than in a scrupulous exactness in the use of words.

While there are these isolated attacks on various points of the daily discipline, we see now and again a bolder line of action in the shape of a general protest against its severity. Children have been known to urge that the punishments inflicted on them are ineffectual; and although their opinion on such a matter is hardly disinterested, it is sometimes pertinent enough. An American boy, aged five years and ten months, began to cry because he was forbidden to go into the yard to play, and was threatened by his mother with a whipping. Whereupon he observed, "Well now, mamma, that will only make me cry more."

These childish protests are, as we know, wont to be met by the commonplaces about the affection which prompts the correction. But the child finds it hard to swallow these subtleties. For him love is caressing him and doing everything for his present enjoyment; and here is the mother who says she loves him, and often acts as if she did, transforming herself into an ogre to torment him and make him miserable. He may accept her assurance that she scolds and chastises him because she is a good mother; only he is apt to wish that she were a shade less good. A boy of four had one morning to remain in bed till ten o'clock as a punishment for misbehavior. He proceeded to address his mother on this wise: "If I had any little children I'd be a worse mother than you —I'd be quite a bad mother. I'd let my children get up directly I had done my breakfast, at any rate."

If, on the other hand, the mother puts forward her own comfort as the ground of the restraint, she may be met by this kind of thing: "I wish you'd be a little more self-sacrificing and let me make a noise."

Enough has been said to illustrate the ways in which the natural child kicks against the imposition of restraints on his free activity. He begins by showing himself an open foe to authority. For a long time after, while making a certain show of submission, he harbors in his breast something of the rebel's spirit. He does his best to avoid the most galling parts of the daily discipline, and displays an admirable ingenuity in devising excuses for apparent acts of insubordination. Where candor is permitted he is apt to prove himself an exceedingly acute critic of the system which is imposed on him.

All this, moreover, seems to show that a child objects not only to the particular administration under which he happens to live, but to all law, as implying restraints on free activity. Thus, from the child's point of view, so far as we have yet examined it, punishment as such is a thing which ought not to be.

So strong and deep-reaching is this antagonism to law and its restraints apt to be that the childish longing to be "big" is, I believe, grounded on the expectation of liberty. To be big means to the child more than anything else to be rid of all this imposition of commands, to be able to do what one likes without interference from others. This longing may grow intense in the breast of a quite small child. "Do you know," asked a little fellow of four years, "what I shall do when I'm a big man? I'll go to a shop and buy a bun and pick out all the currants." This funny story is characteristic of the movements of young desire. The small prohibition not to pick out the currants is one that may chafe to soreness a child's sensibility.

SKETCH OF ALEXANDER DALLAS BACHE.

THE life which is to be sketched in the following pages contributes support to the doctrine that what a man is to be, or, rather, what he is capable of being, is mainly determined by what his parents and ancestors have been. According to the doctrine of heredity, it is not surprising that Bache, descended from illustrious progenitors on both sides of his family, should himself achieve intellectual eminence. As he received an education that was very appropriate for the work he was to perform, his career does not give any help in answering the question whether heredity is or is not stronger than training.

His most important work is instructive in another way. It shows how effective efforts for the advancement of knowledge made by the power and resources of a great government can be when the right man is secured to direct them, just as other instances have made plain how wasteful and demoralizing such efforts may become when unwisely managed.

Alexander Dallas Bache was born in Philadelphia, July 19, 1806. His father, Richard Bache, was a grandson of Benjamin Franklin, being one of the eight children of Richard Bache, Postmaster-General from 1776 to 1782, and Franklin's only daughter, Sarah. His mother, Sophia Burret (Dallas), was a daughter of

Alexander J. Dallas, who was Madison's Secretary of the Treasury, and sister of George M. Dallas, Vice-President of the United States in Polk's administration.

Dallas Bache, as he was usually called by his intimates, was placed in a classical school at an early age, and proved to be a remarkably bright pupil. The year he was fifteen years old he was appointed a cadet in the Military Academy at West Point. He maintained a high stand in scholarship from the beginning to the end of his course, and graduated in 1825 at the head of his class, although its youngest member. This was no small achievement in a class from which four cadets were assigned to the engineer corps, when only one or two members attained this honor in most classes. Moreover, he went through the whole four years without receiving a demerit mark—equally remarkable in view of the rigid discipline of the academy, and the only instance on record. Students are none too prone to admire one of their fellows who is noted only for studious habits and correct deportment, but young Bache had besides the personal qualities that win esteem. Prof. Joseph Henry, in his memoir read before the National Academy of Sciences, relates of cadet Bache that "his superiority in scholarship was freely acknowledged by every member of his class, while his unassuming manner, friendly demeanor, and fidelity to duty secured him the affection as well as the respect of not only his fellow-pupils, but also of the officers of the institution. It is also remembered that his classmates, with instinctive deference to his scrupulous sense of propriety, forbore to solicit his participation in any amusement which in the slightest degree conflicted with the rules of the academy. So far from this, they commended his course, and took pride to themselves, as members of his class, in his reputation for high standing and exemplary conduct. His roommate—older by several years than he was, and by no means noted for regularity or studious habits—constituted himself, as it were, his guardian, and sedulously excluded all visitors or other interruptions to study during the prescribed hours. For this self-imposed service, gravely rendered as essential to the honor of the class, he was accustomed jocularly to claim immunity for his own delinquencies or shortcomings."

All of young Bache's predispositions for good were stimulated and sustained by the judicious care of his mother, not only while he was a child at home, but also by means of a ready pen during the whole of his residence at West Point. It should not be inferred that the young man attained perfection in his conduct. "When a child he is said to have been quick-tempered, and at later periods of his life, when suddenly provoked beyond his habitual power of endurance, he sometimes gave way to manifestations of temper which might have surprised those who only knew him in his usual state of calm deportment. These ebullitions were, however, of rare occurrence, and always of short duration."

On graduating, Lieutenant Bache was assigned to duty at the academy as assistant professor. A year later he was transferred at his own request to engineering service on the fortifications at Newport, R. I., under Major (afterward General) J. G. Totten. Here he remained two years. One of his recreations during this period was making a collection of shells of mollusks.

In 1828, being then twenty-two years of age, Lieutenant Bache resigned his commission in the army to accept a call to the chair of Natural Philosophy and Chemistry at the University of Pennsylvania. This change was welcome in more ways than one. He was engaged to Miss Nancy Clarke Fowler, the daughter of an old and highly respected citizen of Newport, but marriage was apparently a remote prospect, for he had only the stinted pay of a lieutenant of engineers, out of which he must contribute to the support of his mother and her younger children. The salary of his new position, however, justified him in hastening the happy event.

His year's experience in teaching at West Point assisted Mr. Bache in taking up his duties at the university. He was a very successful instructor, and popular with his students. But he did not rest content with imparting knowledge obtained by the labors of others. He joined the Franklin Institute, then newly established, and took a prominent part in its investigations for the promotion of the mechanical arts.

For a full account of his labors in connection with this society we must here be content with referring to the volumes of its Journal from 1828 to 1835 inclusive. One of the most important and fruitful of these was the investigation of the bursting of steam boilers, of which he was the principal director. From inquiries and experiments, the latter not unattended with danger, "the most frequent cause of explosion was found to be the gradual heating of the boiler beyond its power of resistance; and, next to this, the sudden generation of steam by allowing the water to become too low, and its subsequent contact with the overheated metal of the sides and other portions of the boiler. The generation of gas from the decomposition of water as a cause of explosion was disproved, as was also the dispersion of water in the form of spray through superheated steam."

Early in 1829 Mr. Bache was elected to membership in the American Philosophical Society, and at once entered upon various researches in pure science in co-operation with his fellow-members. With the aid of his wife and of his former pupil, John F. Fraser, he determined with accuracy, for the first time in this country, the periods of the daily variations of the magnetic needle, and by another series of observations established the connection between certain perturbations of the terrestrial magnetism and the aurora borealis. With Prof. Courtenay he investigated the magnetic dip at various places in the United States, and with Mr. Espy made a minute survey of part of the track of a tornado which visited New Jersey, June 19, 1835.

After Stephen Girard died, in 1832, Prof. Bache was elected one of the trustees of the College for Orphans, founded by the will of the childless merchant. Three years later the trustees decided to select a president for the institution, in order that he might go abroad and study European methods of education while other preparations were being made. Prof. Bache, then only thirty years of age, was selected for the position. Although regretting the consequent interruption of his scientific researches, in which he had become much absorbed, he accepted the appointment, and departed on his mission, September 30, 1836. Two years were spent agreeably and profitably in Europe, and on his return Prof. Bache made a report to the trustees embodying his observations on the schools of England, France, Prussia, Austria, Switzerland, and Italy, with the many helpful conclusions and suggestions that he had derived from these data. The document was printed, making a large octavo volume.

As the preparations for opening the college were not yet complete, Prof. Bache offered his services gratuitously to reorganize the public schools of Philadelphia, and his offer was gladly accepted by the municipal authorities. A year later, finding that the trustees of the college were still unprepared to open the institution, he relinquished the salary of his office and accepted from the city a much smaller compensation for his time. His work on the public schools was completed in 1842, and resulted in a system that has been taken as a model by other cities in various parts of the United States. So highly were his labors appreciated that the Central High School was frequently called Bache Institute.

Girard College having made very little progress, he now resigned all connection with it, and accepted his former chair at the University of Pennsylvania, with its welcome opportunities for scientific research. The preceding six years had by no means been a blank with respect to his favorite investigations. When he went to Europe he took care to provide himself with a set of portable instruments, with which, as a relief from the labors imposed by the special object of his mission, he made a connected series of observations on the dip and intensity of terrestrial magnetism at important places on the Continent and in Great Britain.

After his return to Philadelphia he co-operated in the undertaking of the British Association to determine by contemporaneous observations at widely separated points the fluctuations of the magnetic and meteorological elements of the globe. He also made in his summer vacations a magnetic survey of Pennsylvania. Mr. Cramp, afterward the famous shipbuilder, was then a boy in the high school, and assisted Prof. Bache in his observations.

Valuable instruments and methods for performing scientific observations were devised by Bache during this period. He invented an ingenious instrument for determining the dew point, which is especially valuable where readings must be made by persons without special scientific training. Only much later did he learn that the principle of the device had already been used by Belli, of Milan. He also introduced a modification of Osler's anemometer and invented a thermoscope of contact, both of which avoided difficulties involved in the use of previous instruments.

The way in which a man conducts a controversy is always a severe test of his character. Bache had one with Denison Olmsted on the periodical recurrence of meteors. Prof. Gould, in his American Association memoir, thus describes the occurrence: "Mr. Bache maintained that there was no recurrence in 1834; Prof. Olmsted, on the other hand, maintained the reverse. Prof. Bache instituted special inquiries at the military posts (where, of course, sentinels were on duty) along all the frontiers of the United States, also among the night police of various cities, and at the universities, and he found but one exception to the statement that no unusual number of meteors was seen. Of this controversy Bache wrote, in 1846:

"'There is something yet to be found out on this subject which may reconcile our opinions. Neither I nor any of those watching with me, or for me, have seen an unusual number of meteors on the night of the 12th of November in any year since the great night at Philadelphia, and we have taken great pains to be sure. Yet I can not doubt the testimony as given for some other places. . . . I had a complimentary letter from the professor in regard to my manner of conducting the controversy, which I valued more highly than if I had gained the victory.'"

The year after Prof. Bache resumed his old position at the university he was called to the superintendency of the United States Coast Survey, left vacant by the death of Mr. Hassler. His appointment to this position was first suggested by members of the American Philosophical Society, and the nomination was fully concurred in by the other principal scientific and literary institutions of the country.

Although the Coast Survey had been founded a quarter of a century, the policy of Congress toward it had been changeable and its appropriations limited. It had been suspended fifteen years of that time, so that its work was but just begun. The Atlantic coast line had been surveyed only from Point Judith, on the coast of Rhode Island, to Cape Henlopen, at the entrance of Delaware Bay. "The new superintendent," says Prof. Henry in his memoir, "saw the necessity of greatly enlarging the plan, so as to embrace a much broader field of simultaneous labor than it had previously included. He divided the whole coast line into sections, and organized, under separate parties, the essential operations of the survey simultaneously in each. He commenced the exploration of the Gulf Stream, and at the same time projected a series of observations on the tides, on the magnetism of the earth, and the direction of the winds at different seasons of the year. He also instituted a succession of researches in regard to the bottom of the ocean within soundings, and the forms of animal life which are found there, thus offering new and unexpected indications to the navigator. He pressed into service, for the determination of longitude, the electric telegraph; for the ready reproduction of charts, photography; and for multiplying copperplate engravings, the new art of electrotyping. In planning and directing the execution of these varied improvements, which exacted so much comprehensiveness in design and minuteness in detail, Prof. Bache was entirely successful. He was equally fortunate, principally through the moral influence of its character, in impressing upon the Government, and especially upon Congress, a more just estimate of what such a survey required for its maintenance and creditable prosecution. Not only was a largely increased appropriation needed to carry out this more comprehensive plan, but also to meet the expenses consequent upon the extension of the shore line itself. Our seacoast, when the survey commenced, already exceeded in length that of any other civilized nation, but in 1845 it was still more extended by the annexation of Texas, and again, in 1848, by our acquisitions on the Pacific. Prof. Bache was in the habit of answering the question often propounded to him by members of Congress, 'When will this survey be completed?' by asking, 'When will you cease annexing territory?'"

Prof. Bache's policy of dividing the Atlantic and Gulf coast (we had no Pacific coast in 1843) into sections, and carrying on work in all the sections at the same time greatly allayed sectional jealousies in States which the previous operations of the survey had not reached and had great influence in winning public favor for the survey. He had a wonderful faculty for enlisting the efforts and talents of others in carrying out his plans. "As rapidly as means allowed, the services of American scientists throughout the land were enlisted in aid of the survey, and the whole intellectual resources of the country thus made tributary to its usefulness and success. Thus Walker, Peirce, Bailey, Agassiz, Barnard, Kendall, Mitchell, Bond, Alexander, and many others, were called on to assist in the advancement of the undertaking; and this large and wise policy prevailed during the whole period of his superintendence."* Many of the ablest officers of the navy and the army were brought into the Coast Survey service, and gained experience of great value in the duties many of them were afterward called upon to perform in the civil war.

The efficiency of the survey was greatly increased by improved instrumental equipment. Antiquated instruments were replaced by those of the most improved type; an apparatus for the measurement of base lines, invented by Prof. Bache, was introduced, and secured a degree of accuracy before unknown. The method of determining longitude by the exchange of star signals was developed through the agency of Sears C. Walker. Prof. Gould has stated that he had received accounts of this important advance in geodetic practice from the lips of both Bache and Walker, and that "their descriptions varied but in one salient point, namely, that each ascribed the chief merit to the other." The determination of latitudes with the zenith telescope, by Talcott's method, first tested in 1845, was early adopted by the survey. "Thus by the use of the zenith telescope, combined with the determination of longitudes from the adopted meridian by the exchange of star-signals, the geographical position of the primary astronomical stations of the survey could claim, ten or fifteen years ago, to be determined with more accuracy than that of any European observatory."

Stations for tidal observation were established all along the Atlantic, Gulf, and Pacific coasts. The character of the Gulf Stream and other currents along our coast were determined. Twice was Agassiz sent to study the formation of the coral reefs of Florida, and the causes that promote and restrict their growth. The magnetic constants were determined for every important point possible within reach of the survey.

Other duties were assigned to Prof. Bache by the Government from time to time. He was made Superintendent of Weights and Measures, and in the exercise of this function directed a series of investigations relative to the collection of excise duties on distilled spirits, and superintended the construction of a large number of sets of standard weights and measures for distribution to the several States of the Union. He was appointed on a commission created to examine the lighthouse system of the United States, and was a member of the Lighthouse Board, into which this commission was merged, from its organization till

* Address in commemoration of Alexander Dallas Bache, by Benjamin Apthorp Gould, delivered before the American Association for the Advancement of Science, August 6, 1868.

his death. In this work he took a lively interest and rendered important service.

As to the connection of Prof. Bache with the Smithsonian Institution we can not have better testimony than that of him who was identified with the institution for more than thirty years, its first secretary. Prof. Henry says: "In 1846 he had been named in the act of incorporation as one of the regents of the Smithsonian Institution, and by successive re-election was continued by Congress in this office until his death, a period of nearly twenty years. To say that he assisted in shaping the policy of the establishment would not be enough. It was almost exclusively through his predominating influence that the policy which has given the institution its present celebrity was, after much opposition, finally adopted." * Not the least of Bache's services to the institution was securing Henry for its secretary. The latter states, in the place just quoted, that "it was entirely due to the persuasive influence of the professor" that he was induced to take the position.

Although not fond of physical exertion, Prof. Bache had been accustomed to spend part of each summer in a tent at some station of the survey on the top of a mountain, where he took part in the measurement of angles and directed the movements of field parties at other stations. The civil war brought added labors upon him so that his constant presence in Washington was required, and his health no longer obtained the yearly recuperation of this season of outdoor life. Being solicited by the Governor of Pennsylvania to plan lines of defense for Philadelphia, he consented, although overburdened with other public duties, and personally superintended the construction of some of the works. Unaccustomed for many years to direct exposure to the sun, this undertaking brought on the first indications of the malady that ended his life. He had been subject to attacks of "sick headache"—a tendency which he seems to have inherited—and now various symptoms of softening of the brain came upon him in succession. For several months he was very anxious about the business of the Coast Survey, and with difficulty could be restrained from attempting to perform the duties of his office. As the malady increased, however, his attention was gradually withdrawn from the exterior world, with which he almost ceased to hold active communication. A trip to Europe, covering a period of eighteen months, produced no permanent benefit. He died a short time after his return, at Newport, R. I., February 17, 1867.

The ability and worth of Dallas Bache brought him many and high honors. There were few for our leading learned societies

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* Biographical Memoirs of the National Academy of Sciences, i, 197, 198.

that did not number him among their associates. He was President of the American Association for the Advancement of Science in 1850 and 1851, of the American Philosophical Society in 1855 and 1856, and of the National Academy of Sciences from its establishment in 1863 until his death. He was a member also of the Royal Society of London, the Imperial Academy of Sciences at St. Petersburg, the Institute of France, the Royal Society of Edinburgh, the Royal and Imperial Geographical Society of Vienna, the Royal Academy of Turin, the Mathematical Society of Hamburg, the Academy of Sciences in the Institute of Bologna, the Royal Astronomical Society of London, and the Royal Irish Academy of Dublin.

The degree of LL. D. was conferred upon him by the principal American universities, and he received several medals from foreign governments for his distinguished services to science in the course of his labors on the Coast Survey and in other researches.

Mr. Bache was gifted with quick apprehension, and at the same time with deep intelligence, which is not always allied to the former quality. He had also great power of application. When at the head of a body of workers those under him were always nerved to do their best, because they saw that the master did not spare himself. He was always ready to learn from others. He would listen carefully to younger men if he saw that they had ideas which might be developed to good purpose. After arguing vehemently in opposition to the views of his brother on a matter under consideration, he would often come out on the same side of the question, and explain that his contention was designed to draw out arguments.

In his home he dropped science, and was a genial companion of old and young. Although not prepossessing in face, he was charming in manner and disposition. He was a very lovable man, and there was always plenty of company at his house in Washington. His favorite relaxation was reading light novels. He had a great appreciation of humor, but failed in trying to contribute humorously to the entertainment of others.

As an evidence of his high appreciation of abstract science derived from original investigation, he left his property in trust to the National Academy of Sciences, the income to be devoted to the prosecution of researches in physical and natural science, by assisting experimenters and observers, and the publication of the results of their investigations.

Appended to the memorial address by Dr. Benjamin A. Gould already cited is a list of the published scientific papers of Prof. Bache, embracing one hundred and twenty-three titles, besides thirty-five annual reports, and twenty-one reports on harbors made jointly with Messrs. Totten and Davis.

Correspondence.

ARE ANIMALS LEFT-HANDED?

Editor Popular Science Monthly:

In The Popular Science Monthly for March, 1894, page 615, Prof. J. Mark Baldwin says, in a footnote: "I know only the assertion of Vierordt that parrots grasp and hold food with the left claw, that lions strike with the left paw, and his quotation from Livingstone — i. e., 'All animals are left-handed.' (Vierordt, *loc. cit.*, page 428.) Dr. W. Ogle reports observations on parrots and monkeys in Trans. Royal Med. and Chirur. Society, 1871."

I have tried to verify these observations on two parrots lately brought from Mexico. I find that in grasping a finger offered as a perch the parrots almost always put the left foot forward. Usually the finger thus offered is that of the right hand. But when the left finger is offered to the parrots they put forward the right foot. There is, however, apparently a small residuum of preference for the left foot. This seems to be due to the fact that men are usually right-handed and offer the right hand to the parrot. The left foot is the one naturally put forward by the parrot in this case, and through repetition of this action a species of left-footedness is induced. My general conclusion is that there is no evidence that the parrot is naturally left-footed. The appearance of left-footedness is due entirely to the fact that those who offer the finger or food to parrots do so as a rule with the right hand. Repetition of this process makes the parrot more or less left-footed in time.

David S. Jordan.

Palo Alto, Cal., *May* 16, 1895.

IMITATIVE HABITS OF THE BLUE JAY.

Editor Popular Science Monthly:

Sir: In reading Variation in the Habits of Animals, I see the author is not in line with The Study of Birds Out-of-doors, or she would not have written, "The practice of mocking the hawk is, at present at least, confined, so far as I know, to the individuals of such limited area—this one town—that with Mr. Ridgway we must believe this peculiarity exhibited by the blue jay to be scarcely the 'manifestation of a regional impress.'"

My boyhood and early manhood were spent in the country, in middle Tennessee, where I had ample opportunity to observe the habits and, I might say, peculiarities of certain birds. The blue jay not only mocks the hawk, which I have heard him do hundreds of times, but mocks also many other birds. The catbird possesses this faculty in a remarkable degree, and so rapidly does he "change his tune" that if he was not visible we should be apt to say, What a lovely mocking bird you have singing in your apple tree! Don't again mistake the jay for a hawk, for wherever you hear the jay he mocks the hawk, redbird, and many of his other neighbours. Yours truly,

W. A. Howard, M. D.

Waco, Texas, *September* 7, 1895.

Editor Popular Science Monthly:

Dear Sir: I noticed in the September Monthly, in the article, Variation in the Habits of Animals, by G. C. Davenport, that the writer speaks of the blue jay (*Cyanurus cristata*, or more recently *Cyanocitta cristata*) as acquiring and using the cry of the hawk in order to assist in the fight with English sparrows, and she seemed to imply that it was an accomplishment of the blue jay in that region only. I have heard in the wooded lands of southeastern Indiana the blue jay give a fairly good imitation of the shrill, piercing, drawn-out cry of the large chicken hawk (*Buteo borealis*) at different times for as much as twenty years. I think this cry has not been developed in this region, at least, in the fight with recent enemies, but rather that the blue jay—robber and despoiler that he is—has now and then used this cry to terrify smaller birds for untold years.

Yours truly,

Prof. Glenn Culbertson.

Hanover College, Hanover, Ind., *September* 19, 1895.

ORIGIN OF THE TERM AGNOSTIC.

Editor Popular Science Monthly:

Sir: In the September Forum appears an article on Prof. Huxley by Richard H. Hutton, editor of The Spectator, in which, on pages 27 and 28, he states that Prof. Huxley "claimed to be in the strictest sense an Agnostic," and further states that Prof. Huxley borrowed that term from an "incident related in the Acts of the Apostles," where reference is made to the fact that the Athenians had erected an altar "Agnosto Theo"—to the Unknown God. Is not Mr. Hutton mistaken in regard to the origin of this term? In a letter written to Mr. J. A. Skilton, December 10, 1889, and published in the Popular Science Monthly for June, 1890, Mr. Huxley expressly states that the term "Agnostic" was not suggested by the passage to which Mr. Hutton refers, but came into his mind "as a fit antithesis to 'Gnostic'—the 'Gnostics' being those ancient heretics who professed to know most about those very things of which I am quite sure I know nothing." As the use of the term in theological discussion has become universal, it is interesting to know how Prof. Huxley came to introduce it

J. T. Gorman.

Opelika, Ala., *September* 14, 1895.

Editor's Table.

THE PRESENT POSITION OF ANTHROPOLOGY.

AMONG the scientific addresses of the present year we are disposed to assign a high place in point of interest and general merit to that on The Aims of Anthropology, delivered at the August meeting of the American Association for the Advancement of Science by the retiring president, Prof. Brinton, and reprinted in this number of the Monthly. Like others who have advocated the claims of that science, the professor almost overwhelms us with the enumeration of all its tributary streams of knowledge; but more successfully than most, he enables us to keep in view the unity of aim in anthropological study. He makes us feel that it is concerned not with unrelated or but slightly related details in regard to man, but with man himself, as a great organic fact, as the crowning product of creation, whom to know is for each of us in the truest sense self-knowledge. "Hearken unto me," said the prophet of old, "all ye that love righteousness! Look unto the rock whence ye are hewn, and the hole of the pit whence ye are digged." It is in the same spirit, we imagine, that Dr. Brinton asks us to look into our origins, and into whatever else can throw light upon what we really are. As regards the origin of man, science, he asserts, has now established beyond cavil that, far from having fallen from some original high estate and forfeited a pristine paradise, the earliest man was also "the lowest, the most ignorant, the most brutish, naked, homeless, half speechless." Such as he was, however, he had within him that which made possible for him a progress denied to all other animal races, that secured for him long since the mastery of the planet, and that holds out to him the prospect of a future civilization far in advance of anything he has heretofore enjoyed.

The most vitalizing discovery that has been made within recent years, in its bearings upon anthropology, Dr. Brinton considers to be that of the psychical unity of mankind, "the parallelism of his development everywhere and in all times; nay, more, the nigh absolute uniformity of his thoughts and actions when in the same degree of development, no matter where he is or in what epoch living." Seeing that savage tribes represent a stage of human culture which has left traces in ourselves, but the perfect manifestation of which will soon have passed away forever, he calls earnestly for a prolonged and profound study of such savage races as still exist, though none of them are in his opinion quite low enough to represent fully primitive man. He also strongly recommends the study of folklore, inasmuch as "the stories, the superstitions, the beliefs, and customs which prevail among the unlettered, the isolated, and the young, are nothing else than survivals of the mythologies, the legal usages, and the sacred rites of earlier generations. . . . It is surprising," he adds, "to observe how much of the past we have been able to construct from this humble and long-neglected material."

The zeal of the learned doctor seems almost to assume a slight character of ferocity when he goes on to declare: "The generations of the past escape our personal investigation, but not our pursuit. We rifle their graves, measure their skulls, and analyze their bones; we carry to our museums the utensils and weapons, the gods and jewels, which sad and loving hands laid beside them; we dig up the foundations of their houses, and cart off the monuments which proud kings set up. Nothing is sacred to us; and yet nothing to us is vile or worthless." If the doctor had wished to quote Horace, he might have said very appositely "*omne sacrum rapiente dextrâ*"; but we should be loath to take him at his word that to the anthropologist nothing is sacred. We believe, on the contrary, that to the true anthropologist the cause of humanity is very sacred; and that it is because an exhaustive knowledge of what man has been and is will, as he considers, greatly advance human well-being, by placing our systems of instruction and all our social arrangements on a more scientific basis, that, in his consuming desire for knowledge, he is prepared even for spoliation.

One of the most important branches or subdivisions of anthropology is ethnology. Its mission, Dr. Brinton says, is "to define the universal in humanity." It aims to define "the influences which the geographical and other environment exercises on the individual, the social group, and the race; and conversely how much in each remains unaltered by these external forces." Like political economy, according to its orthodox professors at least, it has nothing to do with what ought to be; its sole concern is with what is. Ethnology, the doctor asserts with some emphasis, lends no countenance to any absolute doctrine of evolution. He considers that, "taken at its real value, as the provisional and partial result of our observations," that doctrine is a useful guide, but that, "swallowed with unquestioning faith as a final law of the universe," it is no better than the narrowest traditional dogma. At this point we may venture to suggest that the learned doctor is waxing wroth with an imaginary foe, or, if not with an imaginary one, at least with one hardly worthy of his ire. Idle talk about evolution can no more be prevented than idle talk about any other subject, say electricity for example, which some persons believe to be a device, invented probably by Mr. Edison, for getting something out of nothing. No one whose opinion is worth discussing regards evolution otherwise than as a name for the process by which such advancement as the world has hitherto made has been won, and on which we may reasonably depend for further progress in the future, Nature as yet having given no sign that her powers are exhausted or on the point of exhaustion. "The development of humanity as a whole," says Dr. Brinton, "has arisen from the differences of its component parts, its races, nations, tribes. Their specific peculiarities have brought about the struggles which, in the main, have resulted in an advance." Even so, we may hope that in the future, in spite of a growing equalization of general conditions, those differences which, as Dr. Tylor has well pointed out, will more and more assert themselves in the higher regions of thought and feeling, will lead to a steady advance in human capacity and character.

Anthropology, according to its able advocate and professor, possesses no little skill in dodging the most difficult questions. Having investigated penal laws until it finds their common origin in a desire for vengeance, and having analyzed religions until it discovers that they all spring from a dread of the unknown, it will not follow up either inquiry by attempting to ascertain why men dread the unknown or whether there is any more ultimate form or underlying explanation of the desire for vengeance. In the same way, while noting empirically what has made for the improvement of mankind, it will be careful about grappling with the question as to what "improvement" really means. Perhaps we should not complain of these discreetly imposed limitations, but it seems to us that, as regards the question of human improvement at least, anthropology, with its very wide outlook, ought, above all other sciences, to be in a position to give us its *rationale*.

We are glad to find Dr. Brinton, in the conclusion of his valuable address, declaring that "the teachings of anthropology, whether theoretical or practical, lead us back to the individual as the point of departure and also the goal. The state was made for him, not he for the state; any improvement in the group must start by the improvement of its individual members." We hold that this is the teaching of every true form of social science. The doctrine of individualism is not a doctrine of selfishness; it simply aims at arousing each individual to a sense of his own value as a social unit, and at making him feel that, if he wishes to live in an improved society, he should strive to improve himself and his own immediate environment. The intelligent study of sociology, we have no doubt, will work in this direction, inasmuch as it more and more tends to make all classifications and class distinctions appear unreal, and to bring the individual man into prominence as the one subject and center of its labors. On this ground, if on no other, we would wish it every success; and as there are so many different fields that can be explored in its interest, we would counsel those who have no other scientific occupation to see if they can not bring some offering, however slight, to the great construction which we may hope the leaders of the science will one day give to the world.

RELIGION FOR THE AGE.

Canon Samuel A. Barnett, of England, is a man who has devoted much time and labour to the study of social problems in their widest aspect, and whose writings on such subjects are always marked by active human sympathy allied with strong common sense. We therefore turned at once with interest to his article in the September number of the Contemporary Review to see what he had to say on the subject of The Church's Opportunity, and were not at all surprised to find that he had some very pertinent things to say. In Canon Barnett's opinion "the Church" might, if it could only rise to the level of its duty and privilege, lend most useful assistance to the practical solution of our present-day social problems. How this might, in his opinion at least, be done he clearly indicates. The Church performs three main functions: it provides means of worship, it imparts religious teaching, and it interests itself in charitable work; and what it has to do, according to Canon Barnett, is simply, in each department of its activity, to plant itself at the modern standpoint so as to meet the needs of the men and women of today.

In the matter of worship this writer observes that "the words and forms remain the same as those which helped the people of three hundred years ago, although the fashions, the thought, and the whole organization of society have been changed." Cathedrals are little more than "the hunting ground of antiquarians and the practising places of choirs." The Church should "use the art and knowledge of the time as aids to worship." "It might," continues the writer, "by showing the wonders of science, open the eyes of the blind to see something of the height and breadth of the universe"; and the result would be that readier access would be found to men's minds for those sentiments of justice, charity, and mutual forbearance on which the peace and welfare of society must rest. Canon Barnett is quite right when, speaking of the social strugglers of to-day, he says that "conceit, pride in their own methods and aims, restless vanity, selfish anxiety are elements in the present confusion"; nor are we disposed to disagree with him when he says further that "the majority of people think much of themselves, because they are not conscious of One before whom they are as nothing, because, in a word, they do not worship." Here is where the true work of religion comes in, not in opposing the conclusions of science.

"Let science grow from more to more,"

as Tennyson has said,

"But more of reverence in us dwell."

The two are not incompatible, and Canon Barnett seems to feel strongly that it is through neglect of duty on the part of the Church, especially the duty of keeping in touch with the times, that reverence is not more active and influential among men than it is.

Turning to the subject of teaching, this writer is very outspoken. He says in effect that we must find the teaching required by the times in a study of the times. The following quotation will illustrate his meaning: "In the first century slavery was common, and was accepted without question both by Christ and by St. Paul. . . . These teachers, however (the antislavery leaders of the early part of the century), found the spirit behind the words—the Christ of the nineteenth century behind the Christ of the first century. In the name of a contemporary Christ they condemned slavery and convinced their hearers." The reverend gentleman does not observe, as he might have done, that those who appealed merely to the text of Scripture were among the strongest upholders of slavery. The reformers were more or less rationalizers, not pinning their faith to texts, but seeking a spirit and principle of life. The following remarks on religious teaching are much to the point: "Teachers have been too often stewards who bring out only the old things from the treasury, words spoken thousands of years ago, and acts fitted to another age. They go on using a phraseology which is not understood, preaching sermons about dead controversies, and condemning heresies long forgotten. They teach, but the people, tried and troubled by thoughts of duty to the rich or duty to the poor, find no help in their teaching. . . . Bishops might with advantage set candidates for orders to read modern books, and in examination test their powers to observe the signs of the times. The knowledge of Paley and Pearson might be supplemented, if not supplanted, by some knowledge of the movement of scientific and economic thought during the last fifty years, and proof be given that those offering themselves as teachers 'perceive with their eyes and hear with their ears and understand with their hearts.'"

The canon proceeds to discuss the relation of the Church to charitable work, but what we have already quoted will suffice to show how advanced are his views as to the kind of religious ministrations of which society stands at present in need. He believes, and we agree with him, that the Church occupies a position of exceptional advantage for holding up to men the ideals toward which they ought to strive. Ministers of religion are allowed to *preach*, an exercise in which other men must indulge very sparingly, if at all, on pain of being laughed at. They are supposed to be occupied at all times with the highest and most enduring interests of mankind, and they can adopt a tone of elevation and an accent of earnestness which in all others might seem out of place. Moreover, there is something in human nature which is prepared to respond to their appeals. However conventional or even sordid men may be in their daily lives, however immersed they may be in the all but universal game of grab, they feel that somewhere in their natures is a chord which might vibrate to higher impulses. To put it otherwise, every man knows that there is something in him better than that which he habitually shows to the world or to himself; and it is for the religious teacher above all to awaken that hidden, as Matthew Arnold says, "deep-buried self" into life and activity, to make it assert its authority and power. The rest of us deal with the average man and make our appeal in general to average sentiments: the clergyman, the minister of the gospel, testifies by virtue of his office to the existence of a divine element in human nature, and to him therefore, in dealing with men, all things are or should be possible. What he needs, however, as Canon Barnett so clearly points out, is to be armed with the kind of knowledge which will place him at the modern point of view and make him a true interpreter of the times and of contemporary human nature. Let him use the words of his creeds as far as they will go, and show the soul of truth in antiquated forms and usages; but let him not imagine that human thought can ever be confined within or fully expressed by, any formula or set of formulas: the spirit of life is a spirit of growth and of liberty.

In conclusion, we have only to say that we welcome most cordially such utterances as those of the Anglican canon, not because we suppose that he occupies precisely the point of view that we do, but because we feel that no essential claim of science is antagonized by aught that he advances in the name of religion. He may, for anything we know, hold many special opinions which we do not share; but, if so, these to us are of no consequence beside what we take to be his main and most characteristic belief—namely, that religion is not a fetter for the human intellect, but a garment of beauty for the whole man, and that, without a due recognition of science, no perfect or abiding form of religion can be.

HON. DAVID A. WELLS'S ARTICLES ON TAXATION.

THE editor of the Popular Science Monthly is gratified that he is now able to announce to its readers and the general public, the beginning in the present number, which opens the forty-eighth volume of the magazine, of the long-promised and anticipated series of articles by Hon. David A. Wells, on the most important subject of taxation.

For the execution of the task which Mr. Wells has assigned to himself, it is acknowledged that he has enjoyed extraordinary advantages; as Chairman of the United States Revenue Commission, 1865–'66 (an instrumentality devised by President Lincoln in anticipation of the close of the war); United States Special Commissioner of Revenue, 1866–'70 (an office specially created by Congress); chairman of a commission for the revision of the tax laws of the State of New York (specially created by its Legislature, 1870–'72, with a view of obtaining Mr. Wells's services); and subsequent membership of important railroad receiverships; of the Arbitration Board of the associated railways of the United States, 1879–'81, and of the Board of Direction of some of the largest manufacturing and insurance companies in the country. The assertion is therefore warranted that to probably no one person, in either the United States or Europe, has greater opportunities been afforded for study of taxation from the basis of practical experience and administration; and while the prediction may not be warranted, that Mr. Wells's conclusions will be accepted finally as solving the vexed and intricate problems involved in the subject, it is certain that the results of his investigations will prove most valuable and intensely interesting contributions to general economic science, and greatly assist in formulating better systems and rules for taxation, especially in the United States, than are now generally accepted.

The editor also feels warranted in saying that the course pursued by Mr. Wells which made his book on Economic Changes one of the most popular and instructive of recent economical publications, will also characterize the new field of inquiry on which he now enters—namely, to marshal in a clear manner and proper order all the facts that seem capable of explaining the situation of vexed and disputed questions, and of thus indicating where and how the truth should be sought for, with the greatest chances of finding it.

Scientific Literature.

SPECIAL BOOKS.

How many evil doers have escaped the just penalties for their acts and what great sums of money have been lost or expended in litigation for lack of an unfailing means of proving personal identity! If the police know that A. B. committed a certain crime and catch a man who they believe is A. B., but who stoutly denies it, they must establish his identity beyond a reasonable doubt in order to secure a conviction. The testimony of acquaintances and even the photographs in the Rogues' Gallery frequently fail to give certainty on this point. There is, however, a set of marks which, in the words of Pudd'nhead Wilson, "every one carries with him from the cradle to the grave" that seem to afford an infallible test. These are the patterns formed by the little ridges on the tips of the fingers. Mr. *Francis*

Galton, whose study of the subject has already extended over seven years, calculates that there is only one chance in 64,000,000,000 of the pattern on any human finger being identical with that on any other. If the patterns of three or four fingers (or the prints from them in printer's ink) be compared, all possibility of error is eliminated, while with a set of prints from the whole ten fingers assurance is made doubly and trebly sure. Mr. Galton has published on various phases of this subject from time to time, and in his latest book* deals with methods of handling large collections of prints so that reference to them may be simple and rapid. It appears that, with a few border-line exceptions, every print may be classified as a loop, a whorl, or an arch. A loop on the forefinger may open toward the ulnar (little finger) or radial (thumb) side of the hand. Loops on other fingers almost always open toward the ulnar side. Where these particulars are not sufficient, minor points. such as the number of ridges from the nucleus to the outside of a loop, and breaks, junctions, or forks of the lines, etc., which an expert can point out to any intelligent person, will be found conclusive. Mr. Galton presents an abstract of the report of a British departmental committee which fully indorses his system, recommending, however, for registering and identifying habitual criminals that a part of the French system of physical measurements be combined with it. The volume contains a specimen directory of three hundred sets of prints and plates in which nearly two hundred impressions are shown. Mr. Galton suggests that finger prints could be employed also for identifying deserters from the army and detecting impersonators of deceased pensioners. This by no means exhausts their possibilities. What an expensive and troublesome litigation could have been saved if a set of finger prints of the real Tichborne heir had been on file when the "claimant" appeared! An important class of life-insurance frauds would be prevented if the companies should require the taking of finger prints as a part of their physical examination, and the abortive attempt of the United States Government to prevent the personation by Chinese immigrants of fellow-countrymen who had been in the United States and gone home could be made effectual by the same means. Mr. Galton has secured abundant official recognition of his system, and the idea is being brought into wide popular cognizance by Mark Twain's story, cited above, and its dramatization.

No happier choice of a writer to tell *The Story of the Plants* could have been made than *Grant Allen*.† He knows what to tell in order to give his readers a satisfactory bird's-eye view of the subject, he has a most attractive way of telling it, and, above all, he knows what to leave untold. His story is not a string of definitions nor an annotated catalogue of genera and species. It tells how plants obtain their food, how they grow, rest, and perpetuate themselves, and what means they take to overcome obstacles and protect themselves from dangers. Something is told also about the way plants lived before there was any one to describe them, and how they came to differ from one another so much as they now do. Although it is thus seen that the physiology of plants is given chief prominence, considerable is told as to their anatomy. Thus, when showing that plants eat

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* Finger-print Directories. By Francis Galton, F. R. S. London and New York: Macmillan & Co. Pp. 123, 8vo. Price, $2 (5s.).

† The Story of the Plants. By Grant Allen. The Library of Useful Stories. Illustrated. New York: D. Appleton & Co. Pp. 213, 16mo. Price, 40 cents. London: George Newnes, Ltd.

with their leaves, the author describes the chief forms of leaves, but in such a way as to indicate that each form results from an effort of the plant to meet some particular need. Roots are described in the same way. Under the headings How Plants Marry and Various Marriage Customs, the interesting subjects of fertilization and the production of seed are explained. In the chapter What Plants Do for their Young the chief provisions for the dissemination of seeds and the nutrition of the germs within them are described. Some acquaintance with the characteristics of the chief kinds of plants is given under the heading Some Plant Biographies, where whitlow grass, the Mexican agave, the beech tree, the vetch, the coltsfoot, etc., are described. Throughout the book the reasons of things and the adaptation of means to ends are made prominent. The author states that he has "freely admitted the main results of the latest investigations, accepting throughout the evolutionary theory, and making the study of plants a first introduction to the modern principles of heredity, variation, natural selection, and adaptation to the environment." He says further that he will be disappointed if this little book does not lead the reader to pursue the subject in the fields and woods by the aid of a flora. We do not think he will be disappointed.

Is there any limit to the operation of the evolutionary process within the universe as known to us? Is man an exception, and does the popular phrase "lord of creation" mark a real distinction? Mr. *Edmond Kelly** is convinced that man is an exception now, although subject to evolution during the earlier part of his career. Man has developed physically and mentally as other animals have. In a struggle for existence he has shown himself the fittest of all to survive. But now, says Mr. Kelly, this mode of progress has stopped. Under the influence of religion man has developed the faculty of choice and the power of self-restraint, and he is now repressing some of the instincts by which he advanced during his evolutionary period, thereby better fitting himself to live in the social relation. As a member of society he has many grave problems before him, among which Mr. Kelly calls especial attention to municipal misgovernment, pauperism, socialism, and education. Religion is recommended as the guide to be followed in solving them. It might be queried how religion is to remedy the abuses in public affairs that have grown up when religion had a stronger hold upon men than it has now. Mr. Kelly recognises that abuses have grown up under and apparently in connection with religion, but he affirms that theology and various clerical institutions were then dominant rather than real religion. He would by no means bring back the partnership of Church and State where it has been dissolved, but would have religion govern individuals in their performance of social duties. It might be supposed that it would be a matter of indifference to Mr. Kelly whether religion or science were taken as the guide in social affairs, since he takes pains to show that they reach the same goal. Perhaps he could be brought to admit that, in a certain stage of their progress, men are less fitted to follow the guidance of the former than that of the latter. At the present time they are rapidly acquiring the capacity to govern their conduct on scientific principles, but they have so far had great trouble in keep-

* Evolution and Effort. By Edmond Kelly. New York: D. Appleton & Co. Pp. 297, 12mo. Price, $1.25.

ing in touch with their guide when they have attempted to regulate their conduct by religion. Perhaps they may be able to do so in the future, but we think the evolutionary process which Mr. Kelly believes is ended must go on some time longer before man can afford to dispense with the aid which the scientific method gives him.

The bird-loving amateur need be at no loss for guidance. Three manuals adapted to his wants have come to us recently, the latest being a charmingly attractive one entitled *Birdcraft*.* Emerson's query, "Hast thou named all the birds without a gun?" is its motto, and any one who will identify half the species it describes, or verify half it tells about their general appearance, habits, and song, will have occupation enough for several seasons without paying attention to the matters that can be learned only from the dead bird. The sprightliness of the smaller birds makes them delightful subjects of study, their elusiveness adds zest to their pursuit, while the various mental and moral traits indicated by the actions of all kinds well deserve the attention of the psychologist. This instance of the extreme politeness ascribed to the cedar waxwing was observed by the author: "A stout green worm (for they eat animal as well as vegetable food) was passed up and down a row of eight birds; once, twice it went the rounds, until halfway on its third trip it became a wreck and dropped to the ground, so that no one enjoyed it—a commentary, in general, upon useless ceremony." Much pains is taken to represent the songs of the birds described; thus the song of the red-eyed vireo is given in the words of Wilson Flagg as "You see it! you know it! do you hear me? do you believe it?" The bluebird seems to murmur, "Dear, dear, *think* of it, *think* of it!" The Carolina wren cries joyfully, "Sweetheart, sweetheart, sweet!" while there are several versions of the bobolink's rippling song to choose from, and any one may make another to suit his fancy. The song birds by no means monopolize the volume; birds of prey, game birds, shore birds, and waterfowl are all represented by species to be seen in southern New England. Fifteen double-page plates, each bearing from seven to twenty figures of birds in their natural colours, greatly enhance the value of the book.

GENERAL NOTICES.

In *Dr. Kerner's Natural History of Plants*† all the features of the growth, structure, and metamorphoses of vegetation are examined in their relations to one another. Interest was first excited in plants, we are told, by the question of their uses. Other avenues to botanical knowledge have been man's sense of beauty and the impulse to investigate structural differences even down to their most minute characteristics. This has brought the science to its present condition. In addition to these steps, the passion for collecting has been developed. In the later stages of the growth of botany observers have become convinced that every plant undergoes a continuous transformation which follows a definite course, and every species is constructed on a plan fixed within general limits and exhibiting variation in externals only. The systematic arrangement that has grown out of the application of these principles starts with the idea that rather than by similarity between adult forms the relationships of different plants are more correctly indicated by the fact of their exhibiting the same laws of growth

* Birdcraft. By Mabel Osgood Wright. Illustrated. New York and London: Macmillan & Co. Pp. 317, small 8vo. Price, $3 net.

† The Natural History of Plants. From the German of Anton Kerner von Marilaun. By F. W. Oliver. New York: Henry Holt & Co. Half Volumes I and II. Pp. 777. Price, $7.50. London: Blackie & Son. Price, 25*s*. net.

and the same phenomena of reproduction. As the beginning of the plants and of the study of them we are told of the living principle in them, represented by the protoplasts, which are considered as the seat of life, and of their movements, secretions, and constructive activity, and their communication with one another and with the outer world. The next steps are the absorption of nutriment from inorganic substances and organic and the changes it produces in the soil; the conduction of food; and the formation of organic matter from the absorbed inorganic food, with the functions of chlorophyll and the green leaves. Metabolism and the transport of materials are considered with reference to the organic compounds in plants, the transport of substances in living plants, and the propelling forces in the conversion and distribution of materials. Under the heading of the Growth and Construction of Plants are included the Theory of Growth, Growth and Heat, and the Ultimate Structure of Plants. The last chapter of the present volume relates to plant forms as completed structures, and in it are discussed the progressive stages in complexity of structure from unicellular plants to plant bodies and the forms of leaf, stem, and root structures. The volume concludes with the observation that the just pride and satisfaction we may have in what we have gained in the knowledge of plants "must not blind us to the recognition of the fact that most questions concerning the life of plants are as yet only at the commencement of their solution." The work is illustrated by about one thousand original wood-cuts and sixteen plates in oil colors.

*Menschutkin's Analytical Chemistry** is a college manual embracing both qualitative and quantitative analysis. Its most distinctive feature is the care that the author has taken to make the student understand the reasons for what he is doing. In the qualitative determination of metals the corresponding compounds of all the metals of a group are studied, and the conditions necessary for the separation of one group from another are deduced (General Reactions), after which the behavior of the compounds relied upon for detecting single metals (Special Reactions) is considered. A systematic course of analysis for the group in hand follows. With the metalloids, on the contrary, the special reactions of these elements and their compounds are first considered, and the student then passes to the complicated methods required for detecting the elements when occurring together. In the quantitative part the chief methods of gravimetric and volumetric analysis and the analysis of organic compounds are set forth. Here the author has followed also, so far as practicable, the procedure employed in the qualitative part.

It is generally accepted now that all life originated in the sea, and very probably in the littoral or coast region. The constantly varying conditions here, due to the surf and the tides, doubtless had a large share in determining form and structure; the violence of the surf beating its inhabitants to death, and the retreat of the tide exposing them to the attacks of predatory birds and beasts and to new atmospheric conditions. Hence in all probability have originated the various forms of adaptation which are calculated to bring about the survival of the fittest. The widespread effect of these factors in shaping present forms lends a special interest to the study of the littoral life of to-day. The general plan of classification in the work before us * is not that of any single authority. The authors have adopted the views of the leading specialists in the various groups. While this has the advantage of placing before the student the results of recent investigation, it occasions a certain number of discrepancies where the departments overlap, which are likely to lead to confusion. Up to recent times the mollusca have been regarded as one of the four subdivisions of the great family *Malacozoa.* The progress of investigation, however, tends to the belief that the mollusca are not so closely related to these groups as such a classification implies. The authors think that any attempt definitely to relate them to one group or another is to go

* Analytical Chemistry. By N. Menschutkin. Translated by James Locke. London and New York: Macmillan & Co. Pp. 512, 8vo. Price, $4 net.

* Mollusks and Recent and Fossil Brachiopods. Vol. III of the Cambridge Natural History. By A. H. Cooke, A. E. Shipley, and F. R. C. Reed. London and New York: Macmillan & Co. Pp. 535. Price, $2.00.

further than the present state of our knowledge warrants. The group Brachiopoda owes its chief interest to the immense variety and great antiquity of its fossil forms. There are at the present time only about one hundred and twenty extant species. The study of the mollusca occupies 460 pages, the remainder of the work being devoted to the brachiopods. The book is intended apparently as a student's manual. The description is clearly written and contains considerable historical narrative and many good illustrations.

Mr. Clodd justifies his *Primer of Evolution*,* an abridgment of his Story of Creation, by the reception which the larger work received, and the necessity for putting the material into a condensed and inexpensive form in order to reach the general reader. The first portion is descriptive: matter and motion, from the philosophical standpoint; the distribution of matter and the solar system; and finally two long chapters on the past life history of the earth and present life forms, compose Part I. Part II, the explanatory portion, has chapters on the becoming and growth of the universe, the origin of life and life forms, on the origin of species, and social evolution. The book is written in a popular style, and seems an improvement on its more bulky predecessor.

The high disciplinary value of the study of psychology, which gives a scientific basis to education and lifts it out of empiricism, is distinctly shown in the volume before us.† The authors have pointed out, in a very interesting manner, the application of psychology to number. They say that the teacher who knows how the mind works in the construction of number is prepared to help the child to *think* number. They take the position that the normal activity of the mind in constructing number is highly pleasurable. This is confirmed by actual experience and observation of facts in child-life. There are few children who do not delight in counting, and the fact should be taken advantage of by instructors. A sympathetic and competent teacher can interest them so keenly that apparently wonderful results may be obtained with but little difficulty.

The authors speak of how an absolute distaste for number is created by faulty methods of teaching, with arrested development as a natural result. They say it is perhaps not too much to affirm that nine tenths of those who dislike arithmetic, or who at least feel that they have no aptitude for mathematics, owe this misfortune to wrong teaching at first. The teacher can readily learn from an intelligent study how to make the work of the schoolroom consistent with the method under which by Nature's teaching the child has already secured some development of the number activity. Beginning with a group, counting, parting, and wholing are all in harmony with Nature's method, which "promotes the natural exercise of mental function and leads gradually but with ease and certainty to true ideas of number. It minimizes the difficulty with which multiplication and division have hitherto been attended, and helps the child to recognize in the dreaded *terra incognita* of fractions a pleasant and familiar land."

The authors' remarks concerning kindergarten work are sound and are based upon results that are evident to all. There is a sure and pleasurable way, along the line of least resistance, that may be followed in the kindergarten, with great improvement in the method of preparation for a child's work later. The authors say: "Surely something is lacking, either in the kindergarten as a preparation for the primary school or in the primary school as a continuation of the kindergarten, when a child after full training in the kindergarten, together with three years' work in the primary school, is considered able to undertake nothing beyond the 'number twenty.'" They add that under rational and pleasurable training of the number instinct in the kindergarten the child ought to be arithmetically strong enough to make immediate acquaintance with the number twenty, and rapidly acquire, if he has not already acquired, a working conception of much larger numbers.

In the easiest possible manner the authors go on to explain every process of number, and the presentation is such as to interest any one impressed with the necessity of a

* A Primer of Evolution. By Edward Clodd. London and New York: Longmans, Green & Co. Pp. 186. Price, 75 cents.

† Psychology of Number. By Dr. J. A. McClellan and Prof. John Dewey. International Education Series. New York: D. Appleton & Co. Pp. 309, 12mo. Price, $1.50.

sound basis for education, but more particularly those instructors to whom we look for guidance—from kindergarten to college.

Mr. *Frank Sargent Hoffmann's* book on *The Sphere of the State** is the substance, chiefly, of lectures delivered before the senior class of Union College in 1893, and is intended to set forth clearly and concisely the ethical principles involved in the rights and action of the state, and to show how they may be applied under present conditions and principles. In the author's view the state is the primal and universal unit of society; it is coextensive with the human race, and is independent of the existence of nations, and every man is born into it. It is manifold, for many distinct divisions of mankind called states may exist at any given period. The supreme control of all persons and commodities must be with it, and there can never be an individual right to anything in the state that is not subordinate to its right. Dismissing such conceptions as base the organization and extent of the state on geography, race, family relation, language, or religion, the author accepts that which founds it on brotherhood and the needs thereof, and makes the chief and ultimate end of the state, to which all other ends must be subordinate, the perfection of the brotherhood; and all this, the state, the entity, is distinguished from the government, which is only an instrument. The state's first duty is to enlighten its members respecting their ever-varying relations, and what they require—education. While the true and distinctive ground of property is labour, by which it is acquired, and that is performed by individuals, the natural right to property is ultimately resolved into a state right, and the individual's right must in the end be controlled by the needs of the state or the good of the whole brotherhood; and "only from the conception of property as ultimately owned and controlled by the state can we come to a true conception of the property right of each citizen of the state." The principles thus laid down are followed out in their application to the various functions and features of civic and social life; to the creation of corporations and the assigning them their places in the state; to the matter of transportation and its relation to the state; to taxation, the right to impose which belongs only to the state as a whole and is absolute there, but not to any individual; to questions of money; to the treatment of criminals; to relations with the poor; to the government of cities, the family, the Church, and relations with other states. The author's reasoning is profound and comprehensive, his tone is conservative, and the book is full of thought.

Of all the leaders in the late war for the preservation of the Union, General Sheridan* probably comes nearest among the Unionist commanders to fulfilling the popular ideal of a hero. Brave, alert, often brilliant, and nearly always successful, he acquired his full measure of glory while in active service, while nothing happened in his after-life to dim his renown. His biographer was fortunate in his subject. We may say that the subject is as fortunate in its biographer. General Davies served with distinction in the cavalry corps of the Army of the Potomac under General Sheridan from September, 1863, till the end of the war, and his brigade was present in all Sheridan's battles. It was mainly for this reason that he was chosen by the editor of this series to be Sheridan's biographer. He was an officer of correct military information and was, as his narrative proves, a writer with clear perception of what should go into a biography, and was able to estimate correctly the value of each action and to describe his hero justly and without exaggeration or extravagance. He died one month after he had completed this book. He regards General Sheridan as having possessed to an eminent degree the most indispensable qualities of a commander. "He had the ability to think and act promptly and energetically, and, if need were, independently of instructions, and to assume and support with ease whatever responsibilities his situation might require; he had the power to impress his will and personal influence

* The Sphere of the State, or the People as a Body Politic; with Special Consideration of Certain Present Problems. By Frank Sargent Hoffmann. New York and London: G. P. Putnam's Sons, pp. 275.

* Great Commanders: General Sheridan. By General Henry E. Davies. With Portrait and Maps. New York: D. Appleton & Co. Pp. 332. Price, $1.50.

upon all who were under his command." He was not a martinet or a rigid disciplinarian, but exacted implicit obedience from his subordinates and a prompt and energetic performance of duty. He also recognized the reciprocal relations that should exist between a commander and his troops. Great stress has been laid by some writers upon his "dash," but no estimate of his character could be more erroneous than that which made him only a hard-riding, hard-fighting, and reckless soldier, whose fame and success were due to desperate personal courage and impulsive combativeness, with exceptional good fortune. He had energy and dash, and, added to these, judgment, patience, industry, and full knowledge of all the duties of a commander and a soldier, and deserved all the distinction he won.

The *Annual Report of the New York State Board of Charities* for 1894, a bulky volume of 576 pages, is a valuable compilation of statistics relating to the charitable institutions and other charities of the State. The total expenditure of the State charities department for the year ending September 30, 1894, was $3,877,709.80; of county and city institutions, $3,872,985.50; and of private and incorporated societies and associations, $13,231,698.52. This was a total increase over 1893 of $574,410.88.

The Teacher's Mentor (Bardeen, 50 cents) is written to aid the inexperience and guide the uncertainty regarding practical details of the beginner who is without special training. It is, the author says, based on what he now sees would have been useful to him in his early years of teaching. Among the topics considered are, the outfit for teaching, including knowledge of subjects to be taught and general information desirable; necessity for understanding the children; what education is; relations between teacher and trustee; desirability of producing a good first impression on the children; and school routine in detail.

The studies on which *Le Pétrole, l'Asphalte, et le Bitumen* (Petroleum, Asphalt, and Bitumen), of the late Prof. *A. Jaggard*, of Neufchâtel, is based, were begun in the Jura and the asphalt bed of the Val-de-Travers, and were stimulated by the discovery of mineral oil in the United States. Their purpose was to investigate the origin of the natural hydrocarbons. The various theories of petroleum are criticised, the mode of its formation is discussed, the discoveries of beds of it in the Old and New Worlds are described; and bitumen and asphalt are similarly treated. The author concludes that no extraordinary processes or forces are needed to account for the production of these substances, but that it is still going on in the usual course of events, by a kind of natural, slow distillation of organic matter. But in studying the beds it is necessary to discriminate between the original formation of the substances and the displacements which they may have undergone afterward, and which may have had much to do in bringing them into their present position. The book is published by Félix Alcan, Paris, as a number of the French International Scientific Series.

In a similar line, though the starting-point is different, is *Les Merveilles de la Flore Primitive* (Wonders of the Primitive Flora) of M. A. Froment, which is published by Georg & Co., at Geneva and at Paris. It begins with a minute study of the carboniferous vegetation, its structure and forms, and proceeds to the discussion of the way in which the coal-forming plants may have been accumulated and converted into coal. This is done by gradual, unheated distillation, which, under certain other conditions, produces the hydrocarbons. A preponderant function is ascribed to electricity in the production of the coal plants. This well-reasoned essay is followed by a remarkable speculation over what may have happened if Australia fell upon the earth as a meteoric mass.

In obedience to an act of Congress, the *Commissioner of Labor* has made an investigation and a report on *The Slums of Baltimore, Chicago, New York, and Philadelphia.* The report embraces thirty-three tables, in which are given under various classifications the color or race, country of birth, citizenship, illiteracy, occupations, weekly earnings, number of children, bodily condition, etc., of the inhabitants of the districts examined, also the school attendance of their children, the number of families to a tenement, air space to a person, rent paid, and sanitary condition of the tenements. From an analysis of the tables it appears that the slums, as compared with other parts of the cities in which they are, have a larger proportion of foreign-born denizens; sickness does not prevail in them to any greater extent, and most of the bacteria found in the air of the tenements are harmless; the occupations of the slum population are as varied as those followed in other districts, and their earnings are "quite up to the average earnings of the people generally and at large." But few tenements could be reported as in excellent sanitary condition; in Philadelphia and Baltimore those classed as good formed the largest division, while in New York and Chicago those reported as fair were the largest class. Cases of overcrowding were numerous.

Part XXVII of the *Proceedings of the Society for Psychical Research* opens with an account of some experiments in thought transference, by *Henry G. Rawson*, in which drawings were reproduced and cards were named correctly in a large proportion of cases. The chief contribution in the number is a second installment of the experiences of the late W. Stainton Moses, communicated by F. W. H. Myers. These experiences are what are commonly known as spiritual communications. There is also a paper on the Apparent Sources of Subliminal Messages, and reviews of books on hypnotism, the exposure of Mme. Blavatsky, and other psychical subjects.

In *The Coming Revolution* (Boston, Arena Publishing Company) the position is assumed by *Henry L. Call* that the prevailing discontent among the "toiling masses" is a sign that the present conditions of society and the relations of the rich and the wage workers are all wrong and a revulsion is imminent. The author accordingly begins his diagnosis with an examination into the condition of society, and follows it up with inquiries into the causes that have produced that condition; the nature of these causes, and whether they rightfully admit of a remedy and its justification; the application of the remedy to each of the causes in turn; the effects of the remedy; and the manner in which it is to be achieved. The causes of the trouble are abuses of privilege of a political nature and origin. The remedy is to enforce the law of freedom—of social and industrial as well as political freedom; and it is to be secured by political means.

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Fragments of Science.

Nature's Defenses against Disease.—It is maintained by Dr. C. Theodore Williams, of the Hospital for Consumptives, Brompton, England, that in most of the specific modes of treating consumption, particularly in the antiseptic modes, the greatest factor of all—the resisting power of the organism to disease—is ignored, and that it is to this that the physician should lend his aid and support. For if his means are effectual he can ward off disease, or if a patient has been already attacked he can limit its inroads and possibly arrest it altogether. The history of the treatment of phthisis shows that life in the pure air, judicious exercise, light, nourishing dietary, and such aids as cod-liver oil and tonics have effected more than all the bacillicide treatment put together. These all act on the old principle of helping Nature to help herself and reducing the vulnerability of the patient to attack. The weapons of resistance which Nature lends the human body are the leucocytes or phagocytes, studied by Metchnikoff, which absorb the bacilli and destroy their energy. Another destroyer of bacilli is the serum of certain animals; and a third method of destruction is seen in the process of fibrosis, which is largely present in chronic consumption. In a well-organized, well-developed, and therefore well-protected person the bacilli are overwhelmed by the irruption of phagocytes at the point of entry, and immunity is the result. In one of less protective power they may enter and be carried along by the lymphatics to the lymphatic glands, where they undergo digestion and destruction. When, however, the tubercle bacilli gain an entrance, and settle, and destroy the tissues, as in the case of the lung, the most that can be hoped for is that the progress may be obstructed by fibrous growth, or that, through developing and expanding the healthy lung in the neighborhood, pressure may be brought to bear on the diseased portion, inducing a drying process incompatible with the life of bacilli. This process is encouraged by living at high altitudes. The problem of treatment resolves itself principally into means to increase the number and activity of the phagocytes and thus render more probable the destruction of the tubercle bacilli. Moreover, whatever improves the quality of the phagocytes would also improve and enrich the blood and lymph serum, of which they form a principal part. To this quality the author attributes the virtue of cod-liver oil—to which he has found, he says, no substitute comparable. Sunshine and pure air are the best bacillicides. At Davos and St. Moritz phthisical patients almost invariably sleep with open windows throughout the winter, when the thermometer not uncommonly registers —4° F., or 36° below the freezing point, care, of course, being taken to heat the room with stoves, to provide plenty of blankets and coverlets, and to see that the current of external air is not directed on to the patient, but always first ascends to the ceiling. The universal testimony of medical men is to the effect that no harm, and much good, results from this practice. One effect is that patients accustom themselves to living at a lower temperature without noticing it. At Davos, Leysin, and Falkenstein there are covered terraces or long, sheltered corridors, open on one side to the air and protected from wind, where a large number of phthisical patients in various stages of disease recline on couches for the greatest part of the day in all weathers. In the winter there is no heating apparatus, and warmth is kept up by fur clothing and abundant covering.

Requisites of a Public Museum.—"If public libraries, why not public museums?" asked Prof. E. S. Morse in the Atlantic Monthly a year ago. Having discussed the subject in a general way, he comes to the application: "First and foremost, then, the town museum should illustrate the natural products of the immediate region. By natural products is meant, of course, the animals, plants, rocks, and minerals found in the county, or possibly in the State; for a county collection would require but a few extralimital forms to compass the State. Second, a general collection of similar material from elsewhere, to show the relation of the county to the rest of the world. Anatomical, physiological, and morphological series should next find place in such a museum. The minor factors of natural selection, such as protective, alluring, and warning coloration, mimicry, etc., should be illustrated, as far as possible, from collections made in the immediate neighborhood. And, finally, a series of forms to show the phylogenetic development of the animal kingdom should in some way be given. Such a series would require large floor space, and the solution of many perplexing problems as to form of cases and methods of display. Yet a scheme of this sort must ultimately be devised." Such an idea has been attained in part by the Peabody Academy of Science in Salem, the collections of which comprise, first, a remarkable series of the animals and plants, rocks, minerals, and archæological specimens collected in the county of Essex, which are continually increasing as new forms are added; an epitome collection of the animal kingdom, brought from all parts of the world; and an ethnological collection, arranged by countries. These collections are all fully and clearly labeled. At close intervals throughout the entire collection special colored labels are displayed, calling attention by title and shelf number to books in the public library referring to the immediate groups. Courses of lectures are given in the Academy Hall every year, which are practically free to the public.

Life in Balochistan.—An interesting lecture on the northern Balochis, a hill tribe of Balochistan on the northwestern frontier of India, was recently read before the Indian Section of the Society of Arts by Mr. Oswald U. Yates, a gentleman who, while engaged in Government work, spent seventeen years in the neighborhood of these people and gave much of his time to a study of their language, history, and customs. The Balochis are Mohammedans, but not very assiduous votaries; none have been converted to Christianity, however. They are probably a mixture of Kurd and Arab. Their language is quite similar to Persian—so much so that Pottinger, who visited Balochistan in 1830, and who was familiar with Persian, could after a few weeks understand most of what was said to him. In order to be a respected citizen, a Balochi must have long, curly black hair, the longer the better; and a long beard is also considered desirable. They are very superstitious. On certain days they believe it is bad luck to go in certain directions; they are guided in this by a rhyme, which translated is:

"On the 1st and 11th I will not go east.
On the 5th and 15th I will not go west.
On the 3d and 13th I will not go south.
On the 7th and 17th I will not go north."

They augur coming events from an examination of the lines on the shoulder blade of a newly killed goat. Goats are also made use of in discovering the sites of disused wells, this, however, is not peculiar to the Balochis. Their method of irrigating is rather unique. "Before the commencement of the rains, the fields are inclosed by lofty embankments, varying in height from three to ten feet, and inside these banks (called *latbandi*) the water from the hill torrents is admitted; when one is full the next is filled.

The banks are made by bullocks; a board about eighteen inches long and twelve inches broad is attached to a pair of bullocks, who drag it, along almost vertically until a heap of earth is raised in front of it; this board is then thrown flat by means of a cord and dragged on to the bank, with the earth on top of it and there its load is deposited. As soon as the water has sunk into the ground plowing commences, and the seed is sown"; millet is the chief crop. They kill all male colts as soon as they are born. "The reason for killing them is that they can not be taken on marauding expeditions owing to their neighing on seeing a mare." They use the Persian saddle and are very good horsemen. Adultery is punished by the death of both man and woman. They firmly believe in the ordeal by fire. One of the most trying of their tests is the following: In a large vessel filled with scalding hot water are placed two stones of different colors; one of these stones, unknown to the supposed criminal, has been labeled the guilty-stone. In order to establish his innocence he has not only got to choose the other stone, but also remove it from the boiling water by using his naked hand and arm.

The Care of Milk.—The composition of milk admirably adapts it to the growth of all kinds of bacteria; this growth causes in it undesirable chemical changes. As secreted in a healthy animal milk contains no micro-organisms of a dangerous character; but during and subsequent to the process of milking its contamination is inevitable. Various forms of disease—consumption, typhoid and scarlet fevers, diphtheria, etc.—have been in numerous instances traced to an infected milk supply, and it is unquestionable that much of the stomach and intestinal trouble so fatal to young children during the summer months is caused by unhygienic milk. It is plain, therefore, that the elimination of living germs from milk is quite essential to its safe use as a food, especially for infants. The most scrupulous cleanliness has been found inadequate; hence some artificial process becomes necessary. There are two methods in common use, pasteurization and sterilization. The former heats the milk to about 160° F., and the latter to over 212° F. The pasteurizing process, while not quite so thorough, kills any growing bacteria that may be present, and has the advantage over sterilization, of leaving the physical condition and flavor of the milk practically unchanged. A method of pasteurization for family use is as follows: "1. Use only fresh milk (not more than twelve hours old) for this purpose. 2. Place the milk in clean bottles or fruit cans, filling to a uniform level. (If pint and quart cans are used at the same time, an inverted dish or piece of wood will equalize the level.) Set these in a flat-bottomed tin pail and fill with warm water to same level as milk. An inverted pie tin punched with holes will serve as a stand on which to place the bottles during the heating process. 3. Heat water in pail until the temperature reaches 160° F.; then remove from fire, cover with a cloth or tin cover, and allow the whole to stand for half an hour. 4. Remove bottles of milk and cool them as rapidly as possible without danger to bottles, and store in a refrigerator." The following suggestions to buyers of commercially sterilized milk are worthy of note: "1. Label on bottle should show that the material was pasteurized not more than one day previous to delivery. 2. Shake the bottle thoroughly before opening, so as to remix the contents as much as possible. 3. The paper disk should not be replaced after it is once removed. Invert over neck of the bottle a clean, dry tumbler or glass to prevent anything from falling into the bottle. 4. Any unused milk or cream that has been put in another vessel should not be poured back into original bottle again. 5. Keep the original bottle in the coldest part of the refrigerator as much as possible. When so treated, properly pasteurized cream or milk ought to keep perfectly sweet for several (two to four) days, even in the height of the summer season."

Improvement of Crops.—In presenting a new theory respecting the improvement of crops, J. C. Arthur propounds as fundamental, interacting principles, that a decrease in nutrition during the period of growth of an organism favors the development of the reproductive parts at the expense of the vegetative parts. The converse, that an increase in nutrition favors the vegetative parts at the expense of the reproductive parts, is also equally true, and that as a general law large seeds produce stronger plants with a greater capacity for reproduction than small seeds of the same kind. In the economy of Nature, as the food supply is lessened, a greater effort is made on behalf of the parent plants to enhance the chances for perpetuity, but at the same time the largest seeds, having the greatest potentiality, stand the best chance in the future struggle, and, although the best, nourished plants produce the fewest seeds, their greater size gives them decided advantages over seeds from starved plants. The two laws acting together, therefore, aid in maintaining the perpetuity of the species and its full measure of vigor. The two categories of methods for the improvement of crops are the enrichment and cultivation of the soil and the selection of seed, especially of large seed. It is desirable to know that intensive farming will give a better return in all crops grown for fodder, or for the roots, or other portions of the vegetative part of plants, than in those grown for grain and fruit. In either case, but more especially in the latter, the highest vigor and best returns can be obtained only by the use of the best and heaviest seed. When this is done high tillage will increase the yield and make possible the greater improvement of succeeding crops.

Happiness of Animals.—"What makes the happiness of wild animals?" asks a writer in the London Spectator. What the happiness of wild creatures consists in, he continues, "can perhaps be best judged by their daily habits. Within certain limits they are free to choose their life, and presumably they choose what pleases them best. In nearly every case this is one of pure routine. It consists in a daily repetition of a limited series of actions, the greater number of which seem to give them satisfaction rather than pleasure, but make up in the aggregate the sum of animal happiness. Unlike the domestic dog, which welcomes any break in the monotony of life, they never, except in the courting season, seem to seek change, or adventure, or excitement. It may be doubted whether, if the food supply were plentiful and constant, animals or birds would ever care to move beyond the circle in which they can find enough for their daily wants. The probable whereabouts of deer at any time in the twenty-four hours, and their occupation, whether feeding, sleeping, or resting, are known with the utmost certainty by those whose business it is to watch the forest, and could be predicted for any month in the year. . . . The adventurous life, if it is found anywhere among wild creatures, belongs to the carnivorous animals. Yet most of these only wander just so far as is necessary to find their prey, and then prefer to kill some creature that will provide a meal for more than one day. They are naturally indolent, and active only from necessity." Even lack of space is not a serious drawback to the happiness of most animals at the London "Zoo." "The lions and tigers feel the confinement of their inner cages and often strike impatiently at the doors which separate them in winter from their summer palaces, and the wild cattle would enjoy life far more if a roomy paddock could be added to their pens. No hawks or eagles can be happy in cages, because exercise in flight is essential to their health. Parrots, on the other hand, dislike exercise, and consequently live to the greatest age of any creatures in the gardens. Bears seem to share this dislike for unnecessary movements, and 'my lords the elephants,' and all the camels, with true Oriental indifference, would prefer to stand all day doing nothing, if they were not compelled to earn their living by carrying visitors. All the reptiles lead the life of lotus-eaters, and, so far as their brief day lasts, the tropical butterflies in their cages seem equally happy with those which flit among the flowers that line the garden walks."

Picturesque Arctic Nature.—How small, says Julius von Payer, is the matter for artistic reproduction in the old civilized world compared with the rest of the globe! "Has the desert been depicted in such a manner as it undoubtedly deserves to be? Or the Tundra, the primeval forest of the Dark Continent, the swampy shores of Lake Chad, the bridle-path of the Cordilleras, the Tibetan mountain lake, or the coral islands? What of the animal world, if we except our domestic animals and some wild game: the Indian beasts of prey; the African pachyderms; the troops of monkeys or tortoises of Brazil? And then the scenes of human activity: the negro battles; the dreamy, still life of the South Sea islanders; the buffalo hunters; Yakuts so hardened as to sleep almost naked in the snow; India-rubber collectors on the Amazons; Patagonian giants; Niam Niam dwarfs, etc." The author especially commends the polar regions as artistically attractive, where great effects are produced with little color by the varying charms of light conferring life upon even the most monotonous views. In the four years and a half he spent there he was ever charmed by the change in pictures of Nature. "What a magic spell, for instance, is produced even by the twilight, . . . the time without bright light, almost without shade; that of soft, dreamy silhouettes, of the clear green sky, and the pale, silvery tone of the mountains! The snow is now melted, and the blue sea-ice lies bare, scarcely tinged with red by the setting sun. Even the long winter night possesses its artistic charm from the midday arch of light, or the moon, which changes the channels beneath into rivers of silver. The arctic sky alone would enrapture the painter. As the returning sun nears the horizon, every color glows forth, a border of light dividing the part of the atmosphere still in the shadow of the earth from that already lighted up." Then there are the infinitely varied phenomena of refraction, with *Fata Morgana*, giving the most curiously odd and unlike appearances to various objects; vapor effects; the ice blink; variations of snow and bare ground; pastures with reindeer and musk oxen; and vegetation, for, "although there is never the thick flora of our meadows, yet one meets with limited areas either yellow with *Papava nudicaule* or *Ranunculus*, or carmine with *Silene* or *Saxifraga*, or blue with forget-me-not, or white with *Crastium*. East Greenland has its huge Kaiser Franz Josef fiord, surpassing the fiord of Norway, and the whole of Greenland furnishes surpassing mountain landscapes; Spitzbergen has a profile like a saw; and Novaya Zemlya is a table land, buttressed by mountain cones."

Forest Protection in the United States.—In a paper published in the Proceedings of the American Forestry Association, Mr. George H. Parsons, of Colorado Springs, shows that measures for the protection of forests were taken by some of the colonies as early as in the seventeenth century. These provisions were continued everywhere after the formal organization of the Government of the United States, and now each State and Territory has some law, providing more or less severe punishment to any person setting fire to woodland or prairie. But as it is very difficult to find the offender, or to convict him afterward, laws of this class are operative, if at all, by their threat rather than by their execution, and with few exceptions have become dead letters. The only States said to be comparatively free from forest fires are Maine and Massachusetts, and especially New York, whose forest commissioner reports that they are now a thing of the past. Laws encouraging the planting and growing of timber and shade trees are found on the statutes of twenty-two States and Territories, having been adopted more generally in the prairie States. They have been the means of covering with trees thousands of acres, and have driven the prairies many miles westward. Kansas is credited with the largest area planted with forest trees, and Nebraska comes next. These laws have done much good, but, after all, tree-planting along roadsides, and in small, isolated clumps, is not forestry, and legislation of this kind, though indirectly aiding the cause in an educational way, does not preserve or create forests. In the same direction of education is the appointment of Arbor Day, which has become a legal holiday in thirty States and Territories. Being celebrated in the public schools, it is made a most important factor in creating an interest in trees and a knowledge of plant life among people at their most impressionable age. Regular forest commissioners or commissions have been appointed in ten States. They began work actively and enthusiastically, but it is now a question whether they are able to do much good. Politics is gnawing their vitals out.

A Volcanic Dust Deposit in Kansas.—A large deposit of volcanic dust is described in Science by H. J. Harney as existing in central Kansas, in McPherson County, north of the watershed between the Smoky Hill and Little Arkansas, and in the great depression extending from Salina to the Little Arkansas.

The exposure is about fifteen miles long, from two to four feet thick, from forty to fifty feet high, rests on a bed of clay, and is overlaid by a bed of yellow marl. At the lowest point the dust is well assorted and stratified; at the higher points it shows signs of having been deposited in shallow water. It is composed chiefly of silica, with small proportions of ferric and aluminum oxides, protoxide of manganese, water, lime, and traces of other substances. The microscope shows it as consisting almost wholly of microscopic, transparent, silicious flakes of various irregular forms.

Geological Society of America.—The seventh summer meeting of the Geological Society of America was held at Springfield, Mass., Prof. N. S. Shaler presiding. A paper was read by C. H. Hitchcock on the Champlain Glacial Epoch, which was regarded as corresponding with Prof. James Geikie's Mecklenbergian Epoch. In a paper on the Glacial Genesee Lakes, H. L. Fairchild exhibited the relations of the Genesee River drainage basin to surrounding river systems, and endeavoured to determine the glacial history of the region. In his paper on the Bearing of Physiography on Uniformitarianism, W. M. Davis maintained that the success in the interpretation of Nature by means of the physiographic study of land forms confirmed the correctness of the postulates of uniformitarianism and brought to its support a series of facts not in the beginning of the study supposed to bear upon it. J. C. Branner described the decomposition of rocks going on in Brazil as being more profound there than in temperate regions. The chief mechanical agency promoting it is the daily change of temperature to which rocks exposed to the sun are subject, which causes exfoliation and the admission of a number of destructive agencies and reactions. Among these agencies are rain, bringing down corroding acids, insects, and plants. Many papers of more special interest were read on subjects of stratigraphical, glacial, and economical geology, and paleontology. A committee which had been appointed in 1893 to secure the expropriation of the region about Mount Rainier as a public park reported that it had presented the case to a committee of the United States Senate, but had failed to have a bill recommended. The committee was continued, to make another effort.

The French Scientific Association.—The French Association for the Advancement of Science met for 1895 in Bordeaux, where its first meeting was held in 1872. The *maire*, in welcoming the association, referred to the changes which had taken place in the city since then—all for good, and largely for the diffusion of knowledge and the promotion of public comfort. The number of primary schools had been tripled; the Lyceum, in whose halls the sectional meetings were held, had been built, and faculties of law, science, letters, and medicine and pharmacy had been established and an observatory erected; all attracting an attendance of more than two thousand students, and giving the place all the privileges of a university except the name. Museums also and art galleries had been founded, and benevolent institutions brought into existence. All these, the *maire* intimated, were the results of the scientific activity which began with the meeting of 1872. The president, M. Émile Trélat, took salubrity as the subject of his address, in which he gave a felicitous description of the ideal city of health. The work of the previous meeting of the association, which was held at Caen, and the history of the association during the year, were reviewed by the secretary, M. Livon. The association lost many of its distinguished members during the year, among whom were Baron Adolphe d'Eichthal, one of the founders, a benefactor, and president in 1875 at Nantes; Verneuil, the eminent doctor, president in 1885 at Grenoble; Gustave Cotteau, several times president of the Geological Section; Alphonse Guérin, Ferdinand de Lesseps, Recipen, and Armand Lalande, founders; Victor Duruy, and others; and among the foreign associates the Russian mathematician Tchebichef and Carl Vogt, who had attended a number of the meetings. It appears from the financial reports presented by M. Émile Galante, treasurer, that the year's receipts of the association were 86,244 francs.

Infectiousness of Milk.—The Massachusetts Society for Promoting Agriculture has issued a report of work done under its auspices on the above subject. It being already well established that there was much danger of the milk being contaminated if the cow from which it came had tuberculosis of the udder, attention was restricted to the question whether the milk was ever infected when the disease was confined to other parts of the animal. Bacilli were found in the milk from twelve out of thirty-six tuberculous cows. Milk from six out of fifteen infected cows produced bacilli when inoculated into guinea-pigs, and the milk of four out of nineteen cows produced bacilli in rabbits. Bacilli developed in two out of forty-eight rabbits, five out of twelve pigs, and eight out of twenty-one calves to which milk from tuberculous cows was fed. It is interesting to note that microscopic examination revealed bacilli in only one out of thirty-three samples of milk ordinarily supplied to consumers in Boston, but bacilli appeared in rabbits after inoculation with three of the samples which gave negative results under the microscope. A circular sent to eighteen hundred physicians and veterinarians asking "Have you ever seen a case of tuberculosis which it seemed possible to you to trace to a milk supply as a cause?" brought replies from one thousand and thirteen, eight of whom reported cases where they believed children had been infected by mother's milk, and eleven reported cases in which children had been infected by cow's milk, while sixteen spoke of suspicious cases which they had not been able to verify. Some results of inquiries as to the prevalence of bovine tuberculosis and as to tuberculosis among Hebrews are also given.

Extermination of British Species.—In the inaugural address of the president of the Cheltenham, England, Natural History Society, Dr. E. T. Wilson, on Man and the Extinction of Species, are some historical notes on the disappearance of certain species in the British Islands. Within limited areas, the author says, species were not unfrequently eradicated before the use of firearms, as the beaver in England, which, though once common, was in the twelfth century only to be found in one river in Wales and one in Scotland; and wolves, which were practically exterminated in four years after the demand by Edgar for a tribute of five hundred heads annually from his Welsh subjects. "But even the introduction of firearms at first did little beyond giving man an increased advantage in his contest with the more formidable of the lower animals. Far otherwise is it, however, when man, the primitive hunter, gives place to man the tiller of the soil, man the cultivator, who fells forests, drains marshes, plows prairies, and in a thousand ways alters the face of Nature." To most of the larger quadrupeds, and to many birds, space is of vital importance, and space is being rapidly curtailed. The bustard, described by Bewick as common on the plains of Wiltshire, Dorset, and Yorkshire, has disappeared before advancing cultivation. The egret and the crane, once common in Scotland, are now among the rarest of visitors. Drainage in the broads and fens has led to the banishment of many former inhabitants, such as the grey lag goose, and in many parts the bearded tit. Between 1825 and 1855 the avocet, the bustard, and the godwit ceased breeding in Norfolk. About the same time the ruff became uncommon, and the bittern left off breeding regularly in 1850. Eagles and large hawks, such as the kite and the buzzard, and among mammals the otter and even the harmless badger, are becoming rarer year by year before the gun or the trap of the gamekeeper; while the trade collector, with his demand for whole clutches of eggs, contributes to the destruction of some of the rarer species. In 1893 an item was published that two sloops had visited the island of Foula in the Shetlands, the chief breeding station of the great skua, and carried off several dozens of the eggs, and there was reason to believe that not a single young bird was reared on the island during the breeding season of that year.

The Feigning of Death.—The probability of this phenomenon being a pure reflex, in most animals, is indicated by the following experiment on a currant moth, whose powers of "shamming" are so familiar, which is described in a recent letter to Nature by a Mr. Oswald H. Latter: "The moth was first seized by one wing, and it at once feigned death; thereupon its head was cut off with a pair of scissors, and the *animal continued to feign death*. I use the expression advisedly, for absolute immobility was maintained for some seconds and then violent fluttering ensued, causing the animal to rush wildly about the table, but failing to lift it into the air. In this condition any impulse, such as touching or pinching, induced a repetition of 'shamming.' After a strong impulse the shamming was prolonged, and, indeed, a direct connection was obvious between the strength of stimulus and the length of period of quiescence. This power of response to stimulus was maintained for two days, and then weak fluttering set in for some hours, followed by death. We are forced, then, to conclude that here, at any rate, death-feigning is a purely reflex phenomenon, and that the sensory stimulus received by the surface of the body caused inhibitory impulses to arise reflexly from the ganglia of the central nerve chain, and prevented all movement of the locomotor muscles. In confirmation of this it may be mentioned that denuding the wing of its scales over any area caused a marked diminution of sensitiveness over the area so treated. Since all stages between sensory hairs and ordinary scales occur in *Lepidoptera*, it is not unreasonable to assume that the scales still function as tactile end organs in spite of their modification subserving decorative purposes."

MINOR PARAGRAPHS.

Navigators and other writers of the sixteenth and seventeenth centuries speak of a pretended art of controlling the winds which was claimed by Finnish and Lapp wizards, who sold wind in packages consisting of a cord with three knots. "If the first knot is untied," Grimm says, "the wind becomes favourable; if the second, a still better wind is secured; but a tempest inevitably follows the undoing of the third knot." Speaking of Greenland, Nightingale says: "The sailors of the north are so credulous that they often buy these magical cords; and they believe that, if they follow the instructions concerning the way of untying them, they will get whatever sort of wind they want." Like accounts are given by Leems and Scheffer; and the belief is referred to by Shakespeare in Macbeth.

A summary is published in the journal Himmel und Erde of reports made to the Bureau of Statistics in Berlin, which seem to show that cases of damage from lightning are regularly increasing. Thus while, according to Prof. von Bezold, the average number of accidents per year in Bavaria was thirty-two from 1833 to 1843, it has gone up from period to period till in 1880–'83 it was one hundred and thirty-two; and, while in 1855 one hundred and thirty-four persons were struck by lightning and seventy-three of them were killed, the number struck thirty years later was one hundred and eighty-nine, of whom one hundred and sixty-one were killed. The increase is ascribed to a variety of causes, among which are the use of electricity in industry; changes worked upon the earth's surface by the cutting away of woods, drainage, etc.; and the fouling of the air with coal smoke.

As presented by General Greely in a paper at the recent International Geographical Congress, arctic exploration has passed through three important phases. The first was a commercial phase, when the discoveries of Chancellor gave rise to the Muscovy Company and the institution of trade between Great Britain and Russia. The second was the geographical phase, which culminated in the beginning of the present century, and under which an unparalleled wealth of geographical results has been harvested. The third phase of scientific investigation has been prominent in later years, and now dominates, so that no expedition can command support unless its aim is scientific. Altogether, it can be proved that arctic industries have contributed some $12,250,000,000 to the wealth of the world.

Herr S. A. Andrée presented his plan for a balloon expedition to the north pole before the recent International Geographical Congress. He advises that the balloon should be capable of carrying three persons, necessary instruments, and provisions for four months; that it should be so impermeable that it can be kept afloat thirty days; that it be filled somewhere in the arctic region, and be to a certain extent steerable. The start should be made in July, as early as the weather would permit, on a clear day with a brisk south wind blowing, so that it may go north quickly. The central and most inaccessible part of the polar region should be aimed for. Besides geographical work, extensive meteorological observations should be carried on, all possible data collected, and the topographical outfit should not be forgotten.

M. Charles Dufour has found, from observations of the variations of refraction on the Lake of Geneva, that when the air is colder than the water the refracted ray is turned from the perpendicular, and that fine mirages like those of the desert are presented; while, when the water is colder than the air, the refraction is toward the perpendicular, and objects may be seen which are usually concealed by the roundness of the earth. Hence the horizon is usually depressed below the average in winter, and less so in summer. The author suggests that such variations may sometimes lead to errors in observations made at sea.

NOTES.

At a ferry across the Yarkand River, which was crossed by Captain H. Bower during a trip to Turkestan, no rafts are kept ready, but when wanted they are made by the villagers from inflated skins and poplar poles. This raft is tied by a rope to a horse's tail; the horse is then driven into the water and guided by a man strapped to an inflated skin who swims alongside. "How our things got safely over," says Captain Bower, "has been a puzzle to me ever since. The raft was of the craziest description, and swayed about in the current, threatening to capsize every minute. All our things got wet, but no disaster happened, and nothing was missing when an inspection of our baggage was made in the evening."

A satisfactory pavement has been made at Chino, Cal., with the refuse molasses of a sugar factory there. The molasses is mixed with sand to about the consistence of asphalt, and is laid on like an asphalt pavement. The composition dries quickly and becomes permanently hard, the heat of the sun only making it harder.

Having added to its collections during the past year specimens of the *eyra*, *yaguarundi*, the fishing cat of India, and the Bengalese cat, the Zoölogical Society of Philadelphia has now thirteen species of the cat family in its gardens.

Mr. James Constantine Pilling, bibliographer of the Bureau of American Ethnology, who died July 26th, made the study of the languages and literature of the North American Indians his life-work. Soon after becoming connected with the Geological and Geographical Surveys, under Major Powell, in 1875, he made himself very useful in collecting the vocabularies, myths, and legends of the tribes, and in the study and descriptions of their ceremonials. He retired from the survey in 1891, on account of failing health, and devoted himself to the study of the bibliography of American languages. He had published, at the time of his death, nine parts of his work on this subject, relating to as many languages or families of languages—a work which can not fail to be of great value to future students.

Prof. Charles V. Riley, late chief of the Bureau of Entomology, died in Washington, September 14th, from injuries received while riding a bicycle. He was born in London in 1843, studied in France and Germany, came to the United States in 1860, and settled on a farm. He was afterward engaged in editorial work; served in the army during the last year of the civil war; and was appointed State Entomologist of Missouri in 1868. In 1877 he was made chief of the United States Entomological Expedition sent to investigate the Rocky Mountain locust. Later he was placed in charge of the entomological division of the Bureau of Agriculture. He was a prolific writer, chiefly of entomological monographs. He received a gold medal from the French Government for his investigation of the phylloxera, and a medal from the International Forestry Exhibition at Edinburgh.

M. H. Baillon, the French botanist, who died July 19th, was the author of a Botanical Dictionary, and a History of Plants, which have become standard works in their own country. While he was not a member of the Academy of Sciences, he had been elected to the Royal Society.

One hundred and thirty-eight dollars have been contributed at Princeton University, through Prof. J. Mark Baldwin, toward the memorial to Prof. Helmholtz.

The death is announced of Dr. Hoppe Seyler, for many years a professor in the University of Tübingen, and, since 1852, Professor of Physiological and Pathological Chemistry in the University of Strasburg. He was born in 1825.

Prof. Louis Pasteur, the world-famous investigator of germ diseases and on those of the extended application of the system of inoculation as a remedy and preventive, died at his home near St. Cloud, France, September 28th. He had been in a low condition for some time as a result of the increasing paralysis with which he had been afflicted, but became suddenly worse on Friday evening, the 27th, and suffered much from frequent spasms until a few hours before his death, when he became unconscious. A biographical sketch of M. Pasteur was given, with a portrait, in The Popular Science Monthly for March, 1882 (vol. xx, p. 883).

DAVID DALE OWEN.

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PRINCIPLES OF TAXATION.

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I.—THE COMPARATIVELY RECENT TAX EXPERIENCES OF THE FEDERAL GOVERNMENT OF THE UNITED STATES.

BEFORE passing to the detailed consideration under proper and consecutive subdivisions of the above subject, the writer thinks it expedient to outline briefly the exceptional circumstances under which his studies and investigations have been prosecuted; inasmuch, as apart from any expectation of consequent intelligent criticism on his conclusions, a somewhat personal narration may help to a better popular understanding of a great chapter in the nation's fiscal experience, which, although without a parallel in all history, has thus far received scant notice and little appreciation on the part of economic writers and historians.

His first connection with economic and fiscal questions of public import was through the publication, at the darkest financial period of the war—1864—of the results of an inquiry into the resources and prospective debt-paying ability of the United States, and bearing the title of Our Burden and Our Strength. This essay, although first printed privately, was reprinted and circulated by the Loyal Publication Society of New York, and, receiving the approbation of the Government, became one of the current publications of the war period. Reprinted in different sections of the country by loyal citizens, and also in repeated instances in England, translated into French and German, it attained a very large circulation; in excess of two hundred thousand copies. Coming also at a period when the nation was beginning to be alarmed at the magnitude and prospective increase of its public debt, and apprehensive of an impending crushing burden of taxation, its publication and circulation was instrumental in restoring public confidence and maintaining the credit of the Government.

The attention of President Lincoln having been attracted to this publication, he invited the author in early February, 1865, to come to Washington and confer with him and Mr. Fessenden, then Secretary of the Treasury, on the best methods of dealing, after the termination of the war (then evidently near at hand), with the enormous debt and burden of taxation that the war had entailed upon the nation.* The result of this conference was, that an amendment was added, at the last hours of the Thirty-eighth Congress, to a bill "To provide Internal Revenue," and passed March 3, 1865, authorizing the Secretary of the Treasury "to appoint a commission of three persons to inquire and report at the earliest practical moment on the subject of raising by taxation such revenue as may be necessary to supply the wants of the Government, having regard to and including the sources from which such revenue should be drawn, and the best and most effectual mode of raising the same." The commission was further empowered "to inquire into the present and best methods of collecting the revenue," and to take testimony. Of this commission the writer was, unexpectedly to himself, appointed chairman by the then Secretary of the Treasury—Hon. Hugh McCulloch—after the assassination of the President, but in accordance with his previously indicated wishes.† It was also deemed expedient that, of the other members, one should be a representative of the agricultural interests of the West, and the third a citizen of Pennsylvania, the chairman being at the time a citizen of New York; and in accordance with this view Mr. S. S. Hayes, who had distinguished himself as Comptroller of Chicago, and Mr. Stephen Colwell, of Philadelphia, a gentleman of advanced age, and a successful manufacturer of iron, who had written some years before the

* Mr. Lincoln opened the conference by remarking that, although the war was evidently drawing to a close, he feared that great difficulties were yet to be encountered through the possible unwillingness or inability of the nation to pay the war debt, or the great increase in taxation which the war had made necessary; and followed this remark by asking if the writer had anything to suggest on the subject. The offhand answer returned was, that the best thing to be done was to have an examination made by competent persons of the resources of the country and the best methods of making them available for meeting the expenses of the Government through taxation. Turning to the Secretary of the Treasury, Mr. Lincoln remarked: "That's a pretty good idea, Fessenden, isn't it? We'll think about it"; and as the hour (evening) was becoming late, the conference substantially soon ended.

† The appointment was unsolicited and unexpected, and Mr. Fessenden some years afterward stated that when the composition of the commission was under consideration Mr. Lincoln remarked that "he thought we had better let the young man who had suggested the idea of it be at the head of it."

war an able book entitled Ways and Means of Payment, a Full Analysis of the Credit System, were selected. A word of retrospection is here essential to an understanding of the situation.

If it be an axiom in political and social as well as physical and natural science, that the first requisite for progress consists in the correct observation and recording of phenomena, whereby old laws or principles may be verified or extended and new ones discovered, it would be difficult to imagine a field more fruitful for investigation and more promising of reward than the financial and industrial experiences of the United States immediately anterior and subsequent to the outbreak of the civil war—experiences which had truly the character of vast social and political experiments, made on a scale of magnitude rarely if ever before equaled; for the most part emphatically tentative in character, and affecting in their results not only the growth, the income, and the industrial pursuits of the nation directly and immediately concerned, but also in a greater or less degree the trade and commerce of the whole world.

At the breaking out of the civil war in 1861, the United States was in the anomalous position of a great nation practically unencumbered with a national or public debt. Excise, stamp, income, license, and direct or general property taxes under the Federal Government were *absolutely* unknown; the expenses of a simple and economical administration being defrayed almost entirely by indirect taxes, levied in the form of a tariff on the importation of foreign products or merchandise. In fact, the only other noticeable source of national revenue was from the sale of public lands, which, at a maximum price fixed by law of one dollar and a quarter per acre, returned to the Treasury an average income of from one to three millions of dollars per annum; rising in a few instances, during periods of wild speculation to six, fourteen, and in one exceptional year (1836) to even twenty-four millions of dollars.

The average rate of duties imposed on the aggregate value of foreign importations during the thirty years immediately preceding 1860 was about twenty per cent; but for a portion of the time the annual rate was much less, and for a number of years—1834, to 1843 and 1858 to 1861 inclusive—it was not in excess of fifteen per cent.

But notwithstanding these limitations on the sources and amount of income, the requirements of the national Government for all purposes were so moderate that the receipts of its Treasury continually tended to exceed its disbursements; and the difficulty which most frequently presented itself to its financial administrators, was not the customary one in all other countries, of how to avoid an annual deficit, but rather how to manage to escape an inconvenient but inevitable surplus. And it is a curious fact, and one perhaps altogether unprecedented and almost unrecognized in history, that from the years 1837 to 1857 there was rarely a single fiscal year, in which the unexpended balance in the national Treasury—derived from a few sources—at the end of the year, was not in excess of one half of the total expenditure of the preceding year.*

To provide for the use, or rather to get rid of a continual surplus, various plans were from time to time suggested. In one instance the House of Representatives, on motion of Henry Clay (the leading statesman of his day), seriously considered the question of the expediency of the national Government becoming by purchase and investment a partner in various stock corporations or enterprises; and pending any conclusion the surplus funds were deposited in the local or small State banks, with reiterated injunctions *"to loan liberally to merchants."*

In 1836, the unexpended cash balance in the Treasury of the United States reported as available for public purposes, being $65,723,959—$46,001,467 of which was on deposit in ninety-one different State banks—Congress (by act of June 23d of that year) appropriated the sum of $37,468,859 for distribution among the States; of which $27,063,430 was officially certified in September, 1837, as having been actually paid. Most of the States applied the amount apportioned to them for educational purposes. Others used it differently and less wisely: Massachusetts, for example, dividing her share proportionally among her towns and cities, where it was expended at the discretion of the local authorities; in one instance, in a small fishing town, for the construction of walks on the sands for the benefit of pedestrians; and in others for the purchase of houses and lands for the use and settlement of the town's poor.

As might have been expected under such circumstances, fiscal and economic subjects were during the period under consideration, those that least of all attracted the attention of the American people. Few books or essays on such topics were either written or read, while the continually increasing agitation and interest respecting the existence or extension of negro slavery furnished

* During the decade from 1821 to 1831 the average ordinary annual expenditures of the United States were $12,390,000, or at the rate of $1.07 *per capita* of its whole population.

From 1831 to 1841, $24,740,000, or $1.61 *per capita.*

From 1841 to 1851, $33,760,000, or $1.63 *per capita.*

From 1851 to 1861, $57,870,000, or $2.06 *per capita.*

For the year 1894 the total expenditures of the Federal Government, as officially reported, were $442,605,758, or $6.08 *per capita* of the entire population of the country; or $4.50 less expenditure for pensions.

the never-ending and predominant theme for discussion alike to the press, the politicians, the pulpit, Congress, and the local legislatures. There had been, indeed, fierce discussions and political divisions in 1836–'38 respecting the organization and management of banks, and the establishment of a national bank; and in 1840–'41 and 1846, respecting the construction and adjustment of the tariff, and the principles of free trade and protection. But during the decade from 1850 to 1860 all of these questions were generally regarded as old-time issues, and by the generation that then had control of the business and government of the country were both substantially ignored and forgotten; and it was during the latter years of this period, or from 1851 to 1860, that the comparative growth and progress attained by every department of American trade, commerce, and industry was greater than for any corresponding period either before or since, in the history of the nation. During the same decade the increase in population of the country was returned at 35·59 per cent, its increase in wealth at 126·4 per cent, and the average of property to each individual at $510. In short, it would be difficult to find a more happy illustration of the influence of the "noninterference" or "nonobstructive" policy of a government with the trade, commerce, and industry of a highly civilized and active people, than the condition of the United States at that time afforded.

That the country, viewed from a politico-economic standpoint, was at this time in all respects what it should or might have been, is not, however, asserted. The institution of slavery, denying to over four millions of human beings the freedom of the person, the right to real property, and the blessings of education, was tolerated and supported by law. The paper and ordinary currency of the country, neglected by the General Government, and issued by local banks under almost as many different systems as there were States in the Union, was as defective as could be well imagined, and often necessitated a rate of exchange between the different sections of the country which was equal to or in excess of the current rates of interest at the principal commercial centers.

But notwithstanding these drawbacks the people in general were highly prosperous. Pauperism, apart from the large cities, was almost unknown; wealth was very equitably distributed; while the opportunities for elementary education were free, and in all the more densely populated portions of the country amply provided. In short, the prosperity of the people was so great, through the utilization of their natural resources, their activity, and the continued influx of the population and capital of other countries, that it constituted in itself an obstacle to reform; and the nation at large may be said to have actually preferred to endure the various economic and social evils incident to their situation rather than devote time to their consideration and meet the grave political issues consequent upon any change or reformation. What would have happened? what would have been the economic and social condition of the United States, had not the people of its southern section appealed to the arbitrament of the sword in the matter of slavery and consented to its peaceful abolition,* constitutes a most curious and interesting theme for speculation. Certainly it would have been something without precedent in the world's former experience.

It was with such antecedents and under such conditions, that the nation found itself in the early months of 1861 suddenly and unexpectedly involved in a gigantic civil war, in which its very existence was threatened by the uprising of at least a third of its population against the legitimate and regularly constituted Government. The most urgent and important requirement of the Federal Government at the outset was revenue. Men in excess of any immediate necessity volunteered for service in the army, but to equip and supply even such as were needed precipitated an avalanche of expenditure upon the Treasury. To meet these financial requirements there was on the part of the Government neither money, credit, nor any adequate system of raising revenue by taxation; the previous reliable supply of revenue from the customs having at the most critical period, through the diminution of imports consequent upon the political disturbances, become subject to a serious and ominous impairment; while the money returns from all sources, other than loans, for the year 1862 were only $2,867,057. For this latter year the total ordinary receipts of revenue of the Government were but $51,919,000, and its expenditures $456,379,000.

At the outset it was assumed that the war would be short, and that the expenditures of the Government could be met by the agency of loans and an issue of paper money, the detailed history of which, although not yet familiar to the American public, is not directly pertinent to the subject under consideration, and would require a separate essay for its presentation in any degree of fullness. All direct or internal taxation was accordingly for a time avoided; there having been apparently an apprehension on the part of Congress that inasmuch as the people had never been accustomed to it, and as all machinery for assessment and collection was wholly wanting, its adoption would create popular discontent, and thereby interfere with a vigorous prosecution of hostilities. Congress accordingly confined itself at first to the

* Subsequent events have made it clear that with the continuance of slavery the development of the nation must have been greatly retarded.

enactment of measures looking to an increase of revenue from the increase of *indirect* taxes upon imports, and it was not until four months after the actual outbreak of hostilities that a *direct* tax of twenty million dollars was apportioned among the States, and an income tax of three per cent on all incomes in excess of eight hundred dollars was authorized, the first being made to take effect practically *eight* and the second *ten* months after date of enactment. Such laws, of course, became operative in the loyal States only, and produced but comparatively little revenue; and although the sphere of taxation was soon extended, the aggregate receipts from all sources by the Government for the third year of the war—from excise, income, stamps, and all other internal and direct taxes—was less than forty million dollars, and that too at a time when the expenditures were in excess of sixty million dollars per month, or at the rate of more than seven hundred million dollars per annum. And as showing how novel was this whole system of direct and internal taxation to the people, and how completely the Government officials were lacking in all experience in respect to it, the following incident may be cited: The Secretary of the Treasury in his report for 1863 stated that with a view of determining his resources he had employed a very competent person, with the aid of practical men, to estimate the probable amount of revenue to be derived from each department of internal taxation for the current year. The estimate arrived at was eighty-five million dollars, but the actual receipts were less than forty million—$37,640,787.

The people of the loyal States were, however, more determined and earnest in respect to this matter of taxation and revenue than were their rulers, and everywhere the one opinion expressed was, that taxation in all its forms should immediately, and to the largest extent, be made effective and imperative. And Congress, spurred up by and rightfully relying on public sentiment to sustain its action, at last resolutely took up the matter, and devised, or rather drifted into, a system of internal taxation which for its universality and peculiarities has no parallel in anything which had theretofore been recorded in civil history, or is likely to be thereafter.

The great necessity of the situation was revenue, and to obtain it speedily and in large amounts through taxation was the only principle recognized (if it can be called a principle), and was akin to that recommended to the traditionary Irishman on his first visit to Donnybrook Fair: "Wherever you see a head, hit it!" Wherever you find an article, a product, a trade, a profession, a sale, or a source of income, tax it! And so an edict went forth to this effect, and the people cheerfully submitted. Incomes under five thousand dollars were taxed five per cent, with an exemption of five hundred dollars and house rent actually paid. Incomes in excess of five thousand dollars and not in excess of ten thousand dollars were taxed two and a half per cent in addition, and incomes over ten thousand dollars, five per cent additional, without any allowance or exemptions whatever. Nearly every industrial product was taxed. Cotton was taxed at the rate of two cents per pound; salt, six cents per hundred pounds; tobacco, from fifteen to thirty-five cents per pound; cigars, from three to forty dollars per thousand; sugar, from two to three cents and a half per pound. Distilled spirits were taxed progressively; first at twenty cents, and finally at two dollars per proof gallon.

But the most curious and complex taxes were those imposed on the various products of what may be termed ordinary manufacturing industry—a tax, by intent or construction, being first imposed on the raw material, and then on the total or increased value, according to circumstances, of each successive stage of its elaboration up to the finished product. And, as if this was not enough, every manufacturer was compelled to take out an annual license, while the goods produced, if sold by dealers or agents independent of the manufacturers, were subject to an additional tax of one tenth of one per cent, reckoned upon the amount of sales. This tax upon manufactures and products, with the exception of a few articles, was at first fixed, in 1864, at an average of *five* per cent; but in 1865 the rate was increased *twenty* per cent, making the tax for most articles *six* per cent.

Under the operation of this system the Government actually levied and collected on many articles of finished industrial products a tax of six per cent, the effect of which may be thus illustrated: Many manufacturing establishments sold products annually to three times the amount of their invested capital. If the capital invested was one hundred thousand dollars and the sales three hundred thousand, the tax on that business was eighteen thousand dollars, or eighteen per cent on the cost of the establishment.

The sales of its products by a manufacturing establishment are, however, no indication of its profits. It may make and sell to the amount of a million dollars without making a dollar of profit, but that, under the law, was no reason for the nonassessment and noncollection of a tax of sixty thousand dollars on the value of the product represented by its sales.

Again, the effect of the tax on every stage of elaboration of a manufactured product may be illustrated by a great variety of actual examples. Thus, in the case of the manufacture of umbrellas and parasols, it was shown that separate taxes were paid, first, on the sticks or supporting rods; then upon the handles, if carved or turned separately, of bone, wood, or ivory; then, in like manner, upon the brass runners, the tips, the ribs, the cloth composing the cover, the elastic band which fastened the cover when closed, the rubber of which the band was composed, the button to which it was attached; and finally upon the umbrella itself, when the separate parts were aggregated, and thereby converted into a finished product. And if any of the constituents of the umbrella—as the ivory, the silk, or the metal—were of foreign production, the same were subjected on coming into the country to an import duty in addition.

In the case of books and pamphlets, it was proved by the New York Publishers' Association that, including the license and income taxes, the finished book and its constituent materials paid from fifteen to twenty separate and distinct taxes before it came to the reader—the paper and its constituents, the cloth, the glue, the starch, the leather, the slaughtered animal whence the hide furnishing the leather was obtained, the dyes with which the cloth or leather was colored or stained, the thread, the gold leaf, the type metal, the type, and the printing machinery; and then, when the whole was combined, the finished book paid an additional tax of six per cent, which was levied not upon the cost of manufacture but upon the price at which the book was sold. In addition to all these taxes, the manufacturer or publisher paid for the privilege of doing business an annual license tax, and an income tax of from five to ten per cent on his profits, if he had any.

In short, it was as if a frontier line had been drawn about each individual article or product in the nation, across which nothing could pass without being submitted to an exaction.

Besides these taxes on manufactured products of the character specified, a tax of from three to six per cent was imposed on repairs when the value of the article repaired was increased by the reason of the repairs to the extent of ten per cent; and a further tax of six per cent on what was termed "increased values," or the additional value given to any article, which had either paid an import or internal tax, by being "polished, painted, varnished, waxed, gilded, oiled, electrotyped, galvanized, plated, framed, ground, pressed, colored, dyed, trimmed, or ornamented."

The examples of difficult and nice adjudication experienced in enforcing these two classes of taxes are so curious as to justify somewhat more than a passing notice. Thus, if a worker in tin or iron made a stove at one hour and in the next hour repaired a stove to the extent of more than ten per cent of its value, he paid on the product of his *first* hour's work a tax of six per cent, and on his *second* three per cent. In like manner, a blacksmith making a taxable article, and then repairing one exactly like it, was liable to the payment of the two classes of taxes; and the theory of the law, furthermore, was that both the tinsmith and the blacksmith kept a separate and distinct account of their different transactions. Again, if a worker in wood repaired a wheelbarrow worth one dollar, and by so doing added ten cents to its value, the increased value was taxable. But if, on the other hand, he repaired a carriage or pianoforte worth five hundred dollars, no tax accrued unless the value of the repairs exceeded ten per cent, or fifty dollars. The following absurd case was presented for adjudication under these statutes:

A wheelwright repaired a carriage to the extent of eight per cent. The owner then passed it successively to a blacksmith, a painter, and an upholsterer, neither of whom added repairs to the extent of ten per cent, or knew the value of previous repairs or the value of the carriage before it was repaired. The question then was, shall the repairs, however extensive, go untaxed, or shall the owner be taxed? The construction of the law was, that the tax must be assessed on the manufacturer, or persons receiving pay for the work, and that the owner could not be the manufacturer unless he furnished the materials, in whole or in part, for making the repairs; and then the further question arose, whether the subject of repair in the shape of the old carriage furnished by the owner was a material for making the repair, and thus constituted the owner a manufacturer, and as such liable to taxation.

In another case the question came up whether the publishers residing in one assessment district and having their books printed and bound by contract in another, were to be regarded as manufacturers of the books; or whether the printers and binders who executed the work were to be so regarded and taxed. And in two instances, in two contiguous districts in the State of Massachusetts, the law was interpreted in both ways, or in one way in one district and another way in another district; and the parties interested submitted rather than incur the trouble and expense of contesting the matter before the courts.

In fact, it is safe to say that no more complicated and absurd questions have ever seriously occupied the minds of educated men since the discussions of the schoolmen in the eleventh and twelfth centuries (as, for example, as to how many angels could stand at once on the point of a fine needle), than were evolved from the tax system of the United States during and for some time after the war period.

We have said that the people of the United States submitted to such a system. They did more. For such was the fervor of patriotism and the determination to push the war to a successful issue, that they rejoiced in it; and during the continuance of hostilities there was no movement or protest against the system which found any notable response among the masses. The country was rich, and its accumulated resources had not for two generations been subjected by either the national or state governments to extraordinary taxation. Wealth, moreover, was very uniformly distributed, and the people pointed with pride to the annually increasing receipts of revenue under the new system; which, starting with $41,000,000 of internal revenue in 1863, rose rapidly to $117,000,000 in 1864, $211,000,000 in 1865, and culminated in 1866 with the large sum of $310,000,000, making the total revenue for that year, drawn from all sources by so-called taxation, $559,000,000, the largest sum previously contributed in any one year for the support of any Government by the free consent of its people.

So long, moreover, as the war lasted, the attempts to evade taxation by illicit methods were exceptional and in amount inconsiderable. The demand for most manufactured and agricultural products, owing to the enormous consumption of the armies and the withdrawal of labor from its accustomed vocations by enlistments, was fully equal to or in excess of supply. Prices rose rapidly with every increasing taxation or additional issues of paper money,* and under such circumstances the fiscal requirements of the war were not regarded by the majority of producers as oppressive. But, on the contrary, counting the taxes as elements of cost and reckoning profit as a percentage of the whole cost, it was generally the case that the aggregate profits of the producer were actually enhanced by reason of the taxes, to an extent considerably greater than they would have been had no taxes whatever been collected. Indeed, it was not infrequently the case that the manufacturers themselves were the most strenuous advocates for continued and rapidly increasing taxation, with a view of realizing thereby, through an advance in prices, large additional profits on products, or constituents of products, previously assessed or imported at lower rates of (customs) duties, and to bring about such advances influence and money were used without scruple.

* Among the absurd theories put forth in justification of an extravagant issue of (irredeemable) paper money was a favorite one, that such a policy was a matter of necessity to make money easy, in order that the securities (bonds) representing Government loans should be easily floated; the one uppermost idea in the heads of the Government officials having been, apparently, that in the floating thus contrived, the bonds *alone* would possess the property of buoyancy. But in this they were mistaken. The bonds indeed floated, but everything else floated with them; or, to borrow the language of a writer of the period (who criticised this experience from the humorous point of view), "the bonds were floated, but by just about the same operation as that by which things are floated in the suburbs of a town or city submerged in a heavy freshet—hencoops floated, cellars floated, streets floated, barge houses and outhouses floated, stray children and first floors floated, all creation floated and floated together." The market for five-twenties was made easy, the market for flour, beef, cotton, and military stores, of which the Government was compelled to purchase immense quantities, was made particularly easy. The whole country was put under water and remained so for a considerable period after the war terminated.

Thus, in the case of distilled spirits, the taxation was advanced in successive years from twenty cents per gallon to sixty cents, next to a dollar and fifty cents, and finally to two dollars per gallon, and in each of these instances, and particularly after the imposition of the first two and lowest rates, the distillers and speculators reckoned, with a great degree of certainty, that a further large advance would be enacted, and that the new law would not be made retroactive or applicable to spirits distilled and assessed previously and at lower rates. In this they were not disappointed, for Congress, under the influences to which it was subjected, did virtually legislate in each instance in the manner expected, and thus gave occasion for the realization of profits in strict conformity with law by the holders of stocks made in anticipation of the several advances, which can not be estimated at a less aggregate than one hundred millions of dollars. Thus, the evidence before the United States Revenue Commission in 1865–'66 showed that there was on the 1st of January, 1864, a stock of tax-paid distilled spirits, made in anticipation of an increased tax, sufficient to meet all the requirements of the country for a period of six months, and on each gallon of this quantity, a profit or revenue, which did not accrue to the Government, of from sixty cents to a dollar and forty cents per gallon was realized. And yet, with this lesson of costly experience before it, the Fifty-third Congress, in advancing the tax on distilled spirits from ninety cents to a dollar and ten cents per gallon, afforded again such facilities to distillers and speculators, for anticipating such advance, as to legislate into their pockets at least ten millions of dollars.

In the case of cotton, which advanced mainly by reason of conditions affecting its production or distribution, it was shown by actual calculation, in respect to one manufacturing corporation in New England, that if they had at the commencement of the war burned their mills, lost their insurance, and sunk their capital other than was invested in cotton, and had subsequently sold their cotton at the highest price obtainable in place of manufacturing it, the result would have afforded to the stockholders an annuity of at least *twelve* per cent on their original investments.

How much the cost of the war and its expression in the form of debt, were unnecessarily increased by this state of affairs, has not until very recently been taken into account by writers on the fiscal history of this period, and probably can not be accurately estimated. But the following data throw great light on the subject: Thus, assuming the general average of prices in the loyal States of the Union before the war, or, more precisely, in 1860, at 100, the average from 1860 to 1865 was 186·71. But for the last year of the war, or in 1865, it was 216·81, and it was during this latter period of greatest increase in prices that the heaviest purchases were made by the Government on account of munitions and supplies. The increased cost of the war by reason of this increase in the price of commodities, which in turn may be in a great degree attributed to the use of irredeemable paper money invested with legal-tender quality, has been estimated * at over a thousand millions of dollars, and the interest on this increased cost, another equal sum. By so much, furthermore, as these supplies and other necessaries of life were increased in price through the depreciation of the currency, those who rendered personal service in the army and navy were deprived of what ought to have been the purchasing power of the payments made to them by the Government for such service.

NEW EVIDENCE OF GLACIAL MAN IN OHIO.

BY PROF. G. FREDERICK WRIGHT.

THE doubt which lingers in the minds of many concerning the sufficiency of the evidence for the existence of man in America during the Glacial period is so great, and has been so industriously fomented in certain quarters, that special interest has been manifested in a fresh discovery recently brought to light in Ohio. The discovery consists of a chipped chert implement, one inch and three quarters long and three quarters of an inch wide in its broadest part, with a projecting shoulder upon one edge, giving to it the character of what, in aboriginal usage, would be called a knife. The implement was found a mile and a half below Brilliant Station on the Ohio River, six miles from Steubenville, Ohio. In view of recent doubts upon the subject, it is necessary to give special attention to the evidence in three particulars: 1. The competence and character of the discoverer. 2. The facilities for noting the undisturbed condition of the gravel in which the implement lay. 3. The evidence that the gravel is of glacial age.

1. *The Competence and Character of the Discoverer.*—Mr. Sam Huston, the discoverer, is a graduate of the Scientific Department of Washington and Jefferson College, and has for twenty years or more been the county surveyor of Jefferson County, Ohio, residing at Steubenville. Having charge of the public improvements of the county, especially of the construction of the turnpikes, his familiarity with the topography, and especially with the gravel deposits along the river terraces, extensively resorted to for road-

* Edward Atkinson.

building and ballast for railroads, is as intimate as it is possible for any one's to be. But in connection with the engrossing occupa-

Fig. 1.—Talus removed, so as to show the Original Condition of the Pit a Few Feet back from the Place where the Implement was found, which is marked by a *.

tions of his public business, Mr. Huston has maintained his love for pure science, and his valuable aid has been solicited by numerous scientific men engaged in making paleontological collections. It was Mr. Huston who discovered for Prof. Samuel H. Scudder the fossil insects of the coal measures which attracted so much attention two or three years ago. Prof. Cope has likewise been greatly indebted to Mr. Huston for fossils collected by him in the neighborhood of Steubenville. The evidence, therefore, is not that of either an unknown or an inexperienced observer.

2. *The Discovery.*—This I will give in Mr. Huston's own language, written out for me at my request.

"Prof. G. F. Wright. "Steubenville, Ohio, *August 13, 1895.*

"My Dear Sir: Below Brilliant, Jefferson County, Ohio, is a very fine remnant of high-level river terrace. Its length is two miles and maximum width over a quarter of a mile. On the West Virginia side of the Ohio River at that point the bluffs rise to a height of over three hundred feet, directly from the water at ordinary level. On the Ohio side there is a flood-plain from fifty to one hundred yards wide and from twenty to thirty feet above low water. Along the west side of this flood-plain is located the river division of the Cleveland and Pittsburg Railroad, along the foot of the high-level terrace. This terrace ranges from sixty-five to eighty feet above low water. Excavations in this terrace to a depth of forty-three feet show it to consist of interstratified sand, fine gravel, and clay in small quantities, all with rare exceptions cross-bedded. Coarse gravel is found at the top of the terrace; but, except for two or three feet on top, only rare pieces of gravel occur of more than one half cubic inch in size. Two small ravines cut through the terrace at Brilliant. A mile below these, Block House Run, and a mile and a half below, Riddle's Run cut through the terrace down to the flood-plain of the river. Otherwise the surface of the terrace is a plain. A half mile of turnpike was built on it, in which the original surface varied less than two feet.

Fig. 2.—General View of the Abandoned Gravel Pit.

Indian mounds and intrusive burials occur at numerous places on the terrace, but the stratification and cross-bedding of the sands and gravels of it are such that intrusive burials or excavations can not be made without leaving evidence so distinct as to be readily seen, and at the face of an excavation a slip or talus is easily detected.

"Over three years ago a sandpit was worked in this terrace at its southern extremity, below Riddle's Run. While the excavation was being made, and at a noon hour, I found a plainly marked but rude flint implement imbedded in the freshly exposed face of the stratified sand and gravel, under about eight feet of undisturbed cross-bedded stratification, only the point of the implement showing on the perpendicular face of the excavation. The condition of the stratification in all of the superincumbent eight feet, which was closely examined by me, was such as to convince me that the implement was not intrusive, but had been deposited with the remainder of the material of the terrace. The condition of the face of the excavation above the find is fairly, but not as clearly as would be desired, shown by the photograph taken by Mr. Doyle of the now abandoned sandpit where the find was made, where slips and talus cover the face.

"Sam Huston."

3. *Glacial Age of the Gravel.*—In company with Mr. Huston, Mr. Joseph B. Doyle, and Mr. Frederick C. MacClave (to whom I am indebted for the photographs and many other favors) I visited the abandoned pit where the implement was found, and studied carefully the situation, and can add my testimony to the correctness of the above description so far as it goes. But a general discussion of the questions relating to these gravel terraces is essential for the information of the general reader.

As shown in the accompanying illustration, the Ohio River occupies a narrow valley which might almost be called a gorge, which it has eroded in the nearly parallel strata of the coal measures to an average depth of about three hundred feet. This gorge is continuous from Louisville, in Kentucky, to the headwaters of the Alleghany and Monongahela Rivers, a distance of more than twelve hundred miles. All the tributaries of the river occupy gorges of similar depth. This erosion has evidently taken place with considerable rapidity consequent upon an elevation of the continent at the close of the Tertiary period, giving a steep gradient to streams which, during the most of the Tertiary period, had been very sluggish. The evidence of this is seen in the narrowness of the gorge and in the gentleness of the slope above the three-hundred-foot line.

Along the three-hundred-foot level there is a line of rock shelves which contain a shallow deposit of loam and pebbles. This is very conspicuous on the Alleghany River and for some distance below Pittsburg, but rather less so as far down as Steubenville. Still, those high-level deposits are clearly marked there on both sides of the river. The most significant thing about these high-level terrace deposits is that they contain granitic pebbles, which are a sure indication that the deposit is postglacial; for none of the tributaries of the Ohio River have access to granite rock, except as fragments have been brought over from Canada by the glacial movement and deposited within their reach.

A sharp discussion concerning the age of the gravel upon these high rock shelves is in progress. On the one hand, Prof. T. C. Chamberlin contends that there have been two glacial periods; that the first period came on before the elevation of land which led to the erosion of the rock gorge, and that therefore this erosion is wholly interglacial, and is evidence of the lapse of an extremely long time between the two periods. On the contrary, I have maintained that the evidence of two distinct glacial periods was insufficient, and have regarded the erosion of this

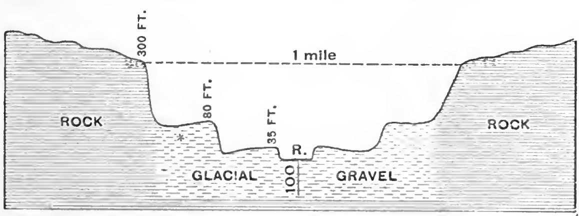

FIG. 3.—SECTION OF THE TROUGH OF THE OHIO AT BRILLIANT. Location of the implement shown by a *.

inner rock gorge as preglacial—that is, as having been effected during the progress of that long period of late Tertiary elevation which culminated in the Glacial period. On this view of the case, the deposits of glacial gravel upon the three-hundred-foot rock shelf have been produced partly by an extensive filling up of the Alleghany gorge as far as Pittsburg and somewhat below, and lower down by the effect of the Cincinnati ice-dam, which set back the water up to this level, and is sufficient to account for many of the facts. Under this view these high-level deposits would coincide approximately with what Dana calls the "Champlain epoch," during which there was considerable depression of land at the north, the influence of which may have been felt as far south as the latitude of Pittsburg.

But whatever may be the difference of opinion about the age of these high-level gravels, there is no disagreement about the glacial character and relatively late age of the lower terraces along the Ohio River such as occur at Steubenville and Brilliant. The rock gorge extends on the average a hundred feet below the present bottom of the river, having been filled up originally by gravel not only to that extent, but to the level of the terrace in which the implement was found. That this extensive deposition of gravel in the old rock gorge is connected with the Glacial period is clearly shown by the fact that these lower terraces can be followed up the banks of every stream which comes out of the glaciated region to the old ice border, where they emerge into the moraines which were deposited directly by the ice. This is shown in our map, on which a small portion of the glaciated area appears with Big Beaver and Little Beaver Creeks flowing out from it. The gravel terraces at Brilliant and Steubenville are shown

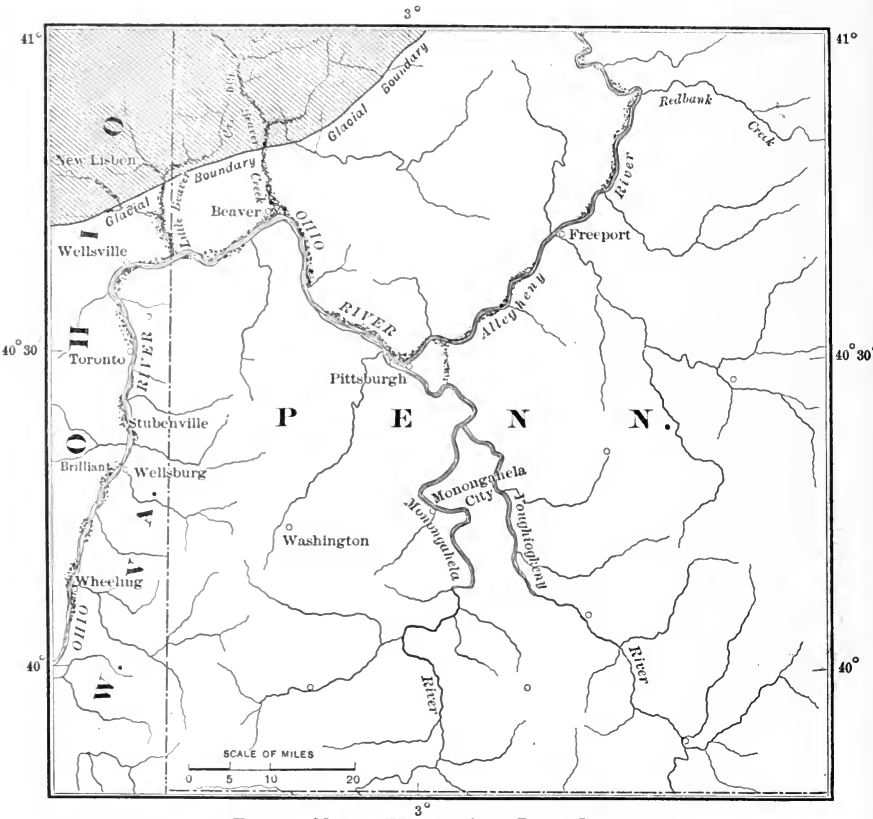

FIG. 4.—MAP OF MIDDLE OHIO RIVER REGION.
Glaciated area, shaded. Terraces shown by dots.

on this, together with other remnants of this terrace farther up the river.

Only those streams which rise in the glaciated area have such terraces. The contrast between the Monongahela and the Alleghany in this respect is very marked. The Alleghany River throughout its course was gorged with this glacial gravel, but the Monongahela River neither had the gravel within reach nor the floods of water coming from the melting ice to distribute it if it had been within reach, therefore the gravel terraces are absent.

The northern tributaries of the Ohio had both these advantages (or disadvantages), and therefore they have the terraces. On the Ohio these are always larger and higher where a tributary comes in from the glaciated region to the north, as, for example, at the mouth of Big Beaver Creek, where the terrace is a hundred and thirty feet above low-water mark. But down the river the supply of gravel diminished, and the terrace becomes correspondingly lower, being at Steubenville and Brilliant only seventy or eighty feet above low water.

I have personally examined every stream emerging from the glaciated area from the Atlantic Ocean to the Mississippi River, and can testify that everywhere substantially the same system of gravel terraces marks them as that which characterizes the Ohio and its tributaries. Without doubt they were formed during the closing stage of the period, when both great torrents of water and vast deposits of glacial *débris* were periodically released by the melting ice sheet.

So far as direct evidence is concerned in estimating the age of implements in these terraces, it relates to the question whether or not they have been found in undisturbed strata of the original terrace. If they are so found they are as old as the deposition of the gravel which took place in glacial times; for since that period of deposition the action of the present river has been confined to eroding an inner channel, such as is shown in Fig. 3, and to working over the gravel within the limits of its own flood-plain. No disturbances by present floods could affect the gravel of the eighty-foot terrace. That has remained constant from the time of its original deposition.

The direct evidence, therefore, regarding this implement would seem to be as clear and positive as it is possible to be. Relying upon the strength of this, I took the implement to the meeting of the American Association for the Advancement of Science at Springfield, Mass., in August last with great confidence. Nor was this misplaced. On being submitted, at a joint meeting of the Geological and Anthropological Sections, to Prof. F. W. Putnam, Mr. F. H. Cushing, Miss Alice Fletcher, and others, the corroborative indications of its antiquity were readily and emphatically recognized.

Prof. Putnam remarked upon the distinctness with which it retained the patina indicative of the conditions in which it is said to have been found, and said without hesitation that the implement in itself bore evidence of being a relic of great antiquity.

Mr. Cushing remarked that there could be no question that it was a finished implement, and not a "reject"; and that not only had it been finished by careful chipping all along the edge, but it had been finished twice, having been at least once resharpened upon its cutting edge; and, what is of special significance, that it had been sharpened not by the more modern processes, described by the speaker in a previous paper, in which the chips were broken from the edge by pressing against it with a piece of bone, but by the older process of striking against the edge with another stone. The type of the implement also was pronounced by Mr. Cushing to be the earliest known, although from the convenience of the form it has always continued in use. It was one, however, which appeared at the very dawn of human development.

Thus the circumstantial evidence connected with the implement itself confirms in a remarkable degree the direct evidence respecting it. And it deserves to be placed, as it doubtless will

Fig. 5.—Face View of the Implement.

Fig. 6.—Face View.

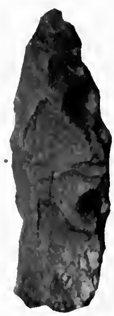

Fig. 7.—Diagonal View of Sharpened Edge.

be, among the most important discoveries heretofore made connecting man with the Glacial period.

In closing, I can not refrain from a few remarks concerning the conditions of life at that period, especially since the prolonged visits which I have made to the retreating ice front in Alaska and in Greenland have rendered it so much easier for me to believe in glacial man than it would have been without those experiences. The neighborhood of the ice border during the Glacial period was probably not an uncomfortable place in which to live. Even in Greenland, where there is no timber, the Eskimos manage to live in a great degree of comfort, and that too with no implements but those of stone and bone which they have made with their own hands. The importation of firearms and of iron implements has been of doubtful advantage to the Eskimos. From all accounts, they flourished better before their contact with Europeans than they have since.

Substantially the same may be said of the tribes in Alaska. There the conditions are in one respect even more closely similar to those which existed on the Delaware and Ohio Rivers where the remains of glacial man have been found in America. Like southeastern Alaska, the Delaware and Ohio Valleys were densely covered with forests. Of this we have abundant evidence in the numerous trunks of trees which were overwhelmed by the advancing ice and buried in its *débris* all along the margin of the glaciated area in Ohio. It was, therefore, easily within the reach of men as intelligent as the Eskimos to maintain a comfortable existence in the valley of the Ohio when the continental glacier had expanded to its farthest extent. He did not need to resort to caverns for shelter, since the forests furnished him with the readiest means for protection.

When we reflect, also, upon the completeness with which the habitations of the modern Indian have disappeared, we need not be surprised at the total disappearance of the habitations of glacial men. Nor is it strange that well-accredited discoveries of his implements have so rarely been made in the undisturbed gravel which gives us the surest evidence of his great antiquity. Naturally, the cautious inhabitant of that time would have been somewhat careful about venturing down into the river valleys, whose terrific and periodical floods were depositing the terrace gravel, and, even though the imbedded implements were much more numerous than they are, they would be relatively so few in proportion to the great mass of material that the chances of finding one in place would be extremely small. I have looked in vain for implements in the extensive gravel pits on the Chelles and the Somme in France, and so have the majority of archæologists who have visited those famous localities. M. Reinach, the Curator of the Museum de Saint-Germain-en-Laye, has well said that one can hope personally to make discoveries of implements in place, as he would like to do, only by transforming himself into a hermit and settling down for a series of years to observe the face of the terraces where public excavations are in progress.

Meanwhile the chance discoveries by competent observers who are on the ground should be accorded their full value. Such discoveries in this country, made by Dr. C. L. Metz at Madisonville, W. C. Mills at Newcomerstown, Mr. Huston at Brilliant—all of which are well attested in Ohio—and by Dr. C. C. Abbott and Profs. Putnam, Carr, and Whitney in the glacial terrace at Trenton, N. J., form a cumulative mass of evidence which can not well be resisted. So considered, the clear testimony of the ancient chipped knife discovered by Mr. Huston at Brilliant, Ohio, must go far to close the question of man's antiquity on the western continent, and to dispel the doubts upon the subject which, for one reason or another, have heretofore existed.

STUDIES OF CHILDHOOD.

XIII.—UNDER LAW.

By JAMES SULLY, M. A., LL. D.,
GROTE PROFESSOR OF THE PHILOSOPHY OF MIND AND LOGIC AT THE UNIVERSITY COLLEGE, LONDON.

(*b*) ON THE SIDE OF LAW.

IN the previous chapters we studied the child as the antagonist of law. It is evident, however, that his relation to law presents another aspect. Thus a good deal of the early criticism of parental government, so far from implying rejection of all rule, plainly implies its acceptance. Some of the earliest and bitterest protests against interference are directed against what looks to the child exceptional or irregular. He is allowed, for example, for some time to use a pair of scissors as a plaything, and is then suddenly deprived of it, his mother having now first discovered the unsuitability of the plaything. In such a case the passionate outburst, the long, bitter protest, attest the sense of injustice, the violation of custom and unwritten law. Again, the keen, resentful opposition of the child to the look of anything like unfairness and partiality in parental government shows that he has a jealous feeling of regard for the universality and the inviolateness of law. Much, too, of the criticism dealt with above reveals a fundamental acknowledgment of law—at least for the purposes of the argument. Thus the very attempt to establish an excuse, a justification, may be said to be a tacit admission that if the action *had been* done as alleged it would have been naughty and deserving of punishment. In truth, the small person's challengings of the *modus operandi* of his mother's rule just because they are often in a true sense *ethical*, clearly start from the assumption of rules, and of the distinction of right and wrong.

This of itself shows that there are compliant as well as non-compliant tendencies in the child toward law and toward authority so far as this is lawful. We may now pass to other parts of a child's behavior which help to make more clear the existence of such law-abiding impulses.

And here we may set out with those reactions of something like remorse which often follow disobedience and punishment in the first tender years. These may at the outset be little more than physical reactions due to the exhaustion of the passionate outburst. But they soon begin to show traces of other feelings. A child in disgrace, before he has a clear moral feeling of shame, suffers through a sense of estrangement, of loneliness, of self-restriction. If the habitual relation between mother and child is a loving and happy one, the situation becomes exceedingly painful. The pride and obstinacy notwithstanding, the culprit feels that he is cut off from more than one half of his life, that his beautiful world is laid in ruins. The same little boy who said, "I'd be a worser mother," when four years and nine months old remarked to his mother that if he could say what he liked to God 'twould be, "Love me when I'm naughty." I think one can hardly conceive of a more eloquent testimony to the suffering of the child in the lonesome, loveless state of punishment.

Is there any analogue of our sense of remorse in this early suffering? The question of an instinctive moral sense in children is a perplexing one, and I do not propose to discuss it now. I would only venture to suggest that in these poignant griefs of child-life there seem to be signs of a consciousness of violated instincts. This is, no doubt, in part the smarting of a loving heart on remembering its unloving action. But there may be more than this. A child of four or five is, I conceive, quite capable of reflecting at such a time that in his fit of naughtiness he has broken with his normal orderly self, that he has set at defiance that which he customarily honors and obeys.

What, it may be asked, are these instincts? In their earliest discernible form they seem to me to be respect for rule, for a regular manner of proceeding as opposed to an irregular. A child, so I understand the little sphinx, is at once the subject of ever-changing caprices—whence the delight in playful defiance of all rule and order—and the reverer of custom, precedent, rule. And, as I conceive, this reverence for precedent and rule is the deeper and stronger, holding full sway in his serious moments.

If this view is correct, the suffering of naughty children is not, as has been said by some, wholly the result of the externals of discipline, punishment, and the loss of the agreeable things which follow good behavior, though this is commonly an element; nor is it merely the sense of loneliness and lovelessness though that is probably a large slice of it; but it contains the germ of something nearer a true remorse, viz., a sense of normal feelings and dispositions set at naught and contradicted.

And now we may ask what evidence there is for the existence of this respect for order and regularity other than that afforded by the childish protests against apparent inconsistencies in the administration of discipline.

Mr. Walter Bagehot tells us that the great initial difficulty in the formation of communities was the fixing of custom. However this be in the case of primitive communities, it seems to me indisputable that in the case of a child brought up in normal surroundings there is a clearly observable instinct to fall in with a common mode of behavior.

This respect for custom is related to the imitative instincts of the child. He does what he sees others do, and so tends to fall in with their manner of life. We all know that these small people take their cue from their elders as to what is allowable. Hence, one difficulty of moral training. A little boy when two years and one month old had happened to see his mother tear a piece of calico. The next day he was discovered to have taken the sheet from the bed and made a rent in it. When scolded, he replied in his childish German, "*Mamma mach 'put*"—i. e., *macht caput* (breaks the calico). It is well when the misleading effect of "example" is so little serious as it was in this case.

In addition to this effect of others' doings in making things allowable in the child's eyes, there is the binding influence of a repeated regular manner of proceeding. This is the might of "custom" in the full sense of the term, the force which underlies all a child's conceptions of "right." In spite of the difficulties of moral training, of drilling children into orderly habits—and I do not lose sight of these—it may confidently be said that a child has an inbred respect for what is customary and has the appearance of a rule of life. Nor is this, I believe, altogether a reflection, by imitation, of others' orderly ways and of the system of rules which are imposed on him by others. I am quite ready to admit that the institution of social life, the regular procession of the daily doings of the house, aided by the system of parental discipline, has much to do with fixing the idea of orderliness or regularity in the child's mind. Yet I believe the facts point to something more, to an innate disposition to follow precedent and rule which precedes education, and is one of the forces to which education can appeal. This disposition has its roots in habit, which is apparently a law of all life; but it is more than the blind impulse of habit, since it is reflective and rational and implies a recognition of the universal.

The first crude manifestations of this disposition to make rules to rationalize life by subjecting it to a general method, is seen in those actions which seem little more than the working of habit, the insistence on the customary lines of procedure at meals and such like. A mother writes that her boy, when five years old, was quite a stickler for punctilious order in these matters. His cup and spoon had to be put in precisely the right place; the sequences of the day, as the lesson before the walk, the walk before bed, had to be rigorously observed. Any breach of the customary was apt to be resented as a sort of impiety. This may be an extreme instance, but my observation leads me to say that such punctiliousness is not uncommon. What is more, I have seen it developing itself where the system of parental government was by no means characterized by severe insistence on such minutiæ of order. And this would seem to show that it can not wholly be set down to the influence of such government. It seems rather to be a spontaneous extension of the realm of rule or law.

This impulse to extend rule appears more plainly in many of the little ceremonial observances of the child. Very charmingly is this respect for rule exhibited in relation to his animals, dolls, and other pets. Not only are they required to do things in a proper orderly manner, but people have to treat them with due deference.

"Every night," writes a mother of her boy, aged two years and seven months, "after I have kissed and shaken hands with him, I have to kiss his 'boy,' that is his doll, who sleeps with him, and to shake its two hands; also to shake the four hoofs of a tiny horse which lies at the foot of his cot. When all this has been gone through he stands up and entreats 'more tata please, more tata'—i. e., 'kiss me again and say more good nights.' These customs of his with regard to kissing are peculiar to himself: he kisses his 'boy' (doll), also pictures of horses, dogs, cocks, and hens, and he puts his head against us *to be kissed;* but he will only shake hands and will not kiss people himself; he reserves his kisses for what he seems to feel inferior things. We kiss our boy, he kisses his; but he insists upon being shaken hands with for his part. If other children come to play, he gives them toys, watches them with delight, tries to give them rides on his 'go-go's,' but does not kiss them; though he will stroke their hair, he does not return their kisses. It seems to me that he regards it as an action to be reserved for an inferior thing."

I have quoted at length this careful bit of maternal observation because it seems to indicate so clearly a spontaneous extension of a custom. The practice of the mother and father in kissing him was generalized into a rule of ceremony in the treatment of all inferiors.

This subject of childish ceremonial is a curious one and deserves a more careful study. It is hardly less interesting than the origin and survival of ceremonial as elucidated by Mr. Herbert Spencer and others. The respect for orderly procedure on all serious occasions, and especially at church, is as exacting as that of any savage tribe. Punch illustrated this some years ago by a picture of a little girl asking her mamma if Mr. So-and-so was not a very wicked man because he didn't "smell his hat" when he came into his pew.

This jealous regard for ceremony and the proprieties of behavior is seen in the enforcement of rules of politeness by children, who will extend them far beyong the scope intended by the parent. A delightful instance of this fell under my own observation as I was walking on Hampstead Heath. It was a spring day and the fat buds of the chestnut were bursting into magnificent green plumes. Two well-dressed "misses," aged, I should say, about nine and eleven, were taking their correct morning walk. The elder called the attention of the younger to one of the trees, pointing to it. The younger exclaimed in a highly shocked tone, "O Maud (or was it 'Mabel'?), you know you *shouldn't* point!" The notion of perpetrating a rudeness on the chestnut tree was funny enough. But the incident is instructive as illustrating the childish tendency to stretch and generalize rules to the utmost.

The domain of prayer well illustrates the same tendency. The child envisages God as a very, very grand person, and naturally therefore extends to him all the courtesies he knows of. Thus he must be addressed politely with the due forms, "Please," "If you please," and so forth. The German child shrinks from using the familiar form "*Du*" in his prayers. As one maiden of seven well put it in reply to a question why she used "*Sie*" in her prayers: "*Ich werde doch den lieben Gott nicht Du nennen: ich kenne ihn ja gar nicht.*" Again, a child feels that he must not worry or bore God (children generally find out that some people look on them as bores), or treat him with any kind of disrespect. C—— objected to his sister's remaining so long at her prayers, apparently on the ground that, as God knew what she had to say, her much talking would be likely to bore him. An American boy of four on one occasion refused to say his prayers, explaining: "Why, they're old. God has heard them so many times that they are old to him too. Why, he knows them as well as I do myself." On the other hand, God must not be kept waiting. "O mamma," said a little boy of three years and eight months (the same that was so insistent about the kissing and hand-shaking), "how long you have kept me awake for you! God has been wondering so whenever I was going to say my prayers." All the words must be nicely said to him. A little boy aged four years and nine months once stopped in the middle of a prayer and asked his mother, "Oh, how do you spell that word?" The question is curious as suggesting that the child may have envisaged his silent communications to the far-off King as a letter. In any case it showed painstaking and the wish not to offend by slovenliness of address.

Not only do children of themselves extend the scope and empire of rule; they show a disposition to make rules for themselves. If a child that is told to do a thing on a single occasion only is found repeating the action on other occasions, this seems to show the germ of a law-making impulse. A little boy of two years and one month was once told to give a lot of old toys to the children of the gardener. Some time after, on receiving some new toys, he put away his old ones as before for the less fortunate children. Every careful observer of children knows that they are apt to proceed this way, to erect particular actions and suggestions into precedents. This tendency gives something of the amusing priggishness to the ways of childhood.

There is little doubt, I think, that this respect for proper orderly behavior, for precedent and general rule, forms a vital element in the child's submission to parental law. In fixing our attention on occasional acts of disobedience and lawlessness we are apt to overlook the ease, the absence of friction with which normal children, if only decently trained, fall in with the larger part of our observances and ordinances.

That the instinct for order does assist moral discipline may be seen in the fact that children are apt to pay enormous deference to our rules. Nothing is more suggestive here than the talk of children among themselves, the emphasis they are wont to lay on the "must" and "must not." The truth is that children have a tremendous belief in law: a rule is apt to present itself to their imagination as a thing supremely sacred and awful before which it prostrates itself.

This recognition of the absolute imperativeness of a rule properly laid down by the recognized authority is seen in children's jealous insistence on the observance of the rule in their own case and in that of others. As has been observed by Preyer, a child of two years and eight months will follow out the prohibitions of the mother when he falls into other hands, sternly protesting, for example, against the nurse giving him the forbidden knife at table. Very proper children rather like to instruct their aunts and other ignorant persons as to the right way of dealing with them, and will rejoice in the opportunity of setting them right even when it means a deprivation for themselves. The self-denying ordinance, "Mamma doesn't let me have many sweets," is by no means beyond the powers of such a child. One can see here, no doubt, traces of a childish sense of self-importance, a feeling of the much-waited-on little sovereign for what befits his supreme worth. Yet, allowing for such elements, there seems to me to be in this behavior a residue of genuine respect for parental law.

These carryings out of the parental behest when intrusted to other hands are instructive as suggesting that the child feels the constraining force of the command when its author is no longer present to enforce it. Perhaps a clearer evidence of respect for the law as such, apart from its particular enforcement by the parent, is supplied by children's way of extending the rules laid down for their own behavior to that of others. This point has already been illustrated in the tendency to universalize the observances of courtesy and the like. No trait is better marked in the normal child than the impulse to subject others to his own disciplinary system. In truth, children are for the most part particularly alert disciplinarians. With what amusing severity are they wont to lay down the law to their dolls, and their animal playmates, subjecting them to precisely the same prohibitions and punishments as those to which they themselves are subject! Nor do they stop here. They enforce the duties just as courageously on their human elders. A mite of eighteen months went up to her elder sister who was crying, and with perfect mimicry of the nurse's corrective manner said, "Hush, hush! papa!" pointing at the same time to the door. The little girl M——, when twenty-two months old, was disappointed because a certain Mr. G—— did not call. In the evening she said, "Mr. D—— not did tum—was very naughty. Mr. D—— have to be whipped." So natural and inevitable to the intelligence of a child does it seem that the system of restraints, rebukes, punishments under which he lives should have universal validity.

This judicial bent of the child is a curious one, and often develops a priggish fondness for setting others morally straight. Small boys have to endure much in this way from the hands of slightly older sisters proficient in matters of law and delighting to enforce the moralities. But sometimes the sisters lapse into naughtiness and then the small boys have their chance. They too can on such occasions be priggish if not downright hypocritical. A little boy had been quarreling with his sister, named Muriel, just before going to bed. When he was undressed he knelt down to say his prayers, Muriel sitting near and listening. He prayed (audibly) in this wise: "Please, God, make Muriel a good girl," then looked up and said in an angry voice, "Do you hear that, Muriel?" and after this digression resumed his petition. I believe fathers, on reading family prayers, have been known to apply portions of Scripture in this personal manner to particular members of the family; and it is even possible that extempore prayers have been invented, as by this little prig of a boy, for the purpose of administering a sort of back-handed moral blow to an erring neighbor.

This mania for correction shows itself too in relation to the authorities themselves. A collection of rebukes and expositions of moral precept supplied by children to their erring parents would be amusing and suggestive. As was illustrated above, a child is especially keen to spy fault in his governors when they are themselves administering authority. Here is another example: A boy of two—the moral instruction of parents by the child begins betimes—would not go to sleep when bidden to do so by his father and mother. At length the father, losing patience, addressed him with a man's fierce emphasis. This mode of admonition, so far from cowing the child, simply offended his sense of propriety, for he rejoined, "You souldn't souldn't Assum" (i.e., "Arthur," the father's name), "you sould speak nicely."

The lengths to which a child with the impulse of moral correction strong in him will sometimes go are quite appalling. One evening a little girl of six had been repeating the Lord's prayer. When she had finished she looked up and said, "I don't like that prayer, you ought not to ask for *bread,* and all that *greediness,* you ought only to ask for goodness!" There is probably in this an imitative reproduction of something the child had had said to herself by her mother or had overheard. Yet allowing for this, one can not but recognize a quite alarming degree of precocious moral priggishness.

We may now turn to what my readers will probably regard as still clearer evidence of a law-fearing instinct in children, viz., their voluntary submission to its commands. We are apt to think of these little ones as doing right only under external compulsion. But although a child of four may be far from attaining to the state of "autonomy of will," or self-legislation spoken of by the philosopher, he may show a germ of such free adoption of law. It is possible that we see the first faint traces of this in a small child's way of giving orders to, rebuking, and praising himself. The little girl M——, when twenty months old, would, when left by her mother alone in a room, say to herself, "Tay dar" (stay there). About the same time, after being naughty and squealing "like a railway whistle," she would after each squeal say in a deep voice, "Be dood, Babba" (her name). At the age of twenty-two months she had been in the garden and misbehaving by treading on the box border, so that she had to be carried away by her mother. She had to confess her fault, wanted to go into the garden again, and promised, "Baba will not be naughty adain." When she was out she looked at the box, saying, "If oo (you) do dat I shall have to take oo in, Babba." Here, no doubt, we see quaint mimicries of the external control; but they seem to me to indicate a movement in the direction of self-control.

Very instructive here is the way in which children will voluntarily come and submit themselves to our discipline. The little girl M——, when less than two years old, would go to her mother, confess some piece of naughtiness, and suggest the punishment. A little boy, aged two years and four months, was deprived of a pencil from Thursday to Sunday for scribbling on the wall paper. His punishment was, however, tempered by permission to draw when taken downstairs. On Saturday he had finished a picture downstairs which pleased him. When his nurse fetched him, she wanted to look at the drawing, but the boy strongly objected, saying, "No Nana (name for nurse) look at it till Sunday." And sure enough, when Sunday came and the pencil was restored to him, he promptly showed nurse his picture. This is an excellent observation full of suggestion as to the way in which a child's mind works. Among other things it seems to show pretty plainly that the little fellow looked on the nursery and all its belongings, including the nurse, during these three days as a place of disgrace, into which the privileges of the artist were not to enter. He was allowed the indulgence of drawing downstairs, but he had no right to exhibit his workmanship to the nurse, who was inseparably associated in his mind with the forbidden nursery drawing. Thus a process of genuine child-thought led to a self-instituted extension of the punishment.

A month later this child "pulled down a picture in the nursery"—the nursery walls seem to have had a fell attraction for him—by standing on a sofa and tugging till the wire broke. He was alone at the time and very much frightened, though not hurt. He was soothed and told to leave the picture alone in future, but was not in any way rebuked. He seemed, however, to think that some punishment was necessary, for he presently asked whether he was going to have a certain favorite frock on that afternoon. He was told "No" (the reason being that the day was wet or something similar), and he said immediately, "'Cause Neil pulled picture down?" Here, I think, we have unmistakable evidence of an expectation of punishment as the fit and proper sequel in a case which, although it did not exactly resemble those already branded by punishment, was felt in a vague way to be disorderly and naughty.

Such stories of expectation of punishment are capped by instances of punishment actually inflicted by the child on himself. I believe it is not uncommon for a child, when possessed by a sense of having been naughty, to object to having nice things at table, on the ground that previously on a like occasion he was deprived of them. But the most curious instance of this moral rigor toward self which I have met with is the following: A girl of nine had been naughty, and was very sorry for her misbehavior. She was noticed coming to her lesson limping, and remarked that she felt very uncomfortable. Being asked by her governess what was the matter with her, she said, "It was very naughty of me to disobey you, so I put my right shoe on to my left foot and my left shoe on to my right foot."

The facts here briefly illustrated seem to me to show that there is in the child from the first a rudiment of true law-abidingness. And this is a force of the greatest consequence to the disciplinarian. It is something which takes side in the child's breast with the reasonable governor and the laws which he or she administers. It secures ready compliance with a large part of the discipline enforced. When the impulse urging toward license has been too strong, and disobedience ensues, this same instinct comes to the aid of order and good conduct by inflicting pains which are the beginning of what we call remorse.

By and by other forces will assist. The affectionate child will reflect on the misery his disobedience causes his mother. A boy of four years and nine months must, one supposes, have woke up to this fact when he remarked to his mother: "Did you choose to be a mother? I think it must be rather tiresome." The day when the child first becomes capable of thus putting himself into his mother's place and realizing, if only for an instant, the trouble he has brought on her, is an all-important one in his moral development.

As our illustrations have suggested, and as every thoughtful parent knows well enough, the problem of moral training in the first years is full of difficulty. Yet our study surely suggests that it is not so hopeless a problem as we are sometimes weakly disposed to think. Perhaps a word or two on this may not inappropriately close this essay.

I will readily concede that the difficulty of inculcating in children a sweet and cheerful obedience arises partly from the nature of the child. There are trying children, just as there are trying dogs that howl and make themselves disagreeable for no discoverable reason but their inherent "cussedness." There are, I doubt not, conscientious, painstaking mothers, who have been baffled by having to manage what appears to be the utterly unmanageable.

Yet I think that we ought to be very slow to pronounce any child unmanageable. I know full well that in the case of these small growing things there are all kinds of hidden physical commotions which breed caprices, ruffle the temper, and make them the opposite of docile. The peevish child who will do nothing, will listen to no suggestion, is assuredly a difficult thing to deal with. But such moodiness and cross-grainedness springing from bodily disturbances will be allowed for by the discerning mother, who will be too wise to bring the severer measures of discipline to bear on a child when subject to its malign influence. Waiving these disturbing factors, however, I should say that a good part, certainly more than one half, of the difficulty of training children is due to our clumsy, bungling modes of going to work.

Sensible persons know that there is a good and a bad way of approaching a child. The wrong ways of trying to constrain children are, alas! numerous. I am not writing an "advice to parents," and am not called on therefore to deal with the much-disputed question of the rightness and the wrongness of corporal punishments. Slaps may be needful in the early stages, even though they do lead to little tussles; a mother assures me that these battles with her several children have all fallen between the ages of sixteen months and two years. It is, however, conceivable that such fights might be avoided altogether; yet a man should be chary of dogmatizing on this delicate matter.

What is beyond doubt is that the slovenly discipline—if indeed discipline it is to be called—which consists in alternations of gushing fondness with almost savage severity, or fits of government and restraint interpolated between long periods of neglect and *laisser faire,* is precisely what develops the rebellious and law-resisting propensities. But discipline can be bad without being a stupid pretense. Everything in the shape of inconsistency, saying one thing at one time, another thing at another, or treating one child in one fashion, another in another, tends to undermine the pillars of authority. Young eyes are quick to note these little contradictions, and they sorely resent them. It is astonishing how careless disciplinarians can show themselves before these astute little critics. It is the commonest thing to tell a child to behave like his elders, forgetting that this, if indeed a rule at all, can only be one of very limited application. Here is a suggestive example of the effect of this sort of teaching sent me by a mother: "At three years and six months, when some visitors were present, she was told not to talk at dinner time. 'Why me no talk? Papa talks.' 'Yes, but papa is grown up and you are only a little girl; you can't do just like grown-up people.' She was silent for some time, but when I told her ten minutes later to sit nicely with her hands on her lap like her cousins, she replied, with a very humorous smile, 'Me tan't (can't) sit like grown-up people, me is only a little girl.'"

We can fail and make children disloyal instead of loyal subjects by unduly magnifying our office, by insisting too much on our authority. Children who are over-ruled, who have no taste of being left unmolested and free to do what they like, can hardly be expected to submit graciously. Another way of carrying parental control to excess is by exacting displays of virtue which are beyond the moral capabilities of the child. A lady sends me this reminiscence of her childhood: She had been promised sixpence when she could play her scales without fault, and succeeded in the exploit on her sixth birthday. The sixpence was given to her, but soon after her mother suggested that she should spend the sixpence in fruit to give to her (the mother's) invalid friend. This was offending the sense of justice, for if the child, is jealous of anything as her very own, it is surely the reward she has earned; and was, moreover, a foolish attempt to call forth generosity where generosity was wholly out of place. An even worse example is that recorded by Ruskin: When a child, he was expected to come down to dessert and crack nuts for the grand older folk while peremptorily forbidden to eat any. Such refined cruelties of government deserve to be defeated in their objects. Much of our ill success in governing children would probably turn out to be attributable to unwisdom in assigning tasks, and more particularly in making exactions which wound that sensitive fiber of a child's heart, the sense of justice.

Parents are, I fear, apt to forget that generosity and the other liberal virtues owe their worth to their spontaneity. They may be suggested and encouraged but can not be exacted. On the other hand, a parent can not be more foolish than to discourage a spontaneous out-going of good impulse, as if nothing were good but what emanated from a spirit of obedience. In a pretty and touching little American work, Beckonings from Little Hands, the writer describes the remorse of a father who after his child's death recalled the little fellow's first crude endeavor to help him by bringing fuel, an endeavor which, alas! he had met with something like a rebuff.

The right method of training which develops and strengthens by bracing exercise the instinct of obedience can not easily be summarized, for it is the outcome of the highest wisdom. I may, however, be permitted to indicate one or two of its main features.

Informed at the outset by a fine moral feeling and a practical tact as to what ought to be expected, the wise mother is concerned before everything to make her laws appear as much a matter of course as the daily sequences of the home life, as unquestionable axioms of behavior; and this not by a foolish vehemence of inculcation, but by a quiet, skillful inweaving of them into the order of the child's world. To expect the right thing, as though the wrong thing were an impossibility, rather than to be always pointing out the wrong thing and threatening consequences; to make all her words and all her own actions support this view of the inevitableness of law; to meet any indications of a disobedient spirit first with misunderstanding and later with amazement—this is surely the first and fundamental matter.

The effectiveness of this discipline depends on the simple psychological principle that difficult actions tend to realize themselves in the measure in which the ideas of them become clear and persistent. Get a child steadily to follow out in thought an act to which he is disinclined and you have more than half mastered the disinclination. The quiet daily insistence of the wise rule of the nursery proceeds by setting up and maintaining the ideas of dutiful actions, and so excluding the thought of disobedient actions.

It has recently been pointed out that in this moral control of the child through suggestion of right actions we have something closely analogous to the action of suggestion upon the hypnotized subject. The mother—the right sort of mother—has on the child's mind something of the subduing influence of the Nancy doctor: she induces ideas of particular actions, gives them force and persistence, so that the young mind is possessed by them, and they work themselves out into fulfillment as occasion arises.

In order that this effect of "obsession," of a full occupation of consciousness with the right idea may result, certain precautions are necessary. As every parent knows, a child may be led by a prohibition to do the very thing he is bidden not to do. We have seen how readily a child's mind moves from an affirmation to a corresponding negation, and conversely. The contradictoriness of a child, his passion for saying the opposite of what you say, shows the same odd manner of working of the young mind. Wanting to do what he is told not to do is another effect of this "contrary suggestion," as it has been called, aided, of course, by the child's dislike of all constraint.* If we want to avoid this effect we must first of all acquire the difficult secret of personal influence, of the masterfulness which does not repel; and secondly, reduce our prohibitions with their contrary suggestions to a minimum.

The action in moral training of this influence of a quasi-hypnotic suggestion becomes more clearly marked when difficulties occur; when some outbreak of willful resistance has to be recognized and met, or some new and relatively arduous feat of obedience has to be initiated. Here I find that intelligent mothers have found their way to methods closely resembling those of the hypnotist. "When R—— is naughty and in a passion" (writes a lady friend of her child, aged three years and three months), "I need only suggest to him that he is some one else, say a friend of his, and he will take it up at once; he will pretend to be the other child, and at last go and call himself, now a good boy, back again." This mode of suggestion, by helping the higher self to detach itself from and control the lower, might, one suspects, be much more widely employed in the moral training of children. Suggestion may work through the emotions. Merely to say, "Mother would like you to do this," is to set up an idea in the child's consciousness by help of the sustaining force of his affection. "If [writes a lady] there was anything L—— particularly wished not to do, his mother had only to say, 'Dobbin [a sort of

* On the nature of this contrary suggestion, see Mark Baldwin, Mental Development in the Child and the Race, p. 145.

canonized toy horse already referred to] would like you to do this,' and it was done without a murmur."

We have another analogue to hypnotic suggestion when a mother prepares her child some time beforehand for a difficult duty, telling him that she expects him to perform it. A mother writes that her boy, when about the age of two years and three months more particularly, was inclined to burst into loud but short fits of crying. "I have found [she says] they are often checked by telling him beforehand what would be expected of him, and exacting a promise that he would do the thing cheerfully. I have seen his face flush up ready to cry when he remembered his promise and controlled himself." This reminds one forcibly of the commands suggested by the hypnotizer to be carried into effect when the subject wakes.

Much more, perhaps, might be done in this direction by choosing the right moment for setting up the persistent ideas in the child's consciousness. I know a lady who got into the way of giving moral exhortation to her somewhat headstrong girl at night before the child fell asleep, and found this very effectual. It is possible that we may be able to apply this idea of preparatory and premonitory suggestion in new and surprising ways to difficult and refractory children.*

One other way in which the wise mother will win the child over to duty is by developing his consciousness of freedom and power. A mother, who was herself a well-known writer for children, has recorded in some notes on her children that when one of her little girls was disinclined to accede to her wish she used to say to her, "Oh, yes, I think when you have remembered how pleasant it is to oblige others you will do it." "I will think about it, mamma," the child would reply, laughing, and then go and hide her head behind a sofa pillow, which she called her "thinking corner." In half a minute she would come out and say, "Oh, yes, mamma, I have thought about it and I will do it." This strikes me as an admirable combination of regulative suggestion with exercise of the young will in moral decision. It gave the child the consciousness of using her own will, and yet maintained the needed measure of guidance and control.

As the moral consciousness develops and new problems arise, new openings for such suggestive guidance occur. How valuable, for example, is the mother's encouragement of the weakly child shrinking from a difficult self-repressive action when she says with inspiring voice, "You *can* do it if you try." Thus, pilotlike,

* The bearings of (hypnotic) suggestion on moral education have been discussed by Guyau, Education and Heredity (English translation), chap. i. Compare also Preyer, *op. cit.*, p. 267 f., and Compayré, *op. cit.*, p. 262.

she conducts the little navigator out into the open main of duty where he will have to steer himself.

I have tried to show that the moral training of children is not beyond human powers. It has its strong supports in child-nature, and these, where there are wisdom and method on the ruler's side, will secure success. I have not said that the mother's task is easy. So far from thinking this, I hold that a mother who bravely faces the problem, neither abandoning the wayward will to its own devices nor, hardly less weakly, handing over the task of disciplining it to a paid substitute, and who by well-considered and steadfast effort succeeds in approaching the perfection I have hinted at, combining the wise ruler with the tender and compassionate parent, is among the few members of our species who are entitled to its reverence.

THE ANATOMY OF SPEED SKATING.

By R. TAIT McKENZIE.

SPEED skating as a distinct branch of athletics is of recent date, but as an art it is one of the oldest cultivated by the vigorous nations of the temperate and frigid zones.

Fitz Stephen, the historian of London, speaks of the sport as taking place in the twelfth century, but the first mention in history occurs eighteen hundred years ago, in the Edda, where the god Uller is represented as distinguished by beauty, arrows, and skates. In 1662, Pepys enters this item in his diary under date December 1st: "So to my Lord Sandwich's, to Mr. Moore, and then over the Parke (where I first in my life, it being a great frost, did see people sliding with their skeates, which is a very pretty art)."

When we consider the improvements that modern ingenuity has added to skates and race tracks, and the modern methods of training, we would expect marked reductions in the time taken to cover the various distances. We have no means of comparing speeds for distances under a mile, but if we can trust the time taken by the watches of 1821 we may accept the fact that in England a Lincolnshire man won one hundred guineas by skating a mile within two seconds of three minutes. The present record is only four or five seconds better (2·56, Johnson, January 7, 1894).

At the beginning of the century (1801) two young women skated thirty miles in two hours at Groningen; and if we go into the dangerous ground of "hearsay" we will find an account of a father who crossed forty leagues one day to rescue his son from danger, and of another who bet that he could cover three leagues on ice while his friend went one and a half on the best horse.

It has had among its devotees no less a man than Goethe, the great German poet, who sought by this means to drive away his persistent sleeplessness and bring back his youthful vigor. One clear, cold morning in December he is said to have jumped from his bed, strapped on his skates, and to have sallied out, reciting the following like one inspired: "Penetrated with the gayety that

Fig. 1.—J. K. McCulloch in Skating Position.

gives the feeling of health, I go to scour afar the glistening crystal. . . . How brilliant is the ice that night has spread on the waters!"

It is also said of him that when he and Klopstock the poet met for the first time—one in his prime and the other in the decline of life—the subject of conversation was not poetry, literature, or æsthetics, as we would suppose, but was entirely devoted to skating.

The prominence of athletic sports has directed much attention to the various problems that are intimately connected with their practice in their various forms, and naturally the question of the anatomical characteristics required for success in any branch of athletics is one of the first to be investigated in the light of modern physiology and anatomy.

One of the teachings of modern physiology is that function makes structure; that if horses are raced generation after generation we get the slender, nervous race horse, while if they pull heavy loads we have developed the Clydesdale type. Again, if a man has to use his right hand and arm only, continuously in his work we get it large and brawny, while the rest of his muscular system may be but poorly developed. It is this specialism that gives such a law a chance of showing its workings, so that one can often pick out a man's trade by peculiarities in his physique.

Fig. 2.—Adolph Norsing in Skating Position.

In athletics, which include the severest forms of physical labor, we would look for examples of the operation of this law, for nowhere has specialism been carried further than in athletic sports.

Such contests as the Penthalon, a revival of the Greek idea of all-around development, which includes a test in running and jumping and weight-putting, are too rare in our modern athletic meets.

Men systematically train for bicycle racing until the particular set of muscles used in that particular exercise—those of legs and thighs—are in a perfect state of development, while the arms remain poor and the chest flat.

The "bicycle stoop" is now a well-recognized deformity, and few men who have devoted much time or attention to racing are entirely free from it, while in many racers the marked dorsal curvature forward (kyphosis) is permanent, unsightly, and injurious to the health.

Heavy gymnastics were the cause of many round shoulders till a reaction took place in the world of physical education, and now body-building is done by the almost exclusive use of light work. This reaction has extended to the more intelligent athletic trainers, who have given up the old drastic methods and have adopted more rational means of obtaining strength and endurance to their *protégés*.

Our present method of testing athletic prowess thus encourages the exclusive development of certain groups of muscles and the neglect of others—sometimes, as we will see, to the permanent deformity of its too zealous votaries.

Other instances of anatomical changes brought about by special feats could be cited, such as the flat foot of the broad-jumper or the broad back and flat chest of the oarsman; but one of the best examples of this effect of function on structure is seen in "speed skating," which the international contests of the last few years have done so much to popularize.

Speed skating differs from ordinary skating in several marked particulars. The skate itself—about eighteen inches long—has a flat blade, almost as thin as a knife, set into a light tube supporting two uprights, circular but hollow. These short upright tubes fasten it to the boot by means of a plate, the whole purpose being to combine the greatest strength and lightness. The boot laces tightly, giving firm support to the ankle.

This form has evolved from the original skate, made of the lower jawbones of horses and cattle carved to the proper shape and polished. In the British Museum the visitor can still see a pair of these primitive instruments, and the workmen occasionally disinter them about Moorfields and Finsbury.

Let us take up the strengths and weaknesses of the modern speed skaters, who, like the Homeric gods, "stride with winged feet over the sea transmuted into solid ground."

The racing posture of all the best skaters is practically the same. The back is kept straight and horizontal, the arms folded across the back except when spurting; then they are swung from side to side, keeping time to the stroke. Thighs are flexed to a right angle, while the knees are kept in half flexion or almost straight (Figs. 1 and 2). In a recent championship race five of the best amateurs in the world were strung out in line, and their rhythmical swing and stride were as if one brain was moving the whole combination. The crouching position, while it does not interfere with respiration, diminishes resistance to the wind—an important advantage—and also gives the best position for using the powerful muscles of the loins and back.

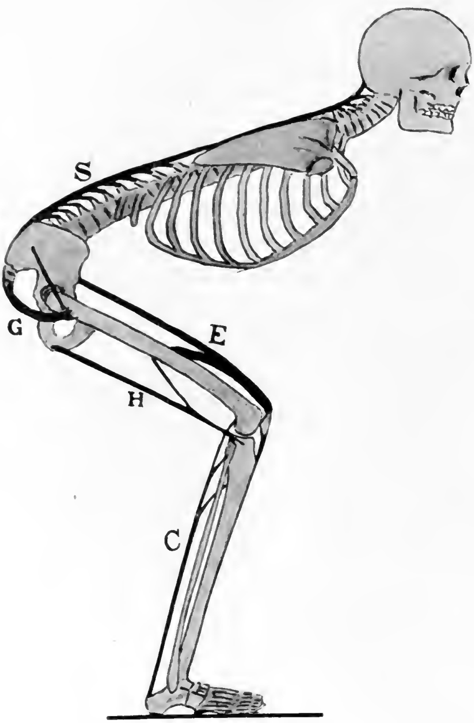

Fig. 3.—Diagram.

The stroke of all the best men is practically the same, and differs from that of ordinary skating both in its direction and in the way it is taken. Its direction is more forward and backward than one from the ordinary short skate, and with the long, flat blade the stroke is given by the whole of the foot flat. Any lifting of the heel in striking out is impossible on account of the length of skate-blade. This has an important bearing on muscular development, as will be seen later.

The muscles most used in speed skating will be seen by the accompanying diagram, in which muscles are represented by the heavy black lines. A stroke is made by extending the knee and hip joints, and the erector spinæ muscles (S) are brought into strong action in straightening the back on the pelvis, which is thereby made firm enough to resist the action of the muscles of the lower limb. The powerful gluteal muscles (G), which in standing keep the body in the upright position, contract strongly,

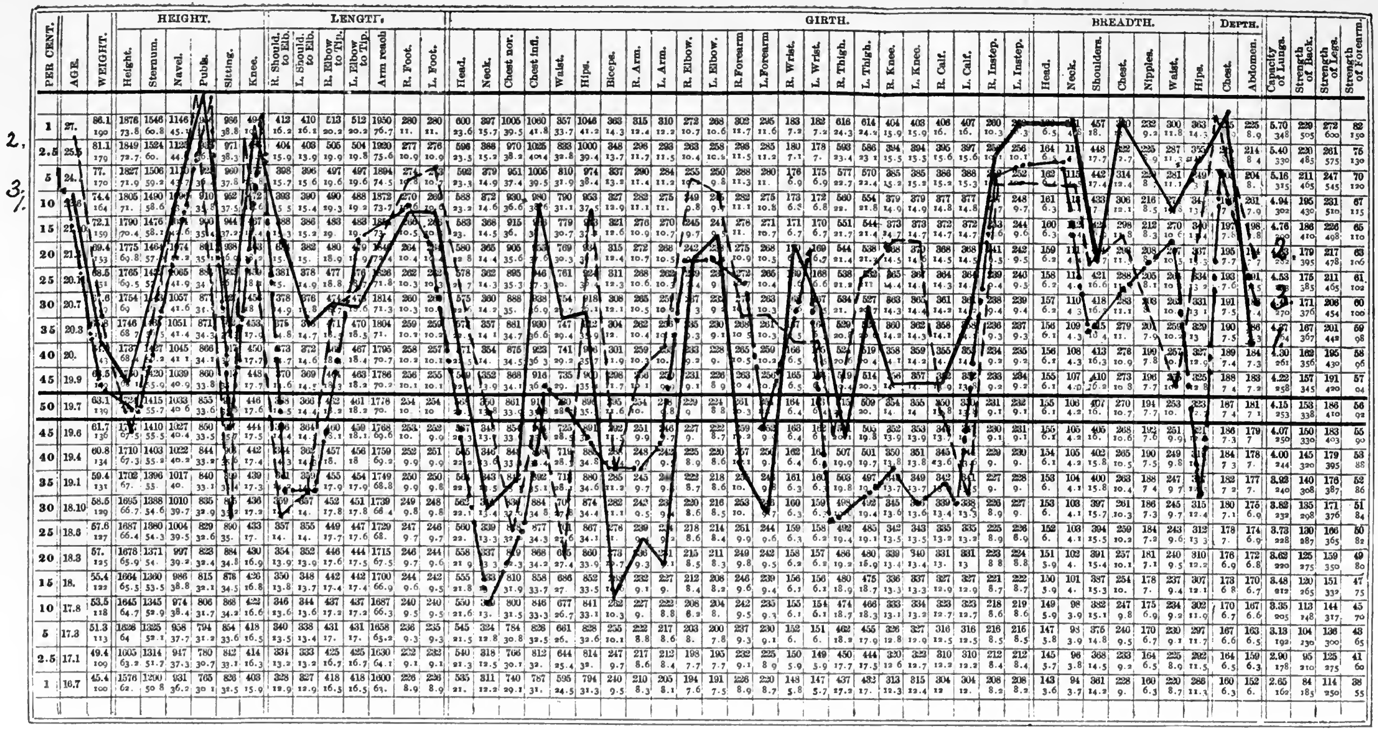

CHART A.—Anthropometric Table compiled from the measures of twenty-three hundred students. The large figures indicate millimetres and kilogrammes; the small, inches and pounds. Also the measures of (1) John S. Johnson ———, (2) Adolph Norsing — — — —, and (3) Olaf Nortwedt ——- - ——- - ——- -, taken February 7, 1894, by R. Tait McKenzie, M. D.

drawing the thigh bone back and out. The hamstring muscles (H) have a similar action, with addition of flexing or bending the knee joint. As the stroke consists in a straightening of this joint, the skater uses the powerful extensors (E) to counteract this latter action of the hamstrings (H).

The extensor muscles (E) are tremendously powerful, and from their double origin on the pelvis and along the front of the thigh bone (femur) they are inserted into the knee-cap (patella), which changes the direction of their pull to a right angle by carrying them over the knee joint to their final insertion on the tibia, just as the wire of a door-bell is carried round the corners on its way to the kitchen. As the only function of the calf muscles (C) is to raise the heel and bend the knee, they will hardly be used at all in skating with long, flat racing skates.

In a speed skater we would look for a strong back and broad neck, due to his attitude while at work. His arms, which are kept idly folded on his back, would be small and weak, as would be his chest muscles. His abdominal muscles would get some work from the constant swaying, and he would have powerful, vigorous gluteal and extensor muscles, with sinewy hamstrings but undersized calves.

An examination of the measurements of some of our most noted skaters will show this special development even better than their photographs.

In the accompanying charts each measurement is compared with those of nearly three thousand Yale students, whose average, or more correctly whose "mean," measurements are inclosed in the two heavy lines, and may be said to fairly represent the proportions of the average young man. The variation from this average, or mean, is marked in percentages in the extreme left-hand column of the chart.

John S. Johnson, of Minneapolis, has had a somewhat meteoric athletic career. Although he has been wheeling and skating for nine years, he has been heard of only about three years, when his phenomenal time was at first scarcely credited. His decisive defeat of the hitherto invincible Joe Donahue in Montreal, February 3, 1894, in all distances up to five miles, brought him up to the top of the tree, where he has remained perched on its topmost branch till the present hour, unquestionably the best man up to five miles on ice. He holds nearly all the records in speed skating.

His trainer never allows him to tire himself, but starts him with short spurts and an easy pace; so that, although he had been eighteen months in training when I examined him (February 5, 1894), he had in that time gained twenty-six pounds. He was then twenty-two years of age, and weighed one hundred and forty-four pounds. While in his sitting height he is surpassed by forty-

PER CENT.	AGE.	WEIGHT.	HEIGHT. Height.	Sternum.	Navel.	Pubis.	Sitting.	Knee.	LENGTH. R. Should. to Elb.	L. Should. to Elb.	R. Elbow to Tip.	L. Elbow to Tip.	Arm reach.
1	27.	86.1 190	1876 73.8	1546 60.8	1146 45.1	956 37.6	986 38.8	494 19.5	412 16.2	410 16.1	513 20.2	512 20.2	1950 76.7
2.5	25.5	81.1 179	1849 72.7	1524 60.	1125 44.3	936 36.8	971 38.3	486 19.1	404 15.9	403 15.9	505 19.9	504 19.8	1920 75.6
5	[illegible]	77. 170	1827 71.9	1506 59.2	1110 43.7	925 36.4	960 37.8	477 18.8	398 15.7	396 15.6	497 19.6	497 19.6	1894 74.5
10	22.	74.4 164	1805 71.	1490 58.6	1096 43.1	910 35.8	952 37.5	472 18.6	393 15.5	390 15.4	490 19.3	488 19.2	1872 73.7
15	21.1	72.1 159	1790 70.4	1476 58.1	1084 42.6	900 35.4	944 37.2	467 18.4	388 15.3	386 15.2	483 19.	483 19.	1854 73.
20	21.4	69.4 153	1775 69.8	1464 57.6	1074 42.2	891 35.1	938 36.9	463 18.2	384 15.1	382 15.	480 18.9	479 18.9	1840 72.4
25	20.11	[illegible] 151	1765 69.5	1452 57.1	1065 41.9	884 34.7	932 36.7	459 18.1	381 15.	378 14.9	477 18.8	476 18.7	1826 71.8
30	20.7	[illegible]	1754 69	1443 56.7	1057 41.6	877 34.5	927 36.5	456 18.	378 14.9	376 14.8	474 18.7	473 18.6	1814 71.3
35	20.8	[illegible]	1746 68.7	1435 56.5	1051 41.4	871 [illegible]	[illegible]	453 17.9	376 14.8	373 14.7	471 18.5	470 18.5	1804 71.
40	20.	[illegible]	1737 68.4	1427 56.2	1045 41.1	[illegible] 34.1	[illegible]	450 17.7	373 14.7	372 14.6	468 18.4	467 18.4	1796 70.7
45	19.9	[illegible] 140	1730 68.1	1420 55.9	[illegible]	860 33.8	[illegible]	448 17.7	370 14.6	369 14.5	464 18.3	463 18.2	1786 70.2
50	19.7	63.1 139	1724 67.8	1415 55.7	[illegible]	855 33.6	910 [illegible]	446 17.6	368 14.5	366 14.4	462 18.2	461 18.1	1778 70.
45	19.6	61.7 136	1717 67.5	1410 55	1027 40.4	850 33.5	907 35.7	444 17.5	366 14.4	364 14.3	460 18.1	459 18.1	1768 69.6
40	19.4	60.8 134	1710 67.3	[illegible]	1022 40.2	844 33.2	903 35.6	442 17.4	364 14.3	362 14.3	457 18.	456 18	1759 69.2
35	19.1	59.4 131	[illegible]	[illegible] 55.	1017 40.	840 33.1	899 35.4	[illegible] 17.3	361 14.2	359 14.2	455 17.9	454 17.9	1749 68.8
30	18.10	58.5 129	[illegible]	1388 54.6	1010 39.7	835 32.9	895 35.2	[illegible]	359 14.1	357 14.	453 17.8	451 17.8	1739 68.4
25	18.6	57.6 127	1687 66.4	1380 54.3	1004 39.5	829 32.6	890 35.	[illegible] 17.	[illegible]	355 14.	449 17.7	447 17.6	1729 68.
20	18.3	57. 125	1676 65.9	1371 54.	997 39.2	823 32.4	884 34.8	430 16.9	[illegible]	352 13.9	446 17.6	444 17.5	[illegible]
15	18.	55.4 122	1664 65.5	1360 53.5	986 38.8	815 32.1	876 34.5	426 16.8	350 13.8	348 13.7	[illegible]	442 17.4	[illegible]
10	17.8	53.6 118	1645 64.7	1345 52.9	974 38.4	806 31.7	868 34.2	422 16.6	346 13.6	[illegible]	437 17.2	[illegible]	1687 66.3
5	17.3	51.8 113	1626 64	[illegible] 52.1	958 37.7	794 31.2	854 33.6	418 16.5	340 13.5	[illegible] 13.4	431 17.	431 17.	1658 65.2
2.5	17.1	49.4 109	1605 63.2	1314 51.7	947 37.3	780 30.7	842 33.1	414 16.3	334 13.2	333 13.2	425 16.7	425 16.7	1630 64.1
1	16.7	45.4 100	1570 62.	1290 50.8	931 36.2	765 30.1	826 32.5	403 15.9	328 12.9	327 12.9	418 16.5	418 16.5	1600 63.

PER CENT.	AGE.	R. Foot.	L. Foot.	GIRTH. Head.	Neck.	Chest nor.	Chest infl.	Waist.	Hips.	Biceps.	R. Arm.	L. Arm.	R. Elbow.	L. Elbow.	R. Forearm.
1	27.	280 11.	280 11.	600 23.6	397 15.7	1006 39.5	1060 41.8	857 33.7	1046 41.2	363 14.3	315 12.4	310 12.2	272 10.7	268 10.6	302 11.7
2.5	25.5	277 10.9	276 10.9	596 23.5	386 15.2	970 38.2	1025 40.4	833 32.8	1000 39.4	348 13.7	298 11.7	293 11.5	263 10.4	258 10.2	293 11.5
5	[illegible]	274 10.8	273 10.7	592 23.3	379 14.9	951 37.4	1005 39.5	810 31.9	974 38.4	337 13.2	290 11.4	284 11.2	255 10.1	250 9.8	288 [illegible]
10	22.	270 10.6	269 10.6	588 23.2	372 14.6	930 36.6	980 38.6	790 31.1	953 37.5	327 12.9	282 11.1	276 11.	[illegible] 9.8	245 [illegible]	282 11.1
15	21.1	266 10.5	266 10.5	583 23.	368 14.5	915 36.	966 38.	779 30.7	943 37.1	321 12.6	276 10.9	270 10.7	245 9.7	241 9.5	278 11.
20	21.4	264 10.4	264 10.4	580 22.8	365 14.4	906 35.6	955 37.6	769 30.3	934 36.8	315 12.4	[illegible]	[illegible]	242 9.5	238 9.4	275 10.9
25	20.11	262 10.3	262 10.3	578 22.7	362 14.3	895 35.3	946 37.3	761 30.	[illegible]	311 12.3	268 10.6	262 10.3	239 9.4	235 9.3	272 10.7
30	20.7	260 10.3	260 10.3	575 22.6	360 14.2	888 35.	938 36.9	754 29.7	918 36.1	[illegible]	265 10.5	259 10.2	237 9.3	232 9.2	270 10.6
35	20.8	259 10.2	259 10.2	573 22.5	357 14.1	881 34.7	[illegible]	747 29.4	912 35.9	[illegible]	262 10.4	256 10.1	235 9.3	230 9.1	268 10.5
40	20.	258 10.2	257 10.1	571 22.5	354 14.	875 34.5	[illegible]	741 29.2	906 35.7	301 11.9	259 10.3	253 10.	233 9.2	228 9.	265 10.5
45	19.9	256 10.1	255 10.1	569 22.4	352 13.9	868 34.1	918 36.1	735 29.	900 35.4	298 11.7	256 10.1	250 9.9	231 9.1	226 8.9	262 10.4
50	19.7	254 10.	254 10.	568 22.3	350 13.8	861 33.9	910 35.8	[illegible]	898 35.3	295 11.6	254 10.	248 9.8	229 9	224 8.8	261 10.3
45	19.6	253 10.	252 9.9	567 22.3	348 13.7	854 33.6	904 35.6	[illegible]	891 35.	292 11.5	251 9.9	246 9.7	227 9.	222 8.7	259 10.2
40	19.4	253 9.9	251 9.9	565 22.2	346 13.6	848 33.[illegible]	898 35.4	719 28.3	885 34.8	288 11.4	248 9.7	242 9.5	225 8.9	220 8.6	257 10.1
35	19.1	250 9.9	[illegible] 9.8	[illegible] 22.2	343 13.[illegible]	84[illegible] 33.[illegible]	892 35.1	713 28.1	880 34.6	285 11.2	245 9.7	240 9.5	222 8.7	218 8.6	255 10.
30	18.10	249 9.[illegible]	248 9.8	562 22.1	341 13.4	[illegible]	884 34.8	707 27.8	874 34.4	282 11.1	242 9.5	237 9.4	220 8.6	216 8.5	253 10.
25	18.6	[illegible] 9.7	246 9.7	560 22.	339 13.3	828 32.6	877 34.5	701 27.6	867 34.1	278 11.	239 9.4	234 9.2	218 8.6	214 8.4	251 9.9
20	18.3	246 9.7	244 9.6	558 21.9	337 13.3	819 32.3	868 34.2	695 27.4	860 33.9	273 10.7	236 9.3	231 9.1	215 8.5	211 8.3	249 9.8
15	18.	244 9.6	242 9.5	555 21.8	333 13.1	810 31.9	858 33.7	686 27.	852 33.5	268 10.6	232 9.1	227 9.	212 8.4	208 8.2	246 9.6
10	17.8	240 9.5	240 9.5	550 21.6	329 13.	800 31.5	846 33.3	677 26.7	841 33.1	262 10.3	227 9.	222 8.8	208 8.2	204 8.	243 9.5
5	17.3	236 9.3	235 9.3	545 21.5	324 12.8	784 30.8	826 32.5	661 26.	826 32.6	255 10.1	222 8.8	217 8.6	203 8.	200 7.8	237 9.3
2.5	17.1	232 9.1	232 9.1	540 21.3	318 12.5	766 30.1	812 32.	644 25.4	814 32.	247 9.7	217 8.6	212 8.4	198 7.7	195 7.7	232 9.1
1	16.7	226 8.9	226 8.9	535 21.	311 12.2	740 29.1	787 31.	595 24.5	794 31.3	240 9.5	210 8.3	205 8.1	194 7.6	191 7.5	226 8.9

PER CENT.	AGE.	L. Forearm.	R. Wrist.	L. Wrist.	R. Thigh.	L. Thigh.	R. Knee.	L. Knee.	R. Calf.	L. Calf.	R. Instep.	L. Instep.
1	27.	295 11.6	183 7.2	182 7.2	616 24.3	614 24.2	404 15.9	403 15.9	406 16.	407 16.	260 10.3	260 10.3
2.5	25.5	285 11.2	180 7.1	178 7.	593 23.4	586 23.1	394 15.5	394 15.5	395 15.6	397 15.6	[illegible]	256 [illegible]
5	[illegible]	[illegible] 11	176 6.9	175 6.9	577 22.7	570 22.4	385 15.2	385 15.2	386 15.2	388 15.[illegible]	252 10.	252 10.
10	22.	[illegible]	173 6.8	172 6.8	560 22.	554 21.8	379 14.9	379 14.9	377 14.8	[illegible]	247 9.7	248 9.7
15	21.1	271 10.7	171 6.7	170 6.7	551 21.7	544 21.4	373 14.7	373 14.7	372 14.7	372 14.7	243 9.6	244 9.6
20	21.4	268 10.5	170 6.7	169 6.7	544 21.4	538 21.2	368 14.5	370 14.6	[illegible] 14.5	368 14.5	241 9.5	242 9.5
25	20.11	265 10.4	[illegible] 6.6	168 6.6	538 21.2	532 21.	365 14.4	367 14.5	[illegible]	364 14.3	239 9.4	240 9.5
30	20.7	263 10.3	168 6.6	167 6.5	534 21.	[illegible]	363 14.3	365 14.4	[illegible]	361 14.2	238 9.4	239 9.4
35	20.8	261 10.3	167 6.5	166 6.5	529 20.8	[illegible]	360 14.2	362 14.3	[illegible]	358 14.1	236 9.3	237 9.3
40	20.	259 10.2	166 6.5	165 6.5	524 20.6	[illegible] 20	358 14.1	359 14.2	355 14.	355 14.	234 9.2	235 9.2
45	19.9	256 10.1	165 6.5	164 6.4	519 20.4	[illegible]	356 14.	357 14.	352 13.9	352 13.8	233 9.2	234 9.2
50	19.7	254 10.	164 6.4	163 6.4	515 20.3	509 20.	354 14.	355 14.	350 13.8	350 13.8	231 9.1	233 9.1
45	19.6	252 9.9	163 6.4	162 6.4	511 20.1	505 19.8	352 13.9	353 13.9	348 13.7	347 13.7	230 9.1	231 9.1
40	19.4	250 9.8	162 6.4	161 6.3	507 19.9	501 19.7	350 13.8	351 [illegible]	345 13.6	344 13.6	229 9.	230 9.
35	19.1	248 9.8	161 6.3	160 6.3	503 19.8	497 19.6	[illegible]	[illegible]	342 13.5	341 13.5	227 9.	228 9.
30	18.10	246 9.7	160 6.3	159 6.3	498 19.6	492 19.4	[illegible]	[illegible]	339 13.4	338 13.3	226 8.9	227 9.
25	18.6	244 9.6	158 6.3	158 6.2	492 19.4	485 19.1	[illegible]	[illegible]	335 13.2	335 13.2	225 8.9	226 8.9
20	18.3	242 9.5	158 6.2	157 6.2	486 19.2	480 18.9	[illegible]	[illegible] 13.4	331 13.	331 13	223 8.8	224 8.8
15	18.	239 9.4	156 6.1	156 6.1	480 18.9	475 18.7	[illegible] 13.3	337 13.3	327 12.9	327 12.9	221 8.7	222 8.7
10	17.8	235 9.3	155 6.1	154 6.1	474 18.7	466 18.3	333 13.1	334 13.2	323 12.7	323 12.7	218 8.6	219 8.6
5	17.3	230 9.1	152 6.	151 6.	462 18.2	455 17.9	326 12.8	327 12.9	318 12.5	316 12.5	216 8.5	216 8.5
2.5	17.1	225 8.9	150 5.9	149 5.9	450 17.7	444 17.5	320 12.6	322 12.7	310 12.2	310 12.2	212 8.4	212 8.4
1	16.7	220 8.7	148 5.8	147 5.7	437 17.2	432 17.	313 12.3	315 12.4	304 12	304 12.	208 8.2	208 8.2

PER CENT.	AGE.	BREADTH. Head.	Neck.	Shoulders.	Chest.	Nipples.	Waist.	Hips.	DEPTH. Chest.	Abdomen.	Capacity of Lungs.	Strength of Back.	Strength of Legs.	Strength of Forearm.
1	27.	166 6.5	121 4.8	457 18.	330 13.	232 9.2	300 11.8	363 14.3	225 8.9	225 8.9	5.70 348	229 505	272 600	82 150
2.5	25.5	164 6.5	119 4.7	448 17.7	322 12.7	225 8.9	287 11.3	355 14.	[illegible]	214 8.4	5.40 330	220 485	261 575	76 130
5	[illegible]	162 6.4	[illegible]	442 17.4	314 12.4	220 8.7	281 11.1	349 13.8	[illegible]	204 8	5.16 315	211 465	247 545	70 120
10	22.	161 6.3	[illegible] 4.4	433 17.	306 12.1	216 8.5	274 10.8	344 13.6	[illegible]	201 7.9	4.94 302	195 430	231 510	67 115
15	21.1	160 6.3	112 4.4	428 16.9	298 11.8	212 8.3	270 10.6	340 13.4	[illegible]	198 7.8	4.76 290	186 410	226 498	65 110
20	21.4	159 6.2	111 4.4	[illegible]	293 [illegible]	208 8.2	267 10.5	337 13.3	[illegible] 7.7	194 7.7	4.63 282	179 395	217 478	63 106
25	20.11	158 6.2	111 4.4	[illegible]	[illegible]	206 8.1	264 10.4	334 13.2	[illegible] 7.6	191 7.5	4.53 273	175 385	211 465	61 102
30	20.7	157 6.2	110 4.3	418 16.5	[illegible] 11.	203 8.	262 10.3	331 13.1	191 7.5	188 7.4	4.45 270	171 376	206 454	60 100
35	20.8	156 6.1	109 4.3	415 16.4	279 11.	201 7.9	259 10.2	329 13	190 7.5	[illegible]	4.37 264	167 367	201 442	59 98
40	20.	156 6.1	108 4.3	413 16.3	276 10.9	199 7.8	257 10.1	327 12.9	189 7.4	184 7.3	4.30 261	162 356	195 430	58 96
45	19.9	155 6.1	107 4.2	410 16.2	273 10.8	[illegible]	255 10	325 12.8	188 7.4	183 7.2	4.22 258	157 345	191 420	57 94
50	19.7	155 6.1	106 4.2	407 16.	270 10.7	[illegible]	253 [illegible]	323 12.7	187 7.4	181 7.1	4.15 253	153 338	186 410	56 92
45	19.6	155 6.2	105 4.2	405 16.	268 10.6	[illegible]	251 9.9	321 12.7	186 7.3	179 7.	4.07 250	150 330	183 403	55 90
40	19.4	154 6.1	105 4.2	402 15.8	265 10.5	190 7.5	249 9.8	319 12.6	184 7.3	178 7.	4.00 244	145 320	179 395	53 88
35	19.1	153 6.	104 4.1	400 15.8	263 10.4	188 7.4	247 9.7	317 12.5	182 7.2	177 7	3.92 240	140 308	176 387	52 86
30	18.10	153 6.	103 4.1	397 15.7	261 10.3	186 7.3	[illegible]	315 [illegible]	180 7.1	176 6.9	3.82 232	135 298	171 376	51 84
25	18.6	152 6.	103 4.1	394 15.5	259 10.2	184 7.2	[illegible]	[illegible]	178 7.	174 6.9	3.73 228	130 287	166 365	50 82
20	18.3	151 5.9	102 4.	391 15.4	257 10.1	181 7.1	[illegible]	310 [illegible]	176 6.9	172 6.8	3.63 220	125 275	159 350	49 80
15	18.	150 5.9	101 4.	387 15.3	254 10.	178 7.	[illegible]	[illegible]	173 6.8	170 6.7	3.48 212	120 265	151 332	47 75
10	17.8	149 5.9	98 3.9	382 15.1	247 9.8	175 6.9	234 9.2	[illegible]	170 6.7	167 6.6	3.35 205	113 248	144 317	45 70
5	17.3	147 5.8	98 3.9	375 14.8	240 9.5	170 6.7	230 9.1	[illegible]	167 6.6	163 6.5	3.18 192	104 230	136 300	43 65
2.5	17.1	145 5.7	96 3.8	368 14.5	233 9.2	164 6.5	225 8.9	[illegible]	164 6.5	159 6.3	2.90 178	95 210	125 275	41 60
1	16.7	143 5.6	94 3.7	361 14.2	228 9.	160 6.3	220 8.7	[illegible]	160 6.3	152 6.	2.65 162	84 185	114 250	38 55

CHART B.—Anthropometric Table with the measures of J. K. McCulloch, taken in February, 1894, by R. Tait McKenzie, M. D.

five per cent of those measured (see Chart A, No. 1), his length of legs rises to the hundred-per-cent class. The girth of the neck is small, but the low chest measurement is due to its rounded shape.

FIG. 4.—JOHNSON.

Its expansive power of seven inches is extraordinary in a chest of that shape. The muscle girths of his arms are exceeded by eighty per cent of young men, while the elbows and wrists show rather heavy bones. The rather small thigh girths will be due partly to their great length. The size of his calves shows about average development—to be attributed to bicycling largely—but the insteps are very large, and his photos show a flat foot. The neck and chest are broad, as would be the shoulders if he had better arm muscles. The "bicycle stoop," amounting almost to deformity in his case, brings the depth of chest up to the one-hundred-per-cent class. His lung capacity is very good, but he can not pull himself up by his arms more than two and a half times, and one dip on the parallels is the extent of his ability. His pulse is only fifty-four to the minute—remarkably slow and strong, and not easily quickened by exercise. The long thighs and "bicycle stoop" are well shown in Fig. 4. Notice particularly the deep chest.

Adolph Norsing has skated since childhood on the rivers and fiords of Norway. For the last five years he has met the champions in this sport both at home and throughout Europe, and has visited America twice. He is a worthy representative of the land of the Vikings, and he now holds the Canadian record for half mile (1·24). His training methods are peculiar: two hours daily, finishing with about three miles at top speed, is his quota of work till the day of the race; his diet is principally oatmeal, eggs, and meat. He allows himself one glass of ale daily at dinner, but otherwise does not use alcohol and has never used tobacco. He is

Fig. 5.—Norsing.

a typical skater; his occupation, that of a carriage painter, is sedentary, and we find in him typical development.

Although not above the forty-five-per-cent class in height, and with his sitting height surpassed by over seventy per cent of young men, his length of lower limb is up to the one-hundred-per-cent class, as in the case of Johnson (see Chart A, No. 2). His other bone lengths are low, except his feet, which are long. The hip and elbow girths show heavy bones. An old fracture of the left femur, with shortening, invalidates the thigh measures somewhat, but the calves are away below the knee girths, while the insteps show a condition of flat foot in this man also.

Great breadth and depth show splendid lung power in a chest round, capacious, and barrel-shaped, but not very mobile, for he has small expansion. His pulse is rather fast (eighty-four), and his strength tests, much above his muscle measurements, would give the impression that if determination and will power can do it he will always be a winner.

In his case, as in that of all the men whose measurements are here shown, the left thigh is the larger, probably from having to bear the body weight in turning the corners of a rink. Fig. 5 shows well the rounded shape of the chest in expansion, also the type of figure shown in the chart.

J. K. McCulloch, of Winnipeg, is certainly the best representative that Canada has produced lately in speed skating, and he takes front rank both in this sport and in bicycling. We would hardly expect the typical development of a skater, however, in this man, who excels as a gymnast and all-round athlete as well. At eleven years of age he was winning boys' races, and his summer evenings are taken up by rowing, canoeing and lacrosse. For the last three years bicycling has been his main form of athletic exercise during the five summer months. In winter he is the mainstay of the Winnipeg Hockey Team, and his special *penchant* for the parallel bars in the gymnasium shows in the well-developed arms and chest. His measurements, plotted on Chart B, show a few of the characteristics of the skater. With height in the thirty-per-cent class we find comparatively short legs and long thighs. His arms are also short. A glance at Fig. 6 well shows the shortness of his leg. His muscle girths are in the eighty to ninety per cent class, while his knee-bone measurements are down to twenty per cent; his narrow hips give origin to very powerful muscles, whose girth make up for these bony deficiencies to speed skating (see Fig. 6). His calves are large, but he tells me since he stopped wheeling, four months ago, they have decreased nearly an inch and a half in girth.

His chest is deep and his strength tests show well-developed arms and back. Fig. 6 shows where his extraordinary speed is obtained: the driving power lies in the very long and muscular thighs. This young man is a natural athlete, and, although not built for a skater, excels in that sport as he would in almost any he took up. He would make a splendid high or broad jumper, and would be a success as a gymnast.

Fig. 7 shows a typical speed skater—Olaf Nortwedt, a professional, aged twenty-four, who has been on skates almost since he could walk. He has taken no other form of exercise, and his best distances are under three miles. This photo, taken on the eve of a race, shows the fine condition of his skating muscles. Here again the body is short—the length of the leg and thigh in the one-

FIG. 6.—MCCULLOCH.

hundred-per-cent class (Chart A, 3), while the arms are not long in proportion. The feet are long and flat, and as a rule his other bone girths and lengths are large, with small muscle girths. The rather small thigh girths are due to their great length in conjunction with very narrow hips; his chest is deep and round, although not mobile. His strength tests show weak, poorly developed arms, but the breadth of neck in him, as in Johnson and Norsing shows good development in the upper muscles of the back. His occupation, that of clerk, is light, so that the natural development of a skater has not been interfered with by other causes, as in the case of McCulloch. The plotting of the measurements of these three great skaters, Johnson, Norsing, and Nortwedt, on Chart A, shows the remarkable similarity of their build. All are about the same height and weight, and we find in all certain characteristics. The typical speed skater has a short body, capacious, round chest, with well-developed back; his thighs are strong and very

Fig. 7.—Olaf Nortwedt.

long, as are also his legs. His feet are large and flat. His weak points are his calves, due to the long, flat skate to which his flattened foot is so closely bound. The large muscles of his chest are not exercised, and his arms, held lying idly along his back, are unused except in an occasional spurt, when they are brought down and swung straight from the shoulder. They say that they catch less wind held that way, and that the position is restful to the tense extensors of the back. This is, no doubt, true, but the result is disastrous to symmetrical development. This type of figure is seen at its best in such skaters as the Donahues, McCormick, the old-time professional, who still skates a fast race although now forty years of age, and in Wilson Breen, a professional, who has been a winner of much gold and glory by means of his long legs and powerful thighs.

The conclusion that speed skating alone is not a good exercise to develop a well-built, symmetrical man will be patent to any one who reviews the facts. If indulged in, it should be, as done by McCulloch, in conjunction with other forms of athletics which bring into action the muscles of the arm, calf, shoulders, and chest.

SUGGESTIBILITY, AUTOMATISM, AND KINDRED PHENOMENA.*

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I. MENTAL CO-ORDINATION AND ORGANIZATION.

THE thoroughgoing parallelism of mind and brain may be regarded as an accepted principle of current psychology. There remain, it is true, a few psychologists who dispute it, and many of those who accept it as a working principle refuse to regard it as final. It is conceivable, say they, that when our knowledge is more complete we shall discover that the relation of mind and brain is very different from what we now suppose it to be. Yet we may be sure that the facts upon which the doctrine of parallelism rests will never be set aside by any new discoveries, and will find their place in that final theory toward which we are slowly moving.

It is somewhat surprising that few, even of those who accept this theory as a working hypothesis, have endeavored to carry it out into all its logical implications and to see how far they will fit the actual facts. It is my own belief that the more thoroughly this is done the more probable does it appear that every mental state has its accompanying physical process, and the more rigorously we apply the dynamic conceptions suggested by our scanty knowledge of these physical processes to their accompanying

* I wish to acknowledge my indebtedness to the recent French and English writers on these topics, especially to Pierre Janet, with whose theory as developed in his work, L'Automatisme Psychologique, the above doctrines are essentially identical. It should be noted, however, that Janet expressly repudiates any attempt to bring his psychological theory into connection with our psycho-physiological speculations.

mental states, the more intelligible does our inner life become to us. Especially is this true of certain curious phenomena to which our current psychology pays little attention—those of automatism, suggestibility, and double consciousness as seen in hypnosis, spirit-writing, trance speech, *et id genus omne*. Not that we are yet in position to explain these phenomena in detail. There is much that defies analysis at our present stage of knowledge, but I have no hesitation in saying that in these dynamic conceptions we have found the key which will in time solve these and many other psychological riddles.

We know little or nothing of what happens in the brain while we live and move and have our being. In the early days of experimental psychology the physical bases of mental states were crudely conceived as gross movements, either of the nerves themselves or of some fluid supposed to flow along the nerves and veins to the brain and heart. Nowadays these simpler conceptions are displaced by theories of chemical activities or molecular vibrations of some kind. For my own part, I am sometimes inclined to suspect that the true physical basis is none of these, but a disturbance of the same medium that transmits light and heat —the ether—and to regard the cellular and fibrous structures of the nervous system as a mechanism for producing and transmitting these disturbances, much as the battery and wires of an electric circuit produce and transmit that mode of ethereal disturbance which we call electricity. However this may be, it is quite certain that the processes which take place in the nervous system are all of one order and are analogous to—nay, a part of—the physical transformations of energy which we see in the outer world. Their proximate source is the stored-up molecular energy of the food we eat; they are disengaged by the operation of external and internal stimuli; they can re-enforce or destroy one another; they can produce extensive muscular, secretory, and nutritive changes in the body.

Although all of these processes are of essentially the same order in that all taken together form one system of forces, the constitution of every part of which depends for its character upon the constitution of all the coexisting parts, it is probable that consciousness is not connected with every part of the system, but only with those processes that take place in the cortex—that is, the outer layer of gray matter that covers the surface of the brain. At every moment of conscious life the cortex is the scene of activities so delicate and complex that we can never hope to frame an adequate conception of them. The masses of cells are forever disengaging pulse after pulse of molecular or ethereal disturbance, probably of a vibratory character; by the countless systems of interlacing fibers these pulses are transmitted from one cortical area to another; meeting, they re-enforce or destroy one another; impinging upon a cell system which was in comparative quiet, they rouse it to activity, and are themselves modified by the pulses which it gives forth. At every second this mass of activities is receiving from the myriads of nerves that reach out to the eye, ear, skin, and other sensitive portions of the body countless other pulses of the same character, but initiated by the physical stimuli of the external world or by the chemical changes of the body. These pulses are not accompanied by consciousness, but when they reach the cortex they merge into the complex mass there existing and contribute their share toward the character of the total conscious state. And in the last place, the activities disengaged within the cortex are ever discharging downward through the outgoing channels into the co-ordinating mechanism at the base of the brain. This controls the systems of muscular contractions needed for the performance of our bodily movements much as the "combination stops" of an organ control the systems of pipes needed to produce any given timbre effect.

Thus the consciousness that you and I at any moment experience depends for its character upon the constitution of a system of activities as definite and determinate as any known to the physicist, although so complex that we can never hope to unravel it. To compare the complex with the simple, we have all seen the play of color upon the surface of a soap bubble. These colors depend for their character upon the constitution of a system of forces far more simple than that which underlies the human consciousness. They are due to the interference of waves of ether reflected from the inner and outer surfaces of the film; they depend, therefore, upon the angle of incidence and the thickness of the film. These two conditions again depend upon the tenacity of the film, the difference between the pressure within and that without the bubble, the action of air currents, the muscular tremor of the hand that holds the pipe, the action of gravity, etc. If any one of these conditions be in any way altered, some change will be made in the tint. This throws light upon one of the reasons why psychology lags so far behind the other sciences. Suppose the physicist should select that one square inch on the surface of the bubble where the colors were brightest, and should endeavor to formulate for each, in terms of the others, the laws of existence and sequence, ignoring the while the system of forces upon which those colors depend: however painstaking his efforts, they would meet with little success, and this has been the fate of the psychologist. Too often he has confined his attention to that portion of consciousness which was brightest, or for some other reason the most interesting, while if he had but looked into the marginal or subconscious he would have found traces there of the activities which were all the while affecting the area of greatest vividness.

Not only is consciousness as a whole thus correlated to a system of physical forces, but we find that its several elements are also related to certain subordinate systems of forces which, while forming part of that total, have a certain degree of independence. It is known, for example, that the activities which take place in the occipital or hinder portion of the cortex are accompanied by sensations and ideas of color; those that take place in the temporal region, in the neighborhood of the ear, have to do with sensations and ideas of sound; those of the Rolandic region, which forms an archlike band passing over the brain from a point a little in front of the ear, are probably the basis of sensations and ideas of movements as felt. Since the awakening of these latter tends to produce or sustain the movement in question, and since volition is but another name for the initiation of a movement through an idea representing it or something with which it is associated, this is also a region essential to the performance of voluntary movements. And it is probable that all the definite qualities of sensation and the corresponding ideas are related to more or less well defined portions of the cortex. But we know that even our very simple ideas—as those of a rose, or a book, or a man—involve elements drawn from many of these sources. We must then suppose that the idea of a rose depends upon a co-ordination of processes which, although situated in different portions of the brain, act together in the production of this idea. As my thought flits from the color to the fragrance, to the touch, to the plucking of the rose, so do the pulses of energy pass along the conducting fibers from the region of vision to that of smell, to that of touch, to that of movement. Further, as the rose is to me a relatively stable thing, we must suppose that these physical processes are not merely co-ordinated for the time being, but are organized into a quite permanent system which retains its coherence and existence as a system as long as the idea of a rose remains to me one and the same idea, although consisting of unlike mental elements.

I can not undertake to work out in detail many of the more complex organizations or systems which we can detect in mind. To do that would be to write a treatise on psychology, and my only object at present is to make clear the conceptions of coordination and organization. Yet to two of these more complex forms—and they are unfortunately the most complex of all—I must make some reference, since a comprehension of them is presupposed in the application of this theory to the curious phenomena which we wish to explain.

I have shown that the state of consciousness at any given moment involves a very complex co-ordination of the forces that underlie it. And I have also shown that the permanent existence of any element of consciousness, if at all complex, involves not merely a co-ordination, which might be temporary, but a permanent organization of certain of those forces into enduring systems. Not enduring in the sense that they are always actively operating, but in the sense that when any one element is active it calls into activity the other elements as well. The same is true of consciousness as a whole. We may discern this in two quite different forms. The first is what we may call the permanent form of consciousness. We observe that at any given time consciousness has a certain form of organization which is so constant that we are tempted to think it can not exist in any other form. Some one element or organized group of elements tends to be more clear and distinct than the others. This one is called the center of attention or focus of consciousness; the others constitute the margin. From moment to moment the focus shifts; new elements rise into dominance, and the old fade away. Yet there is always a dominant element, and this it is to which we attend. Usually the focus and margin are inversely related to one another; that is to say, when any given group tends to become more clear and distinct the other elements tend to lose with respect to clearness and distinctness. This is what we mean when we say that we can not attend to two things at once. But it is not always true. There are states in which the heightening of one element tends to heighten all the others as well. In imminent danger, for instance, there is frequently an intense exaltation of the total content of consciousness, and the same phenomenon is occasionally found as a precursor of an epileptic attack. Now, this constant form into which consciousness tends to fall, and which is, by the way, the basis of our notion that the mind is a single entity of some sort, is very suggestive. We know that all physical forces, if they can in any way act upon one another, tend to coalesce into one common resultant, and I think it probable that in the law of attention we see the mental manifestation of some form of coalescence between the physical forces which form its basis.

Again, the consciousness of each of us forms a permanent entity which we severally call "myself." Into all the problems connected with this word of many meanings I can not enter, but of one thing we may be quite certain—whatever the consciousness of self may be, it is largely dependent upon the continuity and uniformity of our memories. Any great change in a man's life which introduces into his present a mass of experiences quite out of keeping with his past is apt to introduce into his consciousness of personal identity a strange sense of unreality and uncertainty. He rubs his eyes and says: "Who am I? Am I really John

Smith? Am I the man who did this and that? or is it merely a dream?" And when we go further, and totally destroy a man's memories, as not infrequently happens in cases of disease or accident, we find that the consciousness of personal identity is also gone. The man may know that he is *somebody*, or at least that he *ought* to be somebody, but he can not tell who he is. If the injury be greater still, even this consciousness that he ought to be somebody is lost, and the patient sinks into a condition of dementia, which we can not well understand because it is so utterly unlike anything that we have experienced.

Now, evidently, this is very like the case of the simple idea. I have shown that the permanence and identity of any such idea, as that of a rose, which is the standard illustration in psycholgy, depends upon the organization of a permanent system of physical forces of some kind, and I think we have reason to believe that the man remains the same for much the same reason, although the elements entering into that system are a thousandfold more numerous and more complexly interlaced.

PROFESSOR FORBES ON "HARNESSING NIAGARA."

BY ERNEST A. LE SUEUR, Sc. B.

THE past few months have seen the successful completion of a gigantic work, of epoch-making extent and significance—the Niagara Falls electrical power transmission plant. An article appeared in these pages in September, 1894, describing something of the difficulties which had been met and overcome by the engineers in charge of the water power and generator installation of the Cataract Construction Company, as the corporation which had the contracts for erecting the plant was named.

Prof. George Forbes, who held the position of consulting electrical engineer to that company, is to be heartily congratulated upon the success that has crowned his efforts. It becomes pertinent at present to insist, however, that Prof. Forbes should be content to limit his claims to glory to the considerable work that he has undoubtedly accomplished, for, unfortunately, he appears not overanxious to define that limit when discoursing to the public about his achievements.

There has been some bickering between Prof. Forbes and Prof. Rowland, of Johns Hopkins, as to which of the two was the originator of certain of the novel points in the Niagara Falls Power Company's generators. The atmosphere is very murky in consequence, but some facts would seem to have filtered through, and we shall take occasion to refer to them later. What seems to call for notice at this moment is a paper by Prof. Forbes, which appeared in the September Blackwood's, entitled Harnessing Niagara.

It is doubtful if any American magazine would have published that article, even had it contained fewer references to the shortcomings of the United States. It seems to us, however, that it would have been much better for it to have appeared in this country than in Great Britain, because of the freer criticism it would here have had, and because America's faults would then have been told where it might be hoped that, coming from so authoritative a source, certain valuable reforms would result.

A large portion of the article is devoted to a description of Forbes's own unusual endowments and capabilities, natural and acquired, which, it would appear, fitted him for the position of consulting electrical engineer to the Cataract Construction Company, not less than for the suppression of the American railway conductor.* A perusal of the article brings to one's mind the couplet by a famous English librettist:

> " He was the bravest man in France ;
> He said so, and he ought to know."

Having noted the title of the paper, we are astonished at the space that is devoted to placing the demerits of this country in relief against the author's excellences, especially in so short an article. To quote certain instances, he says: "There are two great mistakes commonly made as to Americans: one is, that they are original inventors; the other is, that they are humorous. Neither of these propositions is true." The chief argument he advances against our possession of humor is that "their periodical literature is filled with so-called wit, but it smells strongly of the midnight oil." This is most sadly true, but, if one on this side of the water may judge, how much more so is it with British publications of alleged humorousness! The professsor admits, however, that in the matter of humor there are some most brilliant exceptions in America. May we not ask whether Great Britain, for instance, can produce exceptions in this line to vie with the United States ?

In support of his theory that the inventive faculty is lacking in the New World, he states that Americans are competent merely to design, not invent, and, by implication, informs us that his own talents in the inventive line are the real article, and that

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* He informs us that on a New York Central train he created disorder in the ranks of six (?) conductors ("the most insolent class of men in the country"), who filled the smoking room to the exclusion of himself. The subsequent verdict of one of the conductors is stated to have been that there were no flies (*sic*) on Prof. Forbes.

no American was competent to undertake what he has successfully accomplished; and, later, dwells at length upon his improvements in dynamo construction in the matter of revolving fields. The importance of the device of rotating the fields instead of the armature in the situation he was dealing with was great, but, as that was the form of the first alternating dynamo ever constructed (in 1833), the novelty of the mere principle, which is what he refers to, is not greatly in evidence, nor, we may add, is the inventive faculty.

In leaving the non-inventive-humorous proposition he says: "Invention and humor require a gift of imagination, the same gift that shows itself in poetry and letters, in music, painting, and sculpture; and in no one of these directions has this gift of imagination been found to predominate among Americans." Letting the last sentence pass, we may observe that it would be as pertinent to deny to the ancient Greeks the possession of any one of the qualities last named because (what will probably be admitted) the inventive talent did not predominate among them.

"They like giving big names to things in America," says our scientist. "A pond is a lake, and a hill is a mountain; they never speak of the sea, it must be called the ocean; a meeting is a convention, a dictionary is a 'speller and a definer,' a town is a city, a chairman is a president, and so on." If I am not mistaken, Max O'Rell has told us much the same thing, and we ought therefore to take it to heart. O'Rell has wonderful insight and an unfailing impartiality, which Prof. Forbes lacks. Take, for instance, the cases the latter cites in support of his proposition. How false some of them are, and how purely local most of the rest! Then, to take one of his instances, it would seem as though Americans were not exceeding their rights in using the word "city" in the nationally defined technical sense of a place of over such and such a population. The method possesses indisputable advantages over the British plan, by which, we understand, no place without a cathedral can be called a city. The latter system of nomenclature has much to recommend it on the ground of mediæval simplicity, but results in the omission of several places of great size and importance from the list of English cities.

We are informed that in this country "the average man is not a good specimen. He is apt to be a most awful 'bounder,' has no taste, and does not know the meaning of the word 'repose.'" We must waive comment on the first accusation on the ground of insufficient information as to what a bounder is. As to the rest, we might suggest to Prof. Forbes that one may possess all the repose that ever marked the caste of Vere de Vere, when experimenting with *bons mots* on railway conductors, and yet be sadly wanting, both in that quality and in the good taste he refers to, in his literary efforts. One singular example of lack of dignity in the paper under discussion is an attack on Lord Kelvin, describing a line of action of his as hitherto unknown among professional men, in which he attempts to take the edge off that statement by mentioning that distinguished man as his most esteemed and oldest scientific friend.

A remarkable thing is that Prof. Forbes admits that there are exceptions to his somewhat sweeping condemnation of this country, for, after making the uncompromising generalization about the average American, he says that it is not necessary to meet the specimen except in hotels and trains, and thereafter follows a list of no less than fifteen names in one paragraph of fashionable friends of his who were, of course, delightful, the bearing of which on the title matter of the paper is obscure. At the beginning of his article also he makes disparaging reference to our experts, and, at the end, "wishes to bear tribute to the kindly friendship which I almost universally experienced at the hands of American engineers." We have one fine sentiment to record: "An Englishman in America should always try to retain his Englishness." This should apply to any one who is proud of his country; but, unfortunately, the reasons the professor urges for holding that aim in view constitute only another fling at Americans.

Turning now to such portions of the paper as do actually bear upon the Niagara work, we have, as above mentioned, the professor's remarkable claim to originality in the matter of the revolving fields. Again, in describing the steps leading to his choice of apparatus, he says: "I soon realized the fact that not only could the latter (alternating) current be more easily obtained at high pressures, but that it could more easily, and without moving machinery, be transformed to any required pressure at any spot when it was wanted." This statement, it is to be regretted, is nothing short of dishonest. Forbes is here speaking of the year 1890, at which date the fact that he refers to as having worked out for himself was literally the A B C of electrical work, and part of the common knowledge of thousands of "line" laborers throughout the world.

With regard to the two points so far mentioned the distinguished engineer has not sought to belittle the work of others, but only to magnify his own; he has not, however, confined himself to this more moderate course, and we find him stating that "the highest scientific authority in America had taken up the same position as Lord Kelvin," referring to the latter's alleged strenuous opposition to the use of the alternating current. The eminent authority referred to would seem to be Prof. Rowland, of Baltimore. This gentleman, who ought to know what it was he advised, states positively that he did not strenuously oppose the use of the alternating current; that he did not oppose it at all; and that, moreover, his opinion was given in 1889, not 1890; that what he did advise at that early date, in view of the untried state of either direct or alternating current transmission, was merely caution in adopting plans, which advice, we may add, was most carefully followed, as will be seen from the fact that the main plans, not to speak of the details, were not decided upon until three years later, during which interval some most remarkable developments had taken place both in the design of machinery for use with alternating current and in the practical transmission of the latter over an immense distance in Europe.

Our writer says: "Until I went to America the manufacturers of electrical machinery never had a consulting engineer to reckon with, but dealt directly with the financiers, who knew nothing about cost or efficiency of machinery," and reference is later made to his being the first to get guarantees of performance from manufacturers of such machinery. The present writer speaks from personal experience in declaring this to be incorrect. The way in which a company, larger and even more representative than the chief one with which Prof. Forbes did business, filled an eleven-hundred-horse-power contract under guarantee, and later supplied an auxiliary generator to make the guarantee good, would perhaps have impressed that gentleman. The particular occurrence referred to is immediately within the writer's knowledge, and the extremely exacting specifications for the said machinery were written and insisted upon by consulting engineers and not by the financiers. It should, however, be unnecessary to say that, of course, the method of requiring guarantees and of employing engineers to write specifications was common in the electrical business, as well as in all others, long before the advent of Forbes.

There are other points in the professor's paper besides those already referred to which require contradiction, and still others, covered by the matter in controversy between himself and Prof. Rowland, which there is every reason to believe might be improved in the matter of accuracy, but which, since directly opposite statements are put forth by the two men, we must be content to let stand in default of other sources of information regarding them.

An opinion of Prof. Forbes that surprises us is set forth in the sentence, "I had always wished to put the dynamos at the bottom of the pit close to the turbines, and I still believe that this arrangement would have served us better." It is the opinion of the writer that it is an unusually good thing for the Niagara Falls Power Company that the above was not done. In his experience it is a practical impossibility to keep penstocks under great head from leaking, and the moisture thereby communicated to the atmosphere, as well as that due to the location of the dynamo room at the bottom of a narrow pit one hundred and fifty feet deep, with a torrent carrying a hundred million gallons per hour raging immediately beneath, could not well fail to impair the machines' insulation. Since the latter must carry a vast electrical pressure of alternating current, any impairment would be fatal to the maintenance of the plant. An instance occurs to mind in which a generator plant was located on a level with the wheel cases, and this not at the bottom of the pit by any means, but at the top of a draught tube some feet above the level of the surrounding ground, and in which, owing to the moisture unavoidably present, the generators had subsequently to be removed.

It is impossible, without quoting most of the article in question, to convey an adequate impression of the egotism that pervades it. A few phrases may, however, be of assistance to an understanding of this.

"The electrical work which I have carried out has been done at a cost that seems incredible to many."

"I did not care to go much into society."

"On such occasions I would write to my millionaires and tell them that if they did not do what I told them," etc.

"I had a lovely house in parklike grounds."

"I had a nigger servant."

"I had thus become well acquainted with the system which Nicola Tesla, a young Montenegrin, was experimenting on," etc.

We fancy that most people know the name and fame of "the young Montenegrin" a good deal better than they do those of Forbes.

In fact, the whole article is quite alliterative from the continuous repetitions of the first personal pronoun singular.

In an opening paragraph Prof. Forbes speaks of the production of the paper under discussion as the result of an attempt to curb a natural tendency to reticence, and, later, in describing the Falls of Niagara, he says, "The most impressive points of view are those that make you feel the smallest." It is not apparent whether the professor himself experienced the sensation, but, if he did, the depression must have been evanescent, for near the end he says that, while his company ascribes his "splendid results" mainly to engineering skill, "I am inclined to believe that they were fully as much the result of an exercise of tact, judgment, and forbearance, combined with firmness—qualities which I do not hesitate to say that both the officers of the company and myself recognized in each other." All of which, while possibly true, is scarcely the utterance of a man hampered by a temperament in which reticence and a feeling of insignificance are struggling with each other for supremacy.

Americans have faults and are not more sensitive to having them pointed out than other people, but the tendency among descendants of Anglo-Saxon stock to resent the imputation of the possession of visual motes by ill-tempered owners of larger ocular imperfections is deeply rooted. We have not for many a long day seen an article in a prominent English journal so well designed, by its gratuitous disparagements of America, to keep alive the fast-expiring dislike to the mother country that it is to the interest of all of us to see buried.

HEALTH EXPERIMENTS IN THE FRENCH ARMY.

By STODDARD DEWEY.

THE report made to the French Parliament in April of this year by General Zurlinden, Minister of War, discloses a new aspect of that life in barracks to which the armed peace of Europe condemns all her young men for a period of their best years. It is nothing less than an experimenting on a giant scale with the health and resistance to epidemic disease of French youth under military regimen.

The first and most fatal enemy has always been typhoid fever.

In 1887 the annual number of cases reached eight thousand, with a death-rate of about eight hundred, for much less than five hundred thousand men. This gave an average of deaths from this single disease very nearly equivalent to two out of every thousand men, while the total mortality of the army was only 8·43 per thousand. In the mortality of French civil life, which remains at eleven per thousand, the destructiveness of typhoid fever is still greater, at least in a large number of towns and cities.

Doctors have long known the cause of the prevalence of this disease; but it is not easy to persuade the ordinary citizen of the necessity of precaution in the use of so common a thing as water. Jules Simon tells a story, good by way of illustration, of the alarming typhoid epidemic in Paris a few years ago. Both doctors and Government had warned the people that the germs of the disease were contained in the water of the Seine, and that only filtered and boiled water could be used safely. One day a *café* waiter was discovered replenishing the drinking decanter of his customers from the common spigot giving forth the river water in its unadulterated impurity. When reproached with his deed, he answered indignantly:

"My father and my grandfather drank this water, and they lived to be old men. I have no time to bother with doctors' notions."

During the last month of March there was a sudden outburst of a strange and fatal disease among the old men in the city poorhouse at Nanterre. It was accompanied by tetanoid symptoms (lockjaw), and was attributed by the physician in charge to the ergot of which he discovered traces in the very bad rye bread furnished to the inmates. The director, when asked about the reason assigned, is reported to have answered comfortably, "Doctors' humbug!"

It is the good luck of the army that an intelligent service of hygiene can be enforced whenever the authorities wish. The will began with M. de Freycinet, who was Minister of War through so many changing administrations. He set about substituting spring water or filtered water in place of the water from wells or rivers, which had previously been used by garrisons. By 1890, in comparison with 1887, the number of typhoid cases had diminished in the proportion of thirty-six per cent. By 1891 the decrease was forty-nine per cent. In the single military jurisdiction of Paris it reached seventy-five per cent. This astonishing and satisfactory change followed immediately upon the change of the water supply.

The record of the last three years only confirms this brilliant demonstration of the real work which can be accomplished by rational hygiene. There were five hundred and forty fewer cases of typhoid fever in the army posts in 1894 than in 1891, though the percentage of deaths to cases was slightly higher. But the most striking facts are found in the statistics of particular places like Paris, which has always had the reputation of being a center of this special disease.

Among the soldiers under the military government of the city there were eight hundred and twenty-four typhoid cases in 1888. The following year the number increased to eleven hundred and seventy-nine. At that time the water of the Vanne was substituted for the contaminated Seine water. The cases of the next four years numbered, respectively, only two hundred and ninety-nine, two hundred and seventy-six, two hundred and ninety-three, and two hundred and fifty-eight. Last year the Vanne itself became contaminated through an accident, the history of which has been traced conclusively. The result was an increase of typhoid cases in the Paris garrison to four hundred and thirty-six, of which three hundred and ten occurred in the three months of February, March, and April. During January and February of the present year (1895) there were only eight cases in all.

The fact that typhoid fever comes and goes with impure drinking water could hardly receive a more striking demonstration. Yet the possibility has been realized in the experience of Melun, a garrison town of about twelve thousand inhabitants, situated on the Seine, twenty-eight miles above Paris. Here, in 1889, there were one hundred and twenty-two cases of typhoid fever among the soldiers. The Chamberland filters (Pasteur system) were then introduced, and the cases of the following years numbered, respectively, fifteen, six, two, seven, and seven again for 1894. Suddenly, during the severe weather of February of this year, twenty-eight dragoons, one after the other, came down with the fever. The infantry battalion, living in the same barracks, had not a single case. The secret was soon out. The filters had been allowed to freeze and the soldiers were ordered to drink only the weak infusion of tea furnished them, in which, of course, the water was boiled. The dragoons had simply not obeyed, but had helped themselves to the Seine water from the hydrants.

At Lorient, as in other districts of the coast of Brittany, typhoid fever has long been endemic and still remains so among the civil population. In the garrison, until 1889, there was an average number of one hundred and seventy cases yearly. In 1890 filters were set up, with the result of a decrease in the cases to fifty-eight for that year, while the three following years numbered only two, one, and one, respectively. In 1894 water was brought into the barracks from a spring supposed to be pure. In a short time eleven cases of typhoid fever declared themselves. On examination it was discovered that the spring was contaminated, and the garrison ceased using it for a water supply. The disease has now all but disappeared again.

Similar facts in connection with typhoid fever have been verified in more than twenty widely separated garrison towns. Of the cases which still appear where filtered water is used, the cause has invariably been found, when investigation was possible, to be some accidental use of contaminated water. Thus at Nantes, in Brittany, endemic typhoid fever was reduced by the use of filters to isolated cases. In 1893 there were seventeen, and in 1894 there were thirty cases needing explanation. It was soon remarked that nearly all were among orderlies, who have the habit of taking their meals in certain restaurants of the town. In each of these places it was discovered that the water used was polluted by infiltrations from privies. In four other garrison towns the same fact was reported.

A final instance, which is also one of the most remarkable, is that of Auxerre. Here one hundred and twenty-nine soldiers were down with typhoid fever in 1892. Filters were set up, and there was one single case in each of the two following years.

Only one objection has been urged against this triumph of the theory that pure water is a preservative against typhoid fever. It is probably more apparent than real. It concerns the attendants on the sick in the military hospitals. These men can hardly be exposed to the danger of drinking contaminated water, and yet many of their number fall victims to each typhoid epidemic. In their case the disease seems to have a real contagion. But it should be remembered that the permanence of their service with the sick undermines their strength until the system no longer resists the action of the morbid germs, to which, moreover, they are exposed in a thousand ways. Their case is no exception to the rule that, under ordinary conditions of life, typhoid fever is propagated only by impure drinking water.

With dysentery—that other enemy of the soldier, both in garrison and during campaign—French military hygiene has not proved itself so successful. Until 1892 there was even a steady increase of cases, though not of deaths. Since that time there has been a diminution of cases and, in a measure, of deaths. So far, the only amelioration seems to result from a constant supervision of the daily disinfecting of privies, and from a provision of conveniences which spare the soldier the necessity of suddenly exposing himself to the chill of night in crossing an open yard.

With cholera, on the other hand, the most encouraging progress has been made. The epidemic of 1893 cruelly tried the civil population of Lorient. The garrison had but a single case. This was a soldier who contracted the disease in Vannes, where he had been in attendance on his mother, who died of it. The same experience was repeated at Brest, where the civil population suffered for months together. In the garrison only two cases declared themselves from first to last. In Marseilles, out of nineteen cases there were only three deaths.

For measles and scarlatina the French army has found neither remedy nor preventive. These diseases come to the barracks from the civil population, among which they exist permanently. Both have gone on increasing in the garrisons since 1887—measles with spasmodic intermittences, scarlatina steadily.

The most disquieting progress has been made by that strange malady—*la grippe*. This alone, from the first months of the present year, will give a high rate of mortality to 1895 among the military as well as the civil population. Only one conclusion can so far be drawn from the experience of the army. This is the simple fact that the disease is a permanent danger which military physicians have henceforth to foresee as they do cholera, cerebro-spinal meningitis, and diphtheria.

The latter disease, formerly so rare among adults, has also made alarming progress since 1888 among soldiers. It is now hoped that the antitoxine (serum) of Dr. Roux will be as successful in dealing with the dangerous microbe in garrisons as it has been in children's hospitals.

Vaccination continues to give satisfactory results against smallpox. Certain attendant dangers, which are often alleged against it, are avoided by the establishment of what are called *centres vaccinogènes*, where military physicians supervise the preparation of suitable vaccine. This, in the form of a glycerinated pulp, has been distributed to the Madagascar expedition in quantities sufficient for the revaccination of all the men during the voyage out, and of all the porters and coolies that may be needed after the arrival on the island.

In typhus, the lesson of the barracks confirms what has long been thought to be the only safeguard against its spread. This is the total isolation of cases. The disease, which is so peculiarly contagious, seemed to have abandoned France (excepting certain remote parts of Brittany) after the wars of the first Napoleon. Two years ago it broke out among tramps in the workhouse of Amiens, and soon appeared in Paris. It afterward spread among the same class of the population, in and out of prison, through different parts of the country. In the following year, 1894, it broke out again, to the despair of the medical profession. It seemed to have come back to stay, though the present prospect is more favorable. During both these years there were only six cases in the army. Of these, two occurred among military infirmarians who had volunteered their services for the civil hospitals, and one was that of a gendarme whose duties brought him in close contact with tramps already attacked by the disease.

Certain lessons of hygiene, which have been learned from harsh experience by the army, are not yet appreciated by the general public. One of these is the necessity of keeping in hospitals those who are undoubtedly convalescent from epidemic or contagious diseases. This is sorely against the will of families, and often of the patients themselves, who demand permission to complete the cure at home. Formerly, when this was granted, a frequent consequence was a relapse, and, oftener still, a communication of the disease to a new circle of the population. This has been especially observed of typhoid and eruptive fevers, dysentery, and the *grippe*.

The French army also profits by all the recent discoveries in destroying the germs of disease. Disinfecting apparatus has been indulged in to such an extent that the health service is ready even for an unusual epidemic. What the French oddly call "*coaltarisation*" is applied constantly to the woodwork of barracks. Methods of permanent ventilation have also been adopted. Each garrison is now being provided with a suitable hospital, and the separate barracks have infirmaries well fitted up.

The final result of all this solicitude for the health of the soldiers, who are the choice youth of the entire nation, is twofold:

First, the steady lowering of the mortality among them is of itself an increase of strength to the army and the country. Thus, during the last five years, on the score of typhoid fever alone, hygiene has saved to France the lives of twelve hundred and sixty-five soldiers. In the seven years from 1880 to 1886 the annual death-rate was 8·43 per thousand. In the seven following years it sank to 6·63, and in 1894 to 6·20 per thousand. Meanwhile, the mortality among people who have not the advantage of living under enforced hygiene remains at eleven per thousand.

Secondly, the compulsory military service, with all its disadvantages, gives the younger generation a strong training in practical hygiene. All able-bodied Frenchmen now learn, during a term of years, the practice of bodily cleanliness and what constitutes the health of habitation. These acquired habits they bring back to civil life.

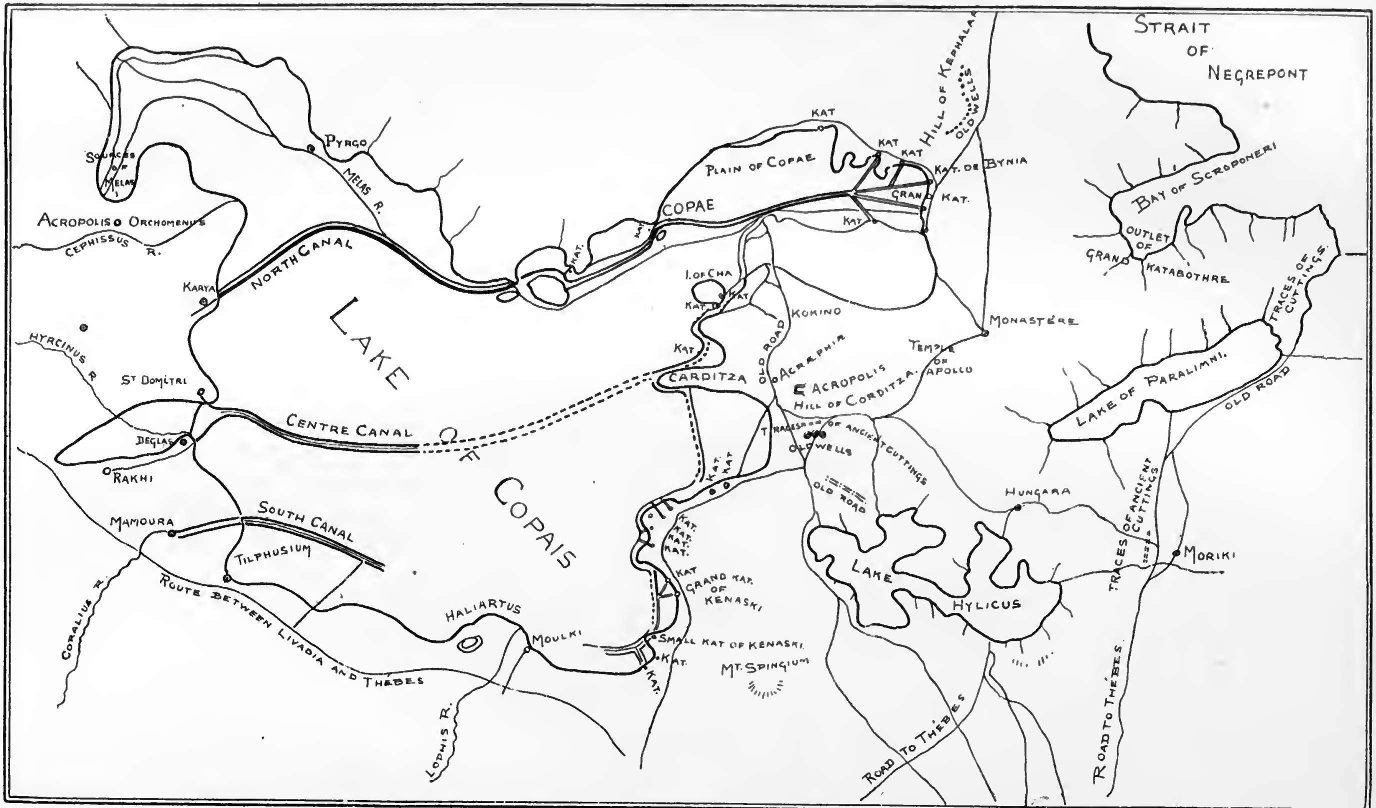
PREHISTORIC ENGINEERING AT LAKE COPAIS.

By JOHN DENISON CHAMPLIN.

HOMER, in his famous catalogue of the Greek and Trojan forces in the second book of the Iliad, enumerates more than twenty towns around Lake Copais which contributed collectively to the Greek fleet eighty ships, in each of which

"Were six score youths, Bœotia's noblest flower."

The district comprising the Copaic basin was at the time of the Trojan war, and probably long anterior even to that, one of the richest and most populous parts of Greece. Its wealth of myth would prove this, even if historic record were wanting. A circle with a radius of twelve or fifteen miles drawn around Copais will include more sites famous in romance and in history than almost any other place of like extent on earth. The Bœotian plain is nearly shut in by mountains the bare mention of whose names calls up a vast panorama of heroic figures, with a shadowy background of demigods and of gods reaching back into cloudland. Prominent above all is double-headed, snow-crowned Parnassus, with Delphi at its feet, its flanks scarred with caves and glens down which still leap the waters of Castaly. South of it, hiding the Corinthian gulf, stretches the range of Helicon, with its lovely valleys and ravines, home of Apollo and the Muses. Still farther south is Cithæron, whose groves echoed the revels of Bacchus and his train, and witnessed the punishment meted to Acteon by the virgin goddess. Under its shadow



Map of Lake Copais and Surroundings.

lies Platæa, its soil enriched with the blood of Mardonius and his Persians; and not far away Leuctra, fatal to Sparta's power, and Cadmean Thebes, home of Œdipus and of Antigone, birthplace of Heracles and of Dionysus, where Amphion sang and the Epigoni fought.

The Copaic basin itself and its surrounding hills are dotted with ruined cities. On the west shore of the lake Minyean Orchomenus, from whose colony of Iolcus sailed Jason and the Argonauts, still dominates the plain with its acropolis, its walls two miles in circuit. Its temple of the Graces, with its musical festivals, drew thither poets and singers from all the Hellenic world. Homer compares its wealth with that of the Egyptian Thebes, and so powerful was it that it held subject all the surrounding region until Heracles slew its king and made it vassal to Thebes. A little west of it is fatal Chæronea, where Philip of Macedon rang the deathknell of Greece, and where, two and a half centuries later, Sulla overthrew Mithridates. Between it and Helicon lies Lebadea, where Crœsus and Mardonius sought their fate from the oracle of Zeus Trophonius; and hard by is Coronea, famous for its temple of the Itonian Artemis and the Pambœotian festival. Near the lake is Tilphusium, with its fountain of Tilphusa, where blind Tiresias drank and died; Alalcomenæ, which claimed to be the birthplace of Athene; Haliartus, under whose walls Lysander fell; Onchestus, founded by Poseidon's son, meeting-place of the Amphictyonic Council; Acræphiæ, noted for its oracle of Apollo; and Medeon, Copæ, Holmones, Hyettus, Hyle, Peteon, and Ocalea, each famous in ancient story, and most of which sent ships and troops to Troy.

With all these evidences of pre-Homeric prosperity, one is tempted to ask, What has changed the conditions in this once favored and still fertile land, which to-day supports but a few thousand souls in scattered villages and hamlets? We find the answer in Strabo, who says: "The spot which the present Lake Copais occupies was formerly, it is said, dry ground, and was cultivated in various ways by the Orchomenians, who lived near it." This traditional account, about the only record of the prehistoric condition of the Copaic basin we possess, would seem to imply that it was kept dry artificially, and we find a partial explanation in other passages in which he describes certain subterraneous caverns and fissures through which the waters were carried off. "If the subterranean passages are stopped up, the waters of the lake increase so as to inundate and cover cities and whole districts, which become uncovered if the same or other passages are again opened." The memory of such a catastrophe, caused by the stoppage of the natural conduits, the result of seismic disturbances, as Strabo intimates, or from want of care in consequence of political disturbances, is embalmed doubtless in the tradition of the Ogygean Deluge, Ogygea being the original name of Bœotia. A similar trouble must have occurred about the time of Alexander the Great, who appears to have contemplated the reclaiming of the

Sustaining Wall of Masonry.

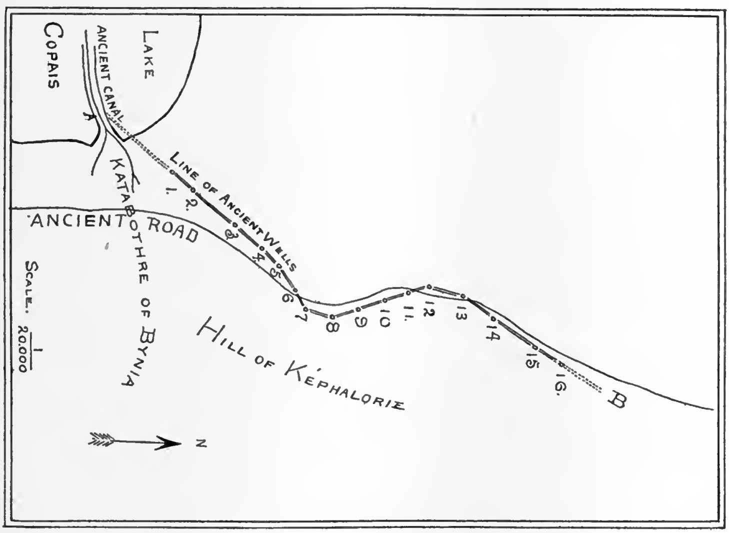
basin. Strabo says: "When the outlets were again obstructed, Crates, the miner, a man of Chalcis, began to clear away the obstructions, but desisted in consequence of the Bœotians being in a state of insurrection, although, as he himself says in the letter to Alexander, many places had been already drained."

These statements of Strabo would lead to the inference that the drainage of the basin by the ancients consisted only in keeping free from obstruction certain subterraneous passages through which the waters flowed to the sea; and this would probably have been the conclusion to-day but for the recent efforts of the Greek government to reclaim the submerged lands. These efforts, under the supervision of experienced engineers, have resulted in nearly draining the basin, and have led to the discovery of a complete ancient system of hydraulic works dating from so remote a period that all record or tradition of their construction has been lost. This system, so vast and comprehensive as to excite the wonder of modern engineers, taking into consideration the primitive appliances of the ancients, served to convert this now miasmatic basin into a fruitful plain, the home, a thousand years before our era, of a thriving and numerous population.

To give a clear conception of these ancient works and of the problems which the prehistoric engineers had to solve, it will be necessary to take a brief topographical survey of the region.

Lake Copais is the receptacle of the drainage of the valley of the Cephissus and of the plain of Chæronea, which is watered by the Hyrcinus, Permessus, Olmeus, Lophis, and other streams that descend from Helicon. All these streams flow in on the south and west sides, where the shores of the lake are simply a continuation of the adjacent plains; but on the north, east, and southwest, where the waters would naturally find an outlet to the sea, the banks form steep, rocky shores.

At the southeast extremity the lake ends in the Bay of Carditza, which is inclosed in a fold of Mount Sphingium, an offshoot of Helicon, and at the northeast in the Bay of Topolias or Kephalari, inclosed in Mount Ptoum. A depression in the flank of Sphingium is called the Hill of Carditza, and behind this, between it and Mount Ptoum, is a smaller lake, Hylice or Hylicus (Likeri). Further east, near the seacoast, lies Mount Messapium, with another small lake, called Paralimni, between it and Mount Ptoum. A similar depression in Mount Ptoum, east of the Bay of Kephalari, is called the Hill of Kephalari. The Copaic basin is



PLAN OF THE WELLS.

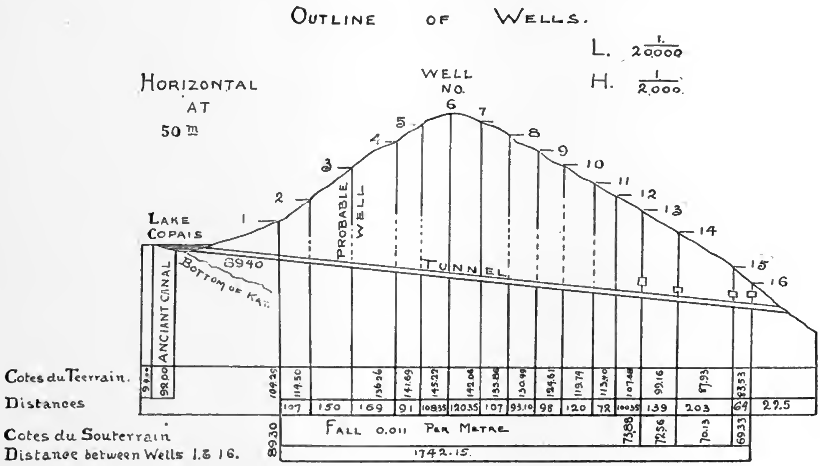
thus a natural *cul-de-sac*, with no apparent outlet; but the pent-up waters have worn fissures through the limestone rocks underlying the hills and formed for themselves, perhaps with some volcanic aid, as Strabo suggests, subterraneous outlets into the Euripus or channel of the sea between Bœotia and Eubœa. There are twenty-three of these subterraneous passages, locally called *katabothra*, but many of them unite underground and only four reach the surface on the east side of the hills. Of these four outlets, one passes southward under Mount Sphingium into Lake Hylice or Likeri, from which there is probably a subterraneous communication with Lake Paralimni and beyond it with the sea. The three others pass eastward under Mount Ptoum and its offshoots. The principal one, called the Katabothra of Bynia, with two openings on the lake side, passes under the Hill of Kephalari in a general direction from southwest to northeast, and opens on the east side of the hill in a large grotto about forty-five metres lower than its source, whence its waters flow through the deep ravine of the Valley of Larymna into the sea.

Strabo says that Lake Copais is three hundred and eighty stadia (about forty-seven miles) in circuit, but it differs greatly at different seasons, sometimes threatening to inundate the whole valley and sometimes forming only a series of fens overgrown with reeds—the auletic or flute reeds of the ancients, from which Pan's pipes were made. Its bottom, which is ninety-five metres above the sea, is a nearly level plain with a slight incline toward the east and a little elevation in the center. Modern travelers, from the time of Sir George Wheler upward, have noted on both its north and its south shores the remains of ancient dykes, in some parts re-enforced with masonry. These dykes, in several places still used as roads, have generally been considered as ancient causeways, means of communication in times of flood between the towns on the banks; but they are now shown to be parts of a system of drainage canals by means of which the superfluous waters of the basin were led to the katabothra under the hills.

The recession of the waters through the efforts of the present engineers has shown that there were three main canals through the entire length of the lake, branching at their western ends into subsidiary canals or feeders for collecting the various tributary waters. These main channels, which for convenience' sake we will call the north, middle, and south canals, are constructed partly of excavations and partly of a series of dykes or causeways, strengthened where necessary by walls of cyclopean masonry. The north canal, the most carefully and solidly constructed of the three, receives the waters of the Cephissus and conducts them into a common channel with those of the Melas, a stream which, rising near Orchomenus, is navigable almost from its source. After their junction the waters flow through a bed, formed on the north by the rocky shore of the lake and on the south by a massive embankment re-enforced by masonry, behind the island of Topolias, the site of ancient Copæ. Thence the canal leaves the shore and, embanked on both sides, crosses the Bay of Kephalari and conducts its waters into the natural fissures under the mountain. This double embankment, though partly ruinous, is still plainly traceable.

The middle canal, constructed to receive the waters of the Hyrcinus, traverses the center of the lake and connects near the east end with the south canal. Unlike the north canal it is made wholly by excavation, the earth thrown out forming its banks, and it is nowhere strengthened by masonry. The alluvial deposits from the stream have nearly obliterated it in parts, but its course is easily traceable and in some places, especially near the western end, the works exhibit formidable dimensions, showing in cross-section an excavation of more than a hundred metres to the lineal metre.

The south canal, for the reception of the waters of the Permessus, Olmeus, and other small streams from Helicon, starts from the southwest end of the lake, and, following the south bank



Profile following the Line of the Wells.

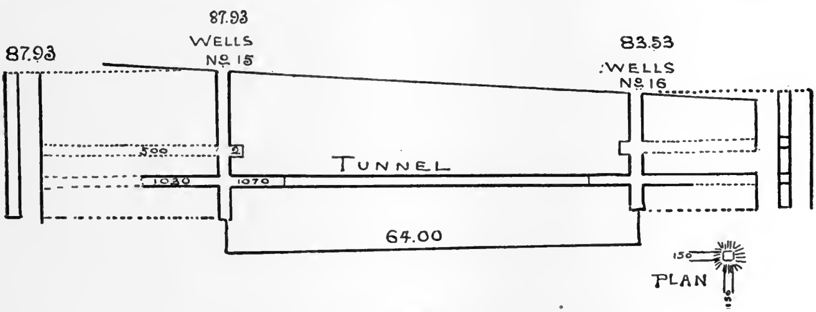
past Tilphusium and Haliartus, rounds the cliffs of Mount Sphingium, a little distance from the shore, and unites probably with the middle canal in the bay of Carditza. The two thus united finally join the north canal in the Bay of Kephalari, and the waters of all three are then conducted in a single channel across the bay and into the several katabothra at its foot. Although most of the first part of this canal is gone, parallel embankments, more than fifty metres apart, inclosing an excavation, are to be seen in places, occasionally strengthened with stone work. At the junction of the several canals especially, the work has been executed with great care, the dykes being sustained by cyclopean walls as solid and probably as ancient as those at Mycæne and Tiryns. Although the main waters of the south canal were poured into the middle and finally into the north canal, all along its course part of their volume was deflected through branch canals into the several katabothra along the east shore. Indeed, the details of the system are much more complicated than are indicated by this brief description, and comprise, in addition to the main canals, many smaller subsidiary ones both for feeding and for draining them. When we take into consideration the difficulties attending excavation in so marshy a soil, and of transporting across it the heavy stones for the embankments, and note the immensity of the plan and the thoroughness and solidity of its execution, we are moved to admiration for the engineers who conceived and built the great works which rendered this part of Bœotia habitable before the dawn of history.

The system involved, too, the clearing and the keeping open of the katabothra, which were liable to become obstructed and sometimes to be entirely closed by the caving of the soil and rocks, and there are many evidences of ancient efforts to enlarge and deepen them. That these efforts were not always successful is proved by the traditions of early inundations, referred to before, caused probably by earthquakes, but which were attributed to the efforts of Hercules when he espoused the cause of his native Thebes against Orchomenus. To guard against the recurrence of a similar catastrophe, the ancient engineers planned several cuttings and tunnels through the hills, which, if they had been carried to completion, would have rounded out the original design and accomplished what the Greek Government is to-day trying to effect—the thorough reclamation of the basin and its protection from any contingency of flood. On the southeast shore of the lake are vestiges of an immense cutting, thirty metres deep, through the Hill of Carditza toward Lake Hylicus, and beyond that traces of works to connect Hylicus with Paralimni, and the latter with the sea. Across the Hill of Carditza, too, are a series of excavated shafts marking the line of a tunnel through the hill constructed with an object similar to that of the cutting—to convey the waters to the sea through the smaller lakes; but the shafts are now filled up and there are no indications that the work was ever completed.

This route is the one adopted by the modern engineers, who, by a tunnel through the Hill of Carditza, not far from the line of the ancient tunnel, seek to carry the waters into Lake Hylicus, thence into Paralimni, and finally through another tunnel into the sea. There is also a plan to deflect a portion of the waters for use in irrigating the plain of Thebes.

A still more ambitious undertaking of the ancient engineers was an attempt to penetrate the Hill of Kephalari at the northeast end of the lake by a tunnel more than a mile and a quarter long. This hill, a depression on the flank of Mount Ptoum, has a maximum height of one hundred and forty-seven metres above the sea and fifty-two metres above the bottom of Lake Copais. Across this depression, from near the openings of the Katabothra of Bynia in the Bay of Kephalari, runs a line of ancient wells or shafts in a general direction from southwest to northeast, not in a straight line, but following the contour of the hill, ending on the east side not far from where the katabothra opens into the Valley of Larymna. There are sixteen of these wells, cut through the hard, gray limestone of which the mountain is composed, and carefully squared, with an average horizontal section of three to four metres. The first shaft, on the west side, is five hundred metres from the lake; the sixteenth, on the east side, two hundred and twenty-five metres from the opening. The wells are at an average distance from each other of about one hundred and sixty metres, and the whole distance from opening to opening is about twenty-four hundred metres.

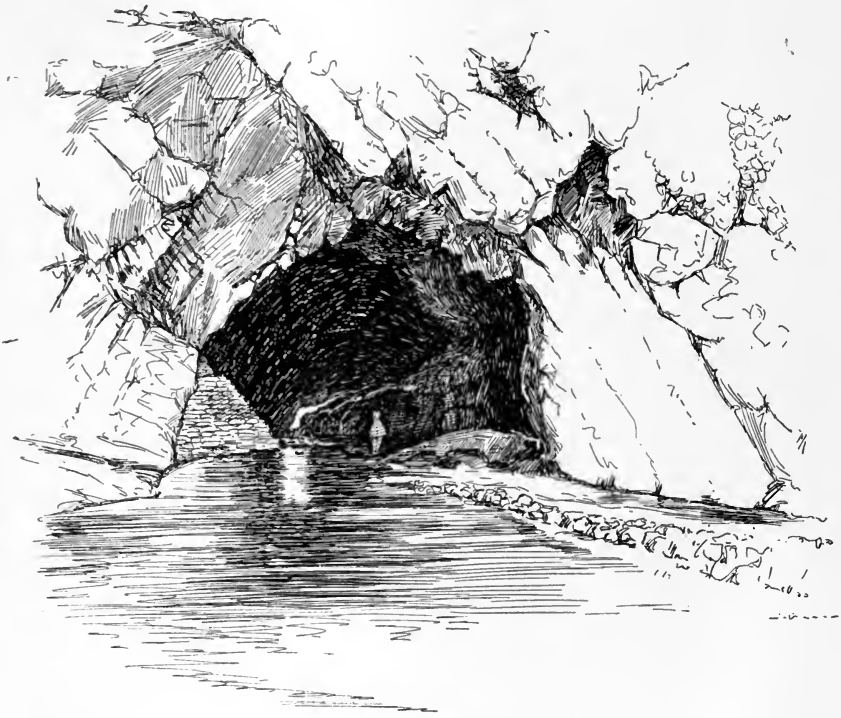
These shafts are not mentioned by any ancient writer, but have been frequently described by modern travelers, notably by Forchhammer, who has given the most complete description



LONGITUDINAL SECTION BETWEEN WELLS 15 AND 16.

of them. The general conclusion in regard to their object was that they were designed to facilitate the clearing of the katabothra when, from caving or other causes, it had become clogged; but in 1846, M. Sauvage, who examined the shafts critically and cleared several of them, came to the conclusion that they were part of a tunnel scheme, and were sunk with the purpose of giving many points of attack to the workmen engaged in excavating the tunnel instead of a single one at each end. To the ancients, ignorant of the use of explosives, this was of great importance, for the cutting with hammer and chisel was arduous and slow. Even with these numerous shafts, which must themselves have been a difficult undertaking, the excavation of so long a tunnel would have cost the labor of many years. In 1882 several more were cleared and thoroughly examined—the first and the second on the west slope toward the lake and the thirteenth, fourteenth, fifteenth, and sixteenth on the east slope of the hill. The first and the sixteenth wells are each eighteen metres deep, while the sixth, at the summit of the hill, is sixty-six metres deep.

Sauvage concluded that the tunnel had been left unfinished, which later examinations have fully proved. The fact that the first and second wells contain water indicates that it had been completed on the lake side for at least five hundred metres. The exploration in 1882 of the thirteenth well, whose orifice is at an elevation of 107·68 metres, discovered, at a depth of 28·35 metres, a horizontal gallery, 1·60 metre wide and 1·65 metre in the axis,



Outlet of Katabothra of Bynia.

cut in each direction about six metres. At 2·15 metres below this was found a second gallery of the same section, cut in the same direction, and the shaft was excavated 2·70 metres farther down, probably for use as a drainage well, ending in a level bottom, its total depth being 36·50 metres. The fourteenth, fifteenth, and sixteenth wells, at decreasing altitudes, show a similar interior disposition, save that in the fourteenth the gallery has been but slightly advanced and there is no drainage well. In the fifteenth shaft, which has a total depth of 78·93 metres, the upper gallery is cut to a depth of five metres on the west and two metres on the east, and the lower one 10·30 metres on the west and 10·70 on the east, while the well is 4·70 metres deep. In the sixteenth well the upper gallery is cut only two metres on the west and none on the east, the lower one seven metres on the west and 7·30 on the east, with a well of 4·20 metres in depth. In the last shaft the two galleries are three metres apart, and in the fifteenth only 2·15 metres, thus showing a tendency to diverge. This would seem to prove that there was no intention of ultimately uniting the two galleries by cutting away the rock between. It is more probable that the upper galleries were begun first, and that some consideration induced the engineers to change the grade and give a greater fall to the tunnel. The mean section of the lower gallery is about two metres, the fall from Copais to its mouth is 0·011 metre to the lineal metre, and its total length completed would have been about twenty-four hundred metres. The cutting of so long a tunnel through so hard a rock with the primitive means at the disposal of the ancients shows not only an audacity of plan and a persistent obstinacy in execution, but also a skill in the art of the engineer and the miner that would be no discredit even to the present age.

Who were the authors of these great works concerning which history is silent and which are themselves their only witnesses? Perhaps this question will never be satisfactorily answered. Leake and others attribute all, the wells of Kephalari as well as the canals, to the Minyans, while some believe that Crates of Chalcis was responsible for the parts exhibiting the most engineering skill, and others ascribe them to some of the earlier Roman emperors. Curtius, in his Die Deichbauten der Minyer, a paper read before the Berlin Academy in 1892, carefully distinguishes two distinct works and methods of work: (1) the utilization of the natural exutories toward which the waters were led by means of dykes and canals, and (2) the formation of an artificial emissary to draw off either all the water or the excess of water from the lake. The first, grand and simple in design, he attributes to the primitive or Homeric age; the last, marked by careful calculation and executed with the skill of the practiced engineer, he ascribes to the age of Alexander, and presumably to Crates, the only name mentioned in connection with it. Unless the future shall bring to light some inscribed stone or other monument which shall give us definite information concerning the promoter who planned or the engineer who executed these vast works, we shall have to accept the judgment of Curtius and give the credit of them to Crates, the miner of Chalcis.*

* I am indebted for much of the material in this article to two articles, by Michel L. Kambanis, in the Bulletin de Correspondance Hellénique, published in 1892 and 1893, entitled Le Dessèchement du Lac Copais par les Anciens; and to an article by Dr. Alfred Philippson, in the Zeitschrift der Gesellschaft für Erdkunde zu Berlin, 1894, entitled Der Kopais-See in Griechenland und seine Umgebung.

SIR JOHN LUBBOCK AND THE RELIGION OF SAVAGES.

By The Very Rev. JAMES CARMICHAEL,
DEAN OF MONTREAL.

THE question as to whether there are races or tribes on the earth entirely without a religion is one that demands on its threshold a definition of the word "religion." That it can not fairly be tied down to advanced forms of belief seems apparent, and hence the necessity of falling back on the original meaning of the word—i. e., that of binding fast the human mind to a sense of the obligation which it owes to supernatural powers. Civilization, education, may make this obligation clearer, and a professed revelation may bring before the mind the attributes of the powers to whom the obligation is felt to be due; but, as long as the obligation is mentally present and the force of the obligation fashions to any important extent not only personal but tribal conduct, so long in fairness we seem bound to acknowledge the religiousness of such persons or tribes, even though such religiousness may never create a theology, or a cut-and-dried system of doctrinal truths.

If this definition of religion be accepted, then it may boldly be asserted that, as far as is known, there is not a tribe on the face of the earth without a religion; indeed, it may be said that, of all human ideas that in any form influence the mind and conduct of man, there is no idea so widespread and influential as the religious idea. To us, living as we think in the light of reason or revelation, such religious ideas may appear unworthy of the name, but when we consider that the most indefinite belief may—and indeed, as a rule, does—lead a savage to fashion his conduct in accordance with what he believes to be the will of higher powers, as far as personal actions are concerned, he stands on exactly the same platform as the most devoted believer in natural or revealed religion.

In such cases, as far as the use of the word religion is concerned, it matters little what the mental idea of the higher power or powers believed in may be. That idea may center itself in a supreme God, or a Trinity of gods, or a multitude of gods, or in good and evil spirits, or in gods dwelling temporarily in common things, or in the spirits of dead ancestors or friends, but as long as any one of such powers demands and receives obedience, and as such obedience fashions life, the most indefinite spirit is practically as powerful as the most clearly defined god. And the same may be said with reference to forms or methods of worship. If the worship, whatever form it takes, is regarded as a necessity, or a privilege, or a charm, or a preservative against evil, or an engine of evil against others, it matters little as to whether it be rendered to God, or spirit, or goblin, or devil, because, whatever the worship is rendered to, the worshiper honestly feels he is in the presence of one whose power is needed to aid him in his life or work, and without whose help he can not be successful.

The chief contestant of universal religiousness has been, and is, Sir John Lubbock, although the force of circumstances has driven him of late to change his mode of presenting his contest. In the earlier editions of his Prehistoric Times he claims that "almost all the most savage races" are "entirely without a religion," "without idea of deity," and that the "almost universal testimony of travelers" supports this assertion. In his fifth edition (1890) he still claims that "almost all the savage races" are "entirely without a religion, without idea of deity," but he proceeds to define what religion is not. It is not "a mere fear of the unknown," it is not "a more or less vague belief in witchcraft," it is something "higher" than all this; and if this "higher estimate" of religion be adopted then his original assertion remains true, that "many, if not all, of the most savage races" are "entirely without a religion, without any idea of a deity." The object of this definition of the word religion is plain. Between the years 1869 and 1890 evidence as to the religiousness of savage tribes kept pouring in from all quarters of the world; the list of unbelieving savages made public by Sir John Lubbock in 1869 was seriously interfered with, and the position taken by Waitz, that "the religious element, so far from being absent from uncultured peoples, influences their whole conception of Nature," was powerfully substantiated. Then Sir John Lubbock repairs his damaged argument, working with the implements of the most bigoted member of an old-fashioned missionary society. He defines religion as something spiritually "higher" than the belief of a Hottentot or Eskimo, and then repeats his assertion of 1869 that "all of the most savage races are entirely without" such "a religion."

Sir John Lubbock's method (pursued consistently through all editions) of adducing evidence in favor of his assertion as to the non-religiousness of savage tribes is palpably unreliable, as far as he professes to give the full intention of the authors quoted. Bates, Caillie, Ross, and others certainly say all that Sir John Lubbock quotes, but they say much more; and what is left unquoted often throws a totally different light on each quotation. He quotes Caillie as follows: "I tried to discover whether the Foulahs (of Wassoula, in central Africa) had any religion of their own; whether they worshiped fetiches, or the sun, moon, or stars; but I could never perceive any religious ceremony among them." * Here Sir John Lubbock plainly means to teach, on the authority of Caillie, that the Foulahs were not even fetich-worshipers; that they were positively without any religion of their own. But if he had read Caillie more carefully—read the context as well as the text—he would have discovered that the Foulahs and kindred tribes were idolaters; for that well-known explorer goes on to say: "Wassoula is a country inhabited by idolatrous Foulahs; they carry on little traffic, and never travel; their idolatry would indeed expose them to the most dreadful slavery if they did. . . . They have each several wives, like all other idolaters." It is plain that Caillie here makes a distinction between higher forms of worship and the grosser worship of images. He sought for the higher form of worship, and found no trace of it, but he evidently found the grosser form, or evidence of it. And it was this grosser form of idolatry that made it dangerous for the Foulahs to travel outside of their limits; for, if they had done so, they would have come into contact with Mohammedanism, pledged to the extirpation of idolatry, and in many countries to the enslavement of persistent idolaters.

The same lack of thoroughness in quotation is noticeable in Lubbock's treatment of the testimony of Bates as to the Brazilian Indians. He says, "According to Bates, 'none of the tribes on the upper Amazons have an idea of a Supreme Being, and consequently have no word to express it in their language.'" This quotation is perfectly correct, but it does not imply what Sir John Lubbock is seeking to prove—namely, that "almost all the savage tribes are entirely without a religion." It simply affirms that Brazilian Indians do not believe in a Supreme Being—an affirmation that might fairly be made with reference to many tribes whose beliefs are very apparent. But in no sense can Bates be quoted as a witness to the absence of religious belief among Brazilian Indians; his testimony runs in the opposite direction. "The mind of the Indian," he writes, "is in a very primitive condition. He has no idea of a Supreme Being, but at the same time he is free from revolting superstitions, his religious notions going no further than belief in an evil spirit, regarded merely as a kind of hobgoblin who is at the bottom of all his failures in fishing, hunting, and so forth." † In this testimony the word "hobgoblin" depreciates in our minds the character of this supernatural being, but few if any savages have such a word in their mental vocabulary. Few if any evil spirits worshiped by savages unite in them the clumsiness and trickery of a hobgoblin; their evil, awful spirits are terrors, entering into all as-

* Travels to Timbuctoo, vol. i, p. 303.

† Bates's Life in the Amazons, vol. ii, p. 137.

pects of life, filled with malignant purposes, and demanding constant worship to propitiate them. Thus the Indians of Carácas, in Venezuela, north of Brazil, while believing in good spirits, render all their worship and offer all their sacrifices to a great evil spirit, and do so because they feel that the good spirits are naturally friendly and do not require to be lured on to perform beneficent actions.

Sir John Lubbock's quotation from Ross as to the Eskimo is equally lacking in thoroughness. Here is his quotation in full: "Speaking of the Eskimo, Ross says: 'Ervick, being the senior of the first party that came on board, was judged to be the most proper person to question on the subject of religion. I directed Sacheuse to ask him if he had any knowledge of a Supreme Being; but, after trying every word used in his language to express it, he could not make him understand what he meant. It was distinctly ascertained that he did not worship the sun, moon, stars, or any image or living creature. When asked what the sun or moon was for, he said, to give light. He had no knowledge or idea how he came into being, or of a future state; but said that when he died he would be put into the ground. Having fully ascertained that he had no idea of a beneficent Supreme Being, I proceeded, through Sacheuse, to inquire if he believed in an evil spirit; but he could not be made to understand what it meant." . . . "He was positive that in this incantation he did not receive assistance from anything; nor could he be made to understand what a good or evil spirit meant.'"

This quotation, standing as it does alone, is unintentionally unfair to Ross, for Sir John Lubbock either did not notice, or has forgotten to quote, words used by Ross elsewhere with reference to the Eskimo, although such words are very important. He says: "Although there is no proof whatever that this people have any idea of a Supreme Being, or of a spirit, good or bad, the circumstance of their having conjurers, and of their going to the moon after death, are of a nature to prevent any conclusion from being drawn to that effect; especially as it must be evident that our knowledge of their language was too imperfect to obtain the whole of their ideas on the subject." *

It scarcely required these honest words of Ross, written, no doubt, to prevent mistakes being made, because in the quotation as given by Sir John Lubbock nothing can be clearer than the fact that Ervick did not understand the questions put to him. "I directed Sacheuse to ask him if had any knowledge of a Supreme Being, but after trying every word used in his own language to express it, he *could not make him understand what he*

* Ross, Voyage of Discovery.

meant." "I proceeded, through Sacheuse, to inquire if he believed in an evil spirit; but he *could not be made to understand what it meant. He could not be made to understand* what a good or evil spirit meant." The probable fact of the matter was that Sacheuse could not speak the Eskimo dialect of those he was catechising. If he did not speak to them in "an unknown tongue," he certainly did in an unfamiliar tongue, the result being a general misunderstanding all round. If Sacheuse had been able to ask his listeners, "Do you believe in a benevolent Creator called 'Torngarsuk' or 'Anguta'?" it is most likely he would have received his answer in the shape of a definite affirmative.

"On Damood Island, between Australia and New Guinea," writes Sir John Lubbock, "Jukes could find no traces of any religious belief or observance."* This certainly is not to be wondered at, as he only spent part of a day there (March 21, 1845), and the effort at interchange of views was singularly weak, as the natives knew only a few words of English, and the English visitors knew nothing of the native language. The portion of the day spent on the island was taken up with bartering with the natives on the seashore, and during part of this time Captain Blackwood and Mr. Jukes struck "off for a walk across the island," in company with one of the natives. During this walk Jukes noticed a superior kind of house which he thought might have been a temple or a place for depositing the dead, or a chief's house, but "they could not make out which," for the simple reason that they could not communicate with their guide.

The case of the Aru Islanders is a striking instance of Sir John's method of quotation. Here are his words: "Mr. Wallace, who had excellent opportunities for judging, and whose merits as an observer no one can question, tells us that in the Aru Islands he could find no trace of a religion; adding, however, that he was but a short time among them." † Mr. Wallace, however, does not agree with Sir John Lubbock as to his "excellent opportunities for judging," for he says, "I could not get much real knowledge of the customs of the Aru people during the short time I was among them." The natives, he tells us, when in contact with foreign races were reserved and taciturn; and that as he could not speak the Aru language, and the natives had "an imperfect knowledge of Malay," he could not "make out very clearly" what at times they said. "I saw no signs of any religion" may mean that, in his rambles as a naturalist through the country about Wanumbai, he never came across anything like a temple or altar. Indeed, no one can read Mr. Wallace's singularly interesting book without noticing that he

* Jukes, Voyage of the Fly, vol. i, p. 164.

† Wallace, Malayan Archipelago.

apparently made no well-sustained effort at religious investigation at Aru or anywhere else.

The following gives evidence of further carelessness in quoting: In writing of certain tribes in the country of Karaque in Africa, Sir John says, "Captain Grant could find no distinct form of religion in some of the comparatively civilized tribes visited by him." * What Captain Grant says is this: "We could not trace any distinct form of religion among this interesting race, but there were certain indications or traces of Jewish worship." Then Captain Grant tells us that the king had "many superstitions"; that he "combined in himself the offices of prophet, priest, and king"; that on the feast of the new moon he "assumed the priestly garb"; and that a younger brother of his "consulted daily with the gods," and was considered a greater prophet and priest than his royal brother.

"According to Burchell," writes Sir John, "the Bachapins (Kaffirs) had no form of worship or religion. They had no belief in a good deity, but some vague idea of an evil being." † One would glean from this quotation that the only approach to religious thought among the Bachapins consisted of a vague belief in an evil spirit, whereas Burchell distinctly states that they possessed a religion, although he believed they had no "form of worship" or "religion." What he says is this: "Their religion may be characterized as an inconsistent jumble of superstition and ignorance, among which no signs were to be discovered of its having ever been derived from any purer source, or that it was aught else than the offspring of barbarous and uncultivated minds." He then further states: "The superstition of the Bachapins—for it can not be called a religion (although he himself had called it so)—is of the weakest and most absurd kind. These people have no outward worship, nor, if one may judge from their never alluding to them, any private devotions; neither could it be discovered that they possessed any very defined or exalted notion of a supreme and beneficent deity, or of a great and first creator. Although they do not worship a good deity, they fear a bad one, whom they name Mooleemo, a word which my interpreter translated by the Dutch word for devil. They also believe in amulets as preservatives against evil, in lucky and unlucky omens, in witchcraft and sorcery."

Now, if language means anything, Burchell's testimony may be summed up thus: "The Bachapin Kaffirs possess a religion scarce worthy of the name, consisting of witchcraft and sorcery and the recognition of an evil spirit called Mooleemo. Their no-

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* A Walk across Africa, p. 145.

† Travels in South Africa, vol. ii, p. 550.

tions with regard to a supreme and beneficent deity, or of a great and first creator, are indefinite and degraded; they have no outward worship, and they never alluded to their offering private devotions." All this, however, implies a great deal more than Sir John's bare statement, "According to Burchell, the Bachapins (Kaffirs) had no form of religion and worship," etc.

"Some of the Australian tribes," writes Sir John, "are said to have no religion," and he gives as his authority for this statement a reference to Collins.* Sir John does not quote literally from Collins; he sums up his testimony, but his mode of doing so is scarcely satisfactory. For Collins, while stating that the Australians worshiped neither sun, moon, nor stars, or any object, admits that those he came in contact with had "some idea of a future life"; that the greater number of them believed that after death they "went to the clouds." Conversing with Ben-nil-long as to where the black men came from, his answer was, "They came from the clouds, and when they died they returned to the clouds—Boo-row-e," and he endeavored to make Collins understand that when the black men died "they ascended as little children." Collins further states that these Australians have ideas of the distinction between good and bad, and of right and wrong, but their knowledge of the difference between right and wrong never extended beyond their existence in this world, and their ideas about the future state had no influence on their lives and actions—an assertion that might, unfortunately, be truthfully made in connection with the religious views of many professing Christians.

In dealing with the lake tribes of Central Africa Sir John gives Burton as his authority for stating that some of them "admit neither God, nor angel, nor devil." His words are: "Burton also states that some of the tribes in the lake districts of Central Africa 'admit neither God, nor angel, nor devil.'" † This quotation is very meager, and its meagerness is scarcely just toward Burton. Burton is describing fetichism, which he says "admits neither God, nor angel, nor devil"—a statement certainly open to argument—and then he proceeds as follows: "Fetichism," he writes, "is the adoration, or rather the propitiation, of natural objects, animate or inanimate—to which certain mysterious influences are attributed. Though instinctively conscious of a Being beyond them, of a first cause to every effect subject to their senses, the Africans have as yet failed to grasp the idea, in their feeble minds it is an embryo rather than an object, at the best a vague god, without personality, attributes, or providence. They call that being Mulungu—the Ahlunga of the Kaffirs, and

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* English Colony in New South Wales, p. 354.

† Transactions of the Ethnological Society, New Series, vol. i, p. 323.

the Utita of the Hottentots. The term, however, may mean a ghost, the firmament, or the sun."

Sir John's method of quotation sometimes implies total unbelief without asserting it, as in his quotation from Father Dobritzhoffer with regard to the Abipones. The words quoted are, "The whole language of these savages does not contain a single word which expresses God or a divinity."* These words taken alone imply atheism, or something akin to it, but in common fairness they should not be taken alone, for Dobritzhoffer tells us that the Abipones hold a somewhat defined faith. They believe in an evil spirit called Groaperikie—i. e., Grandfather—who is represented in the heavens by the Pleiades. In the month of May, on the reappearance of the constellation, they welcome their Grandfather back with joyful shouts, as if he had recovered from sickness, and with the hymn, "What thanks do we owe thee! And art thou returned at last? Ah! thou hast happily recovered." Next day they go out to seek honey to make mead, and as soon as that is prepared they assemble in one place at the setting of the sun to make public demonstration of gladness. Dobritzhoffer further tells us that the Abipones, and indeed all the nations in Paraguay, believe in a system of conjuring, the conjurers being invested with great powers by the evil spirit Grandfather. "From their custom of calling up the shades of the dead, we may deduce that they believe in the immortality of the soul, as may also be collected from their rites and conversation. The other people of Paraguay hold the same opinion as to the immortality of the soul. The jugglers perform the office of priests."

Colden's testimony as to the "Five Nation" Indians of Canada is presented by Sir John Lubbock in such a way as to imply far more than Colden intended. Sir John says, "Colden, who had ample means of judging, assures us that the celebrated 'Five Nations' of Canada had no public worship or any name for God."† Colden certainly does tell us that "they have no kind of public worship," but he plainly never meant to imply that they had no idea of God because they could not express that idea in one word. What he says is this: "I am told they have no radical word to express God, but use a compound word, signifying the Preserver, Sustainer, or Master of the universe."

When one considers the influence that Sir John Lubbock's Prehistoric Times has had on the reading public, and the shock that his statements as to the utter irreligiousness of certain tribes gave many of his readers, one feels inclined to question his authority as a teacher, when his quotations are submitted to the simple test of verification. One wonders how such a man as Sir

* Account of Abipones, vol. ii, p. 57.

† The Five Nations of Canada.

John Lubbock could gather into the compass of a few concluding pages of a really great work such a tissue of misguiding information. His character testifies that he could not do so intentionally, and it is not likely that his religious views are of such a nature as to lead him to rule outside of the pale of religious belief all who do not use a systematic form of worship, or do not acknowledge in creedlike fashion the person of the Divine Being. The only feasible explanation seems to be found in that peculiar blindness which all students know is apt to fall on the eyes of those who are striving to gather material to support a pet theory. In such cases, as the eye runs down page after page of close print, seeking for a scrap of information here or there, it naturally selects the sentence favorable to the theory, and passes over or does not see unfavorable sentences that may contain much more valuable information. Where such a method of investigation is pursued as a basis for quotation, a singularly strong case can commonly be presented on behalf of the theory; above all, where the works relied on have, on account of their age, passed out of general circulation. But such a method is palpably unscientific, being calculated to give a partial view of the point at issue, whatever that may be. If Sir John Lubbock, in the hurry of a busy life, has not fallen under this common temptation, then one knows not how to explain the extraordinary fact that one of the keenest minds in the English scientific world has so persistently left undone what he ought to have done, and done what he ought not to have done, as he gave to the public quotations from other writers.

Another strange fact is apparent. Prehistoric Times has gone through five editions, the first being published in 1859, the second in 1869, and the fifth in 1890. During this period of time investigations into the habits, customs, and religions of isolated and barbarous tribes have been very widespread, and the harvest of information reaped has been very large. But greater light has made no change in Sir John's authorities. Jukes, Collins, Burchell, Caillie, Dobritzhoffer, and Catlin maintain their time-honored position, and the harvest of modern investigation might never have been reaped, as far as Sir John is concerned. It is not the object of this article to enter into this harvest field, though the subject is in every way interesting and the facts close to hand. But a noble work lies before Sir John Lubbock, namely, that of reviewing his original statements in the light of modern investigation, and proceeding to prove the position that there is not a well-authenticated case of a single tribe on the face of the earth wholly destitute of the religious idea.

AMONG THE CANNIBAL ISLANDS.

By LAENAS GIFFORD WELD.

SPREAD out before you a chart of the South Pacific—one upon which are set down the many details useful to the navigator of this strangely interesting region. Besides the intricate labyrinth of islands, reefs, rocks, and shoals which are scattered over its surface, there are recorded the variations of the compass, the directions of the ocean currents, and the results of countless soundings. Running your pencil through all the points on this map for which the indicated depth is fifteen hundred fathoms or thereabouts, you will be able to trace out an irregular and more or less interrupted band, extending from the East Indian seas nearly to the coast of South America. Within the area thus marked out the sea is comparatively shallow; so that, were its bed to be elevated some thousands of feet, we should see emerging from its surface a vast continental area, bordered on the north and south by open seas.

We are told that such a continent once really existed, but that for thousands of years it has been slowly subsiding. The coral polyp has all this time been building up the countless reefs and atolls of this region, keeping their summits flush with the surface of the sea as the subsidence has gone on; so that here, instead of the dull monotony of an ocean desert, we have one of the most striking physical features of the globe. There are volcanic masses among these coral islands which, rising some few thousand feet above the level of the great barrier reefs that surround them, may be looked upon as remnants of this vanishing continent of the Pacific. Among these ancient landmarks none are of more interest than the great Fiji group of islands.

Until within quite recent years the word Fiji was regarded as a synonym for all that is barbaric; and if that epithet, "King of the Cannibal Islands," ever had any real claimant, it must have been in the person of Thakombau, the native potentate who played so important a part in the history of Fiji from the time of its first settlement by Europeans till it was formally annexed by Great Britain.

This regenerate old cannibal had spent the first forty years of his life in wars with his neighboring chiefs and in the practice of the most horrible barbarities. The strangling of his own mother and of his father's four other wives was only a part of the usual ceremony attending the assumption of the title of *Tui Viti*, or King of Fiji. Thakombau was, however, not hostile to the Wesleyan missionaries who had established themselves within his domain; but, while he listened respectfully to their remonstrances, he remained a determined heathen. This continued so long as he was prosperous; but when, in 1854, tribe after tribe had successfully rebelled against him, he began to listen more favorably to the counsels of the Christians. On the 30th of April of that year he gave orders that the great drums at his capital, which had been used till then to summon his people to cannibal feasts, should be beaten to call them together at the mission house to worship the true God. Two years later, having remained true to his new faith, he was united in Christian marriage to his favorite wife, and they were together baptized.

It was the same king who, at a later period, finding himself a mere puppet in the hands of foreigners, who had formed themselves into a government, of which he was the nominal head, brought about a general appeal from the most powerful chiefs to England's Queen for protection—an appeal which was, in 1874, listened to with favor. Upon this occasion Thakombau sent to Queen Victoria his favorite war club, which he himself styled "the former, and until recently the only known, law of Fiji."

The territory thus acquired by the British Empire comprises over two hundred islands of various sizes, some seventy-five of which are inhabited. The largest, Viti Levu, is oval in form, and has an area nearly equal to that of the State of Connecticut. Vanua Levu, lying to the northeast of Viti Levu, rather exceeds Delaware in size. Between these two islands, which are by far the largest in the group, is a channel some thirty miles in width; but the sea here, as well as over an immense area to the north, is so full of coral patches that navigation is exceedingly dangerous. The southern shores of the islands are more accessible, and afford many excellent harbors, of which that of Suva, the English capital, on the southeast coast of Viti Levu, is the best.

The study of the difference in the character of the northern and southern aspects of the larger islands affords an interesting lesson in physical geography. Thrust upward into the currents of the southeast trade winds to a height of over four thousand feet, the mountain ranges act as huge condensers, precipitating in torrents of rain the moisture which these currents have absorbed from the open sea. This condensation takes place principally as the winds blow up the southern mountain slopes, so that comparatively little rain falls upon the north side of the islands. The largest streams, therefore, flow back down the southern slopes to the sea, where they discharge immense volumes of fresh water. As fresh water is fatal to most species of coral polyps, we find here, along the southern coast, comparatively few of those dangerous reefs that fringe the islands on the north.

The fertility of the soil, which in the valleys and on all the southern slopes is thoroughly saturated with moisture, is quite equal to that of other similar regions. In the dense tropical forests, which cover large areas, tree ferns, screw pines, and a multitude of other strange forms contend with one another for the light of day, while affording nourishment to an immense variety of epiphytic mosses, lianas, and ferns, which connect the larger stems and branches with an almost impenetrable network of green.

There are few really indigenous species of animals; rats and flying foxes being the only mammals. As to the others now found here, the names by which they are known point to their European origin; thus we have *seepi* (sheep), *goti* (goat), *collie* (dog), *pussi* (cat), etc. Even the hogs and fowls which run wild in the jungles came originally from the Friendly Islands, where they were introduced by the early navigators.

Living in such a little world as this, the Fijians were of necessity much in advance of the races inhabiting the neighboring Pacific islands. The struggle for securing and holding this fair domain must of itself have led to its possession by a superior race. We find evidences of this superiority not only in the splendid physical development of the Fijians, but also in their relatively advanced religious notions and in their rather elaborate system of mythology. One traveler has likened this people, in some respects, to the primitive Greeks. If we compare the petty maritime enterprises celebrated in Fijian song and story with those recorded by the early Greek poets, we may imagine the difference to be in some measure due to the difference in character of the two archipelagoes which were their respective scenes of action. Upon taking the trouble to translate certain books of Homer into Fijian it was found that their recital was listened to by a company of these untutored savages with the most appreciative attention. This fact certainly speaks well for the mental quality of the race. The one foul blot upon the character of the Fijians was their cannibalism; but, in view of the readiness with which they have abandoned this practice, now that animal food can be easily obtained, we must hold Nature responsible, not only for this curse, but also for the many other barbarities attending it.

The national character of Fiji finds its best expression in the songs once common among the natives, but now, under Christian influences, almost obsolete. These songs or *mekkés,* as they are called, generally recount the story of some ancient hero, of some military campaign or naval expedition, or perhaps of a peaceful fishing excursion. They are generally sung of evenings by the men only, who assemble for the purpose in one of their long, low huts. Here they sit in solemn state on mats laid upon the ground, the only light being that of a smoky fire in one end. According to Major Abercrombie, an eyewitness of the ceremony, one man begins the chant alone; a second soon joins him, then a few more, till finally all present have taken it up, accompanying the wild music by much pantomime and earnest gesticulation. The time is beaten upon a wooden drum by one of their number, and is occasionally accentuated by a general clapping of the hands. After a certain climax has been reached, the music stops quite abruptly with one loud clap.

Yangona, the national beverage, is then served. This liquor is brewed with much formality, accompanied by low chanting. The great wooden bowl having been brought into the center of the room, the operator in charge sits down cross-legged before it. The yangona root is grated (it was formerly chewed by young men selected for the purpose) and deposited in the bowl, the inside of which has, from long use, become covered with a beautiful purple enamel. The requisite number of cocoanut shells of water are measured out and poured over the grated root, the whole being stirred to the music of a solemn chant. The floating particles of the grated root are collected and removed by means of a net of hibiscus fibers skillfully handled by the person in charge of the brew. The liquor thus prepared is handed round in cups of cocoanut shell, the chief being the first to drink. Taking the cup between his two palms, he slowly swallows its contents without removing it from his lips, while the onlookers join in a measured clapping of the hands. When the cup is finally thrown down with a spinning motion, to show that it is empty, all unite in the chorus, "*A matha, a matha*"—it is finished. The others now drink in a certain order of precedence. The liquor is of a dirty yellow color and has a bitter, aromatic taste, not altogether disagreeable. Used in moderation, it acts as a stimulant, but if indulged in too freely a temporary paralysis of the lower extremities follows, and the victim, while perfectly rational, reels and staggers as if drunk.

It is at these meetings around the yangona bowl that the numerous legends and fables of which the Fijians were passionately fond have been handed down in song from generation to generation. As a specimen of these mythical tales we give one which has been rescued from oblivion by the Rev. Thomas Williams and recorded by Mrs. C. F. Gordon Cumming in her At Home in Fiji. It tells of a gigantic bird called "Duck of the Rock." This monster carried off Tutu Wathi Wathi, the beautiful wife of the god Okovo and sister of Rokoua. The two gods gave chase in a large canoe, and as they voyaged came to an island inhabited by beautiful goddesses. Here the brother wished to remain, but, the husband protesting, they sailed on to the Yasawas, the most westerly isles of the group. Here was the cavern in which dwelt the great bird, but it was empty, and they found only one little finger of the hapless Tutu Wathi Wathi. The angry gods now swore to avenge her death, when presently they saw the monster approaching, his great wings darkening the sea like the shadow of a storm cloud. In his beak he carried five large turtles and in his talons ten porpoises. These he deposited upon the rocks and proceeded to devour, while Okovo prayed the other gods to help him by sending a storm of wind. The prayer was answered, and a sudden gust ruffled the feathers of the monster, so that Rokoua was able to force a spear through an unprotected spot into his vitals. Having thus accomplished their just revenge, they took one of the smallest feathers for a new sail, and then cast the dead body into the sea, causing such a surge as to "flood the foundations of the sky."

It is to be regretted that these legends have not been more carefully collected by the earlier settlers in Fiji. Even the few of them which have been preserved exhibit a truly interesting national character. But this national character has been lost since the advent of the European. The Fijian of to-day does not like to be reminded in any way of the old days when cannibalism was in vogue. He is exceedingly sensitive to the sneer of the white man. While the race has been partially rescued from barbarism, it has lost its old vigor and spirit. The native population has of late years been decreasing at an alarming rate. An epidemic of measles, heedlessly introduced in 1875, carried off fifty thousand souls, about one third of the whole population of the islands. Fiji is but the vestige of a former continent, which has gone down beneath the steadily encroaching sea. The Fijians are fast becoming, before the resistless encroachments of the European, only the vestige of a former race.

We have here now a well-ordered British colony. Sugar, cotton, wool, tobacco, bananas, cocoanuts, and other agricultural products are exported in great quantities. The extensive plantations are worked largely by laborers introduced from India and the neighboring Pacific islands. But as a colony Fiji does not prosper. Better times are looked for when the Nicaragua Canal shall have become a reality, as these islands lie upon the great commercial route which will then be established between England and Australia.

ENUMERATING the applications that have been or may be made of zoölogy to the arts and industries, Dr. William A. Hardman showed, in the British Association, that biological principles dominate medicine and surgery; bacteriology and brewing depend on the study of microscopic organisms; economic entomology is of value in agriculture; and zoölogy has a practical application to the fishing industry.

MIRACLES IN FRENCH CANADA.

By EDWARD FARRER.

THE village of Beaupré, on the north shore of the St. Lawrence, twenty-one miles east of Quebec, is famous as the chief seat in America of the cult of Saint Anne, mother of the Virgin Mary. About 1620 a Breton crew, struck by a tempest off the lower end of the Isle of Orleans, vowed a sanctuary to her if she would rescue them, and on being driven ashore at Beaupré, then known as Petit Cap, built her a log chapel. A large wooden church was afterward put up, and in it Laval, first Bishop of New France, whose spiritual empire was so vast that it has since been divided into seventy dioceses, deposited a piece of a finger bone of Saint Anne.* In 1686 a stone church was erected and remains to this day. A much more splendid edifice was completed in 1889, at a cost of half a million dollars. In 1876 Pius IX "was pleased," writes one of the Redemptorist Fathers in charge, "to declare Saint Anne patroness of the Province of Quebec, without prejudice to the title of Saint Joseph, the patron of all Canada." The present Pope has bestowed honors and privileges upon the new church, which has received more relics of the saint, including a fragment of rock from her house in Jerusalem, "from the room, indeed, wherein took place the mysteries of the Immaculate Conception."

In the grandeur of its buildings and decorations, and in the elaborate machinery employed to fire devotion and attract pilgrims, the shrine is now second to none, except perhaps those of Lourdes and La Salette. A railroad has been built from Quebec, and steamboats make connection with the Intercolonial, Quebec Central, Grand Trunk, and Canadian Pacific. Huge boarding houses and hotels offer accommodation to visitors, who can also obtain rooms in the convent of the Gray Nuns. A miracle-working spring has been discovered, and the water is sold in bottles at a depository in the church. The Redemptorists issue a monthly

* The Manual issued by the Redemptorists says Saint Anne was buried near Jerusalem, but her body was subsequently laid in the Church of the Sepulchre of Our Lady, in the Valley of Jehoshaphat. "One day a mysterious bark was seen to approach the shores of France. It had neither sail nor rudder, but God was its pilot. Never had the ocean borne a greater treasure. In this bark were Saint Lazarus with his two pious sisters, Saint Mary Magdalen and Saint Martha, together with several other saintly women. They were fleeing from Palestine with a number of priceless relics, the most precious among which was the hallowed body of Saint Anne. This treasure was placed in the hands of Saint Auspicius, the first Bishop of Apt." It was buried "to protect it from sacrilegious hands, and the place where it had been secreted was wholly forgotten" till, Charlemagne being at Apt one Easter day, "a miracle led to the discovery of the place."

publication to make known the cures. The bandages, sticks, and crutches piled in rows speak for themselves, as also the *ex voto* paintings, one or two by Lebrun, representing the saint in the act of delivering clients from perils by sea and land; American flags, bracelets, wax flowers, guns, knives, tobacco pouches, etc., are gifts from poorer clients who have experienced her kindness. Persons unable to visit the shrine, owing to bodily infirmity or any other restraining cause, may be represented by substitutes or may forward letters containing their requests to the saint; these are deposited beneath the statue in front of the main altar and prayers are said for a favorable answer through her intercession. The number of pilgrims exceeds one hundred thousand a year.

Nature has furnished an admirable setting for the shrine. The St. Lawrence at this point is four miles wide. Directly opposite Beaupré is the Isle of Orleans; behind it, the Saint Anne Mountain and the Laurentian Hills clad with pine, maple, and balm of Gilead. Cap Tourmente lies to the eastward; there the river begins to widen till at Tadousac, where the Saguenay joins it, it is thirty-five miles from shore to shore. To the west are the farm-houses and uplands of Château Richer, the Falls of Montmorency, from their bellowing and white foam called the *Vache*, Beauport and the valley of the St. Charles, Quebec and the historic rock. On summer evenings the old Breton hymn peals over the waters:

> "O sainte Anne, ô Mère chérie!
> Garde au cœur des Bretons la foi des anciens jours;
> Entends du haut du ciel le cri de la patrie—
> Catholique et Breton toujours!"

Even in winter, when the snow lies level with the fences and the St. Lawrence is gorged with ice, Beaupré attracts an occasional devotee. The height of the pilgrim season is from June to the middle of September.

Miracles are wrought for the most part in the new church, though the old one is still favored. Some find no immediate relief, but are cured on reaching home. At the ordinary services the officiating priest marches down from the high altar to some unhappy creature gasping at the rails, and, after a few preliminaries, applies one of the relics, incased in crystal with gold bands, to the part affected, reciting meanwhile the litany of Saint Anne: "Grandmother of our Saviour, Mother of Mary, Ark of Noah, Root of Jesse, Light of the Blind, Tongue of the Dumb." The other sufferers struggle to their feet and watch the process with breathless interest. The dying consumptive bares his breast that the relic may be placed directly over his lungs, then sinks to his knees at the foot of the statue; having finished the litany, the priest turns to the Gospel of Saint Anne; the thurifers surround the patient and swing the incense, the relic is elevated, a bell rings, and the congregation kneels. This is the supreme moment. No time is lost, however, on a busy day, and when it is seen that a miracle is not forthcoming, the poor fellow is bundled into one of the sixteen lateral chapels, where other saints are venerated; his place is taken by another far-gone pilgrim, or perhaps a batch not so grievously afflicted are beckoned to the rails and the relic passed from lip to lip amid the prayers and sobs of five thousand onlookers. No one asks, with the skeptic in the temple of the sea-god, Where be the offerings of them that have perished? if only a single miracle be announced during the week or recorded in the monthly *Annales.*

The golden age of miracles in French Canada dates from the arrival of the Recollets and Jesuits, 1615–'25, and may be said to have terminated about 1860. The Church possesses many relics besides those of Saint Anne, some among the most precious in Christendom,* and has had local martyrs and confessors whose ashes repose here. Nevertheless, the stream of miracles outside Beaupré has gradually dwindled and dried up, and those of Beaupré are losing their old characteristics.

In the early days Saint Anne cured all manner of ailments with an untiring hand. The Relations des Jésuites for 1667 contain an account of the chief miracles wrought down to that time—the cure of Elie Godin of dropsy; Marguerite Bire, of fracture of the leg, Jean Adam, blind of both eyes; Pradere, a French soldier, of paralysis and *une apostume dans l'estomac,* and other wonders to which Laval bore witness. Saint Anne never raised the dead to life, at least not in Canada, nor gave a limb to a one-legged client as Saint Anthony of Padua did, but over and over again she cured heart disease, cancer, apoplexy, and consumption. She interfered to save pious persons from death in the forest, when they had been pinned under a falling tree, by inspiring neighbors to go to their aid or a faithful dog to carry a piece of blood-stained bark to the nearest settlement, and snatched many from ice jams, bush fires, and Dutch men-of-war, in the last case resorting to the

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* At the celebration in 1874 of the second centenary of the erection of the Diocese of Quebec over five hundred relics were exposed. The list is given in Le Deuxième Centenaire, an official account, bearing the *imprimatur* of Cardinal Taschereau. Among them were relics of the *vêtement de pourpre de Jésus Christ, crèche de Jésus Christ, colonne de la flagellation de Jésus Christ, sainte épine de Jésus Christ, table de la dernière scène, terre où Jésus pria, pierre sur laquelle Notre Seigneur s'assit et mangea avec ses apôtres, vraie croix de Jésus Christ,* etc. Also, apparel of the Virgin Mary and Saint Joseph, fragment of the rock struck by Moses, lock of hair of Saint Mary Magdalen, portion of the cloth of the head of Saint John the Baptist, fragment of a wooden altar served by Saint Peter, and of the block on which Saint Paul was beheaded, bones of the Holy Innocents, of the chief disciples, of Saint Stephen the first martyr, etc.

expedient of causing a fog to hide the vessel of her friends. She rendered barren women fruitful, and once or twice cured the dumb; by her efforts attempts to plant Jansenism in the colony were frustrated; she also brought to naught the designs of stray Huguenots. At the siege of Quebec Wolfe dispatched an expedition to harry the river parishes. "Wherever resistance was offered," says Parkman, "farmhouses and villages were laid in ashes, though churches were generally spared." The church at Beaupré was not spared by the troops; it was set on fire three times, but each time Saint Anne extinguished the flames, and some of the Highlanders confessed the miracle. When the north shore down to Cap Tourmente was blazing, nearly all the farmhouses in which she was specially venerated escaped.

But since 1860 or 1865, when the rush of population to the New England factories set in and French Canada began to receive at second hand the new ideas absorbed by the emigrants, the saint has been comparatively listless. She cures headache and dyspepsia, converts Protestants with Catholic wives, finds employment for clients, protects them while traveling, restores lost objects, procures young women admission to convents, and endows those who come to her in a proper spirit with grace and strength to quit evil practices. Now and then we hear of a hysterical girl being cured on the spot, or of an epileptic finding relief, but as a matter of fact the character of the miracles has deteriorated since faith in them has been shaken by New England influences. Hence the rather bitter remark, attributed to Mgr. Bégin, that if the French Canadians are supplanting the Puritan stock, Puritanism is having its revenge in French Canada.

Formerly images of Saint Anne were carried in procession through a parish to bring on rain or to stop rain, a ceremony that reminded one of the old Roman religion and the transportation of Bacchus, Ceres, and Dea Dia through the fields and vineyards by white-clad youths, followed by the lustral water and the full incense box. The practice is falling into desuetude; the *habitant*, like the rest of us, is beginning to be satisfied with the weather as it comes, and to have confidence in the predictions of the meteorological office. A bad crop is still attributed to the backsliding of the farmers or to the nonpayment of tithes. In French Canada the tithe, collectable by law and a first lien on the soil, is every twenty-sixth bushel of cereals. Of late, since the opening of the western prairies, the *habitants* have dropped cereal growing and taken to raising hay for the United States market. In this manner the *curés* have been cheated out of tithes, and some in whom the sense of reverence must have been dim pointed to the McKinley bill, which levied a duty of four dollars per ton, as an expression of the divine wrath.

The Normans and Bretons who colonized New France were governed to the end of their nails, as they used to say, from the mother country. The local self-government of the American colonies, the town meeting and its ramifications, were unknown; they were not allowed to hold meetings nor even to tax themselves for improvements without the royal permission. There were no common schools; the Recollets, or begging friars, taught the A B C as they wandered from parish to parish, but only where they found lodging for the night. As late as 1835 an act of the legislature was passed permitting school trustees to sign their reports with a mark. The *feu-follet*, or Will o' the wisp, was either an unshriven soul or Satan himself; *sorciers* were witches and imps who held their sabbaths on the Isle of Orleans; the *chasse-galerie*, a huntsman with a pack of dogs, appeared on the eve of a storm; but the most formidable apparition was the were-wolf, or *loup-garou*, which was seen as late as 1767 in the county of Kamouraska, seeking whom it might devour. None of these ugly visitors could cross a stream which bore a saint's name. If encountered in the woods, the *feu-follet* could generally be dodged by sticking a needle in the earth or holding out a half-open knife after first making the sign of the cross; but the only safeguards against the others short of making a race for the St. Lawrence or the St. Something-else was for the traveler to carry a bottle of holy water, *Le Formulaire*, a prayer-book originally got up for the Ursuline nuns, or the *petit Albert*, which contained the forms for exorcising evil spirits.

The Jesuits have described the Arcadian simplicity of life and manners and the extraordinary piety of the early settlers, kept fervid both by their ministrations and by the constant Indian attacks. Every church had its own saint and relic, not necessarily of that particular saint, and its own miracles. Laval's successor presented the parish of Saint Paul in the Isle of Orleans with an arm bone of the great apostle of the Gentiles. A few years afterward the parish changed its name to Saint Laurent, and the adjoining parish of Saint Peter thereupon called itself Saint Peter and Saint Paul. The *curés* agreed to exchange relics, but the Saint Laurent people refused to be bound by that arrangement, and one night entered the church of Saint Pierre, carried off their old relic, and left the other, which they deemed an inferior one. Miracles beyond number were reported and passed into popular belief without being vouched for by ecclesiastical authority, such as missionaries using their cloaks as rafts to cross lakes and rivers, checking bush fires by drawing a line on the ground, being directed when they had lost their way and providentially supplied with food.

The Acadians had miracles in plenty. In the introduction to A Legend of Montrose, Sir Walter Scott speaks of the portents which announced the Highland clearings—the notes of the night wind howling down the pass of Balachra modeled to the tune of We Return no More, the song with which Highlanders usually bade farewell to their native land; "the uncouth cries of the Southland shepherds and the barking of their dogs in the midst of the hills long before their actual arrival." I have been told at St. Pierre-Miquelon that the Acadians who fled to those French islands from the country of Evangeline were quite sure they had been forewarned of what was in store by the appearance of British armies in the sky, by dirgelike sounds from the ocean, and the wailing of souls in purgatory heard during Mass for a year before the calamity. In 1811–'12 Bishop Plessis visited Prince Edward Island, and in the account of his journey, published long afterward,* we are told that mysterious voices were heard in the Acadian churches, but not in the churches frequented by the Roman Catholics of Highland Scotch extraction. There was a groaning or sighing voice like that of a person in distress, and a singing voice like that of a woman or a child. On the mainland of New Brunswick these voices followed the Acadians to the lumber shanties, and were heard on Sundays when they gathered for prayer. In the churches the voices were loudest during the recitation of the litany of the Holy Name of Jesus. The good bishop asks: "What are these voices? Whence come they, and for what reason do they make themselves heard?" He comes to the philosophical conclusion that "as they have done no one any harm it matters little whether they cease or keep on." At the *grand dérangement*, as they call their deportation, the Acadians received at least one mark of favor from the Virgin Mary. Abbé Ferland tells the story in his La Gaspesie. Two hundred and fifty of them on board a vessel bound from Port Royal to the Carolinas overpowered the crew during a storm, fastened a scapular to the rudder, and invited the Virgin to take charge; she did so, and in a few hours they made land at Rivière Saint-Jean. The Virgin helped the French at the battle of Ticonderoga, appearing in white on the breastworks as the enemy came up for each fresh attack. She did not appear on the Plains of Abraham, nor during Montgomery's invasion; in the latter campaign, indeed, the mass of the French Canadians would probably have been glad if she had helped the *Bostonnais*.

There were legends among the French Canadians of revelations from heaven having been vouchsafed to the Indians. Mgr. de S. Valier traveled through the Gulf region in 1685–'87 in the capacity of *grand-vicaire* to Laval, and published a report at

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* Le Foyer Canadien, 1865.

Paris in 1688, reprinted at Quebec in 1857. He speaks of the Cruciantaux Indians, who "have a particular respect for the cross," which they wore on their persons, planted over their graves, and attached to their canoes. An Indian "one hundred or one hundred and twenty years old" related that he had witnessed the arrival of the first ship that came from Europe to that part of the country. But the use of the cross among the Indians antedated that event and had not been introduced by outsiders. Once upon a time, during a famine, when the spirits had been appealed to in vain by the medicine men, an old savage saw in a dream a young man who promised the band an early deliverance by virtue of the cross, and showed him three crosses—one to protect them from visitations, another to serve them in their councils, the third to guard them in their journeys. When the old man woke he whittled three crosses just like them, and this is how the cult began. The incantations and *jongleries* of medicine men were sometimes blamed by the early white settlers for causing a failure of the crops. In these modern days the blasphemy of the *habitant* is blamed, though as a rule he seldom blasphemes except when plowing with fractious oxen. In a book (Une Mine, etc.) published in 1880 a worthy Oblat father asks, "Why these bush fires, droughts, wet seasons, frosts, hailstorms, worms, and flies that ruin your crops?" and goes on to ascribe them to the "torrent of bad language that deluges your fields."

When Father Labrosse, a famous Gulf missionary, died at Tadousac, the bells of all the churches were tolled by angels. The *crucifix outragé* is among the relics of the Hôtel-Dieu; it was used by a soldier in divinations by which he undertook to find lost money. A *fête* was established by way of public atonement, and miracles have since been performed with it. Here, as elsewhere, the corruption of names has given rise to legends of the miraculous and the uncanny. Thus Cap d'Espoir, Cape of Hope, has been twisted by English sailors into Cape Despair; the French have accepted the corruption and made it Cap Désespoir. Then to account for the name, tradition says one of the vessels of Sir Hovenden Walker's expedition against Quebec was cast away at the spot, and the remains of a wreck are still shown and known as the *naufrage anglais*. Till a few years ago the fishermen at Cap Désespoir used to be warned of storms by the apparition of this English frigate, with her terror-stricken officers and men gazing landward and the captain apparently upbraiding the pilot. The fishermen of the Gulf of St. Lawrence are as superstitious as fishermen elsewhere. They hear the lamentations of lost souls like the *braillard* off Rivière de la Madeleine and see supernatural lights like the *feu des Roussis* at Paspebiac. The haddock, *le poisson de Saint-Pierre*, was the first fish caught at the miraculous draught in Lake Gennesaret, and the finger marks of the apostle are on its back. Nevertheless it is not a lucky fish, possibly because "their net brake" and they "filled both the ships so that they began to sink." The French-Canadian fisherman and the fisherman from old France work side by side on the Banks of Newfoundland. There is a marked difference in their accent and intonation as well as in their physical appearance, three hundred years of existence in the New World having made the French Canadian swarthier and leaner than the man from Saint Malo. On the rocks of Cap à l'Aigle at St. Pierre-Miquelon there is a white statue of the Virgin, and as his vessel passes it the French Canadian is careful to salute the "old mother," but the fisherman from France ignores her. While the latter sings modern songs from the *cafés* of Paris, the former sticks to the songs his ancestors brought from France—Malbrough, Dans les prisons de Nantes, Sur le pont d'Avignon, Par derrièr' chez ma tante, En roulant ma boule, etc. Both believe that a *sorcier* can find the best fishing ground on the Banks, that a dog on board brings good luck, that it is bad luck to whistle, and so on. At home the French-Canadian fisherman occasionally sees the Wandering Jew striding along the beach in the direction of Labrador, which, by the way, was the heritage of Cain. To meet him face to face brings good luck if you happen to be returning from vespers, but not otherwise. There is an old ballad about him in which, "near the town of Bruxell's in Brabant," he accompanies two honest fellows into a tavern and over a *pot de bière fraîche* describes the events at Jerusalem that led to his being banished "to everywhere and nowhere without end":

"Sur le mont du Calvaire
Jésus portait sa croix;
Il me dit, débonnaire,
Passant devant chez moi:
Veux-toi bien, mon ami,
Que je repose ici?"

But the Wandering Jew—Isaac Laquedemme by name, and by trade a shoemaker—was in bad humor that day, and replied *sans raison:*

"Ôtes-toi, criminelle,
De devant ma maison;
Avance et marche donc
Car tu me fais affront!"

Then came the terrible sentence:

"Jésus, la bonté même,
Me dit en soupirant:

'Tu marcheras toi-même
Pendant plus de mille ans;
Le dernier jugement
Finira ton tourment!'"

He has been tramping ever since, wearing his shoemaker's apron, and always with five sous, never more or less, in his pocket, glad to drink a glass of wine with any honest *bourgeois* he meets, but much tormented in soul when he halts for that purpose. The ballad, as sung in French Canada, is given in full in Ernest Gagnon's collection.

Among the miracles recorded by ecclesiastics, the most striking was the defeat of the English expedition against Quebec in 1690 by the Virgin Mary, to whom a church, still standing in Lower Town—Notre Dame des Victoires—was forthwith dedicated. Miraculous cures were wrought by the relics of the Jesuit Brebeuf, murdered in the country of the Hurons near Penetanguishene, and through invoking the Jesuit Le Jeune. These are about the only miracles officially credited to the Jesuits; they bear no comparison with those ascribed to the Jesuit Anchieta in Brazil; still less with those of St. Francis Xavier and the missionary thaumaturgists of his day. The performance of miracles by the Canadian Jesuits may possibly have been hindered by the presence of heretic traders from the neighboring English and Dutch colonies; it was cynically suggested at the time that unless they could banish the smallpox, always raging among the Indians and frequently attacking the settlements, it was useless to work minor wonders as a means of impressing either red men or white.

The nuns were more successful. Marie de l'Incarnation and the Mère de Saint-Augustin possessed the spiritual *charismata* of the Christian women of whom Tertullian wrote: "There is at this day among us a sister who has the gift of revelations, which she receives in church amid the solemnities of the Lord's day by ecstasy of the spirit; she converses with angels and sometimes also with the Lord, and she both hears and sees mysteries." The astounding visions of these two Quebec nuns are described at length by a recent biographer, Abbé Casgrain. Both were forewarned of the earthquake of 1663, when, as the Relations say, rivers and lakes changed their beds, mountains were swallowed, and forests hurled in the air, the trees falling on end with the roots upward; the warning was conveyed by the appearance of demons, which gathered over Quebec and were restrained for a time, but only for a time, by a majestic youth of whom they stood in awe. The statue of Notre Dame de Toute-Grâce, at the Hôtel-Dieu Convent, was wonderfully gifted. The Mère du Saint-Esprit, of that house, foretold its destruction by fire. In 1810 a Protestant woman visited it at Christmas and prayed before the manger. She bore a child, which was the image of *l'Enfant Jésus,* and became a nun of extraordinary piety, on whom the Virgin lavished favors. Marguerite Bourgeois, founder of the Congregation of Our Lady at Montreal, is now undergoing the process of canonization; numerous miracles were worked by her before and after her death. Probably, in modern opinion, the most splendid miracle of all was the courage displayed by these well-born women in crossing the ocean and spending their lives amid the rigors of a semiarctic climate, Indian alarms, sieges, pestilence, and all the privations and hardships of a new colony for the glory of God.

When the Island of Montreal was wanted by the Sulpicians, a lay agent, apparently under Jesuit influence, had a vision in which the owner was guaranteed heaven without purgatory. The property, which has made the Sulpicians one of the richest orders in America, was immediately transferred. This, I believe, is the only instance of note in which the supernatural was invoked for a doubtful purpose. All the other visions and miracles can be accounted for without the hypothesis of conscious deceit. It was essentially a time when, as Dean Milman wrote of another age, "the Christian lived in a supernatural world; the notion of the divine power—the perpetual interference of the Deity, the agency of the countless invisible beings which hovered over mankind—was so strongly impressed upon the belief that every extraordinary and almost every ordinary incident became a miracle; . . . a mythic period was thus gradually formed in which reality melted into fable, and invention unconsciously trespassed on the province of history." This is kinder than Gibbon's verdict: "If the eyes of the spectators have sometimes been deceived by fraud, the understanding of the readers has much more frequently been insulted by fiction."

The seigniorial tenure, a mitigated feudalism based upon the Custom of Paris (1510), was abolished by the Canadian Parliament in 1854. It was then, a scoffing Parisian said, that the *habitant* of French Canada discovered that Louis XVI was dead. When he began to migrate to New England he learned other things that are slowly undermining his cradle beliefs, and we may say without a scoff that it will not be long till Good Saint Anne is dead.

REMARKING on some of the results achieved by the Challenger Expedition in the antarctic seas, Dr. Murray says that the amount of animal life found in the antarctic region south of 40° is very much more abundant than in any other part of the world. One of the great secrets of oceanic circulation may possibly be found by investigation of those regions. Certainly one of the greatest pieces of scientific and oceanographic work yet to be done on the surface of the globe awaits efforts in these regions.

HAS IMMIGRATION INCREASED POPULATION?

By SYDNEY G. FISHER.

THE immigration which formed the basis of our colonial population was very slight. The men who fought the Revolution and created the United States were almost exclusively native. The population of New England, as is well known, was produced out of an immigration of not much over 20,000, all of whom arrived before the year 1640. From 1640 until about 1820, a period of nearly two hundred years, the growth of New England was by the childbearing of the original and native stock. There was no immigration worth mentioning; but, on the contrary, an overflow into neighboring colonies, New York and the West. Franklin, writing in 1751, when the population of all the colonies was about a million, said that the immigration which had produced this number was generally believed to have been less than 80,000.*

Modern immigration set in some time in the beginning of the present century, and had grown to noticeable proportions about 1820, when the national Government decided to take statistics of it. By 1830 all observers agree that the foreigners had begun to have a decided influence and effect, and that a change could be distinctly seen. By 1840 the Native American or Know-Nothing movement had begun; in 1850 it had become a distinct political party; and in 1856 had a candidate for the presidency.

One of the strongest arguments used against the Know-Nothings was that immigration would greatly increase the population, and in that way the wealth and strength of the country. The rate of increase by births among the colonists had been remarkably rapid and had astonished the people of Europe. Franklin was among the first to call the attention of learned men to this phenomenon. In some parts of the country the people, without the aid of immigration, doubled themselves in twenty-five or twenty-seven years; and there were traditions of particular localities in which the doubling had taken place within less than twenty years. No record of a like increase over such an extended territory could be found in the history of the civilized world.

For the fifty years that followed the Revolution, when immigration was at a minimum, this natural increase was greater than ever. The whole population in that time doubled itself about every twenty-three years. It was therefore very natural for the people who believed in the immigration experiment to suppose that if to this increase in every decade were added a couple of million immigrants, who would presumably have children in the same

* Franklin's Works (Sparks's edition), vol. ii, p. 319.

rapid manner as the natives, the population, wealth, and strength of the United States would be forced forward in a manner that would produce results of inconceivable grandeur. It certainly did look like an enormous boom, irresistibly attractive both for its possibilities and for its uncertainties. The difficulty with it was that, like the rest of the experiment, it was all based upon "presume" and "suppose."

If the calculations had turned out as expected, we should undoubtedly now have a population of at least a hundred millions. Jefferson, writing in the year 1815, prophesied eighty millions for the year 1875, which would give considerably over a hundred millions for the year 1893. But, curiously enough, when the alien element had reached a certain point, about the year 1830, the native population began to fall off in births, and the more the aliens increased in numbers the fewer became the births of the natives. The foreigners themselves were not as prolific as the old native stock had been; and the consequence is that we have now to-day not as many people as we would have had if the immigrants had never come near us and the native stock had continued their old rate of increase.

The statistics which show this were very ably discussed many years ago by Mr. Edward Jarvis, and recently General Francis Walker has again called attention to them. The calculation is a simple one. We have the population at the close of each decade and also the number of foreigners in the country. Confining ourselves to the white population, if we subtract from the total whites at the close of a decade the number of foreigners at the close of the decade and find the difference between that result and the native whites at the end of the previous decade, we have the natural increase of the native population, and can easily find the percentage.

Let us therefore construct in this way a table which will show the growth of the native white population by decades from 1750 to 1890. Previous to 1750 the numbers by even decades are not obtainable. For the population previous to 1790 we shall take Bancroft's estimates, which are now generally accepted, and for the time after 1790 we shall rely on the revised figures of the national census. For the time previous to 1800 the number of foreign born living in the country has never been estimated, but they were very few and would not materially alter the results.

To find the number of natives it will be necessary to deduct from the total number of whites not only the European foreign born but also the people who came to us by a stroke of the pen when we acquired the Louisiana territory, Florida, Texas, New Mexico, and California. Louisiana was purchased in 1803, and her people considerably swelled the census of 1810. How much they increased it is hard to say, for between 1803 and the time the census was taken in 1810 a large number of our people moved into the new territory, so that the population of the new territory for 1810 gives more than the number we ought to deduct. It is certain we ought to deduct something, and equally certain that we shall never know the exact amount. The best authorities, however, seem to indicate 20,000 as about the proper number. For Florida it is about 12,000, and for Texas, New Mexico, and California, which came to us by the Mexican War, it is about 90,000, to be deducted from the total whites as given by the census of 1850. We shall also have to make a deduction from the whites in the census of 1860, because part of the returns for California in the census of 1850 were burned, and the natives of that Commonwealth were not all given in the census of 1850, but appeared in the census of 1860. A deduction of about 70,000 will probably account for all of them.

Decades.	Total whites.	Foreign whites.	By new territory.	Per cent of native increase.	Corrections for census of 1870.	
1750......	1,040,000					
1760......	1,385,000			33·17		
1770......	1,850,000			33·57		
1780......	2,383,000			28·81		Revolution.
1790......	3,177,257			33·33		
1800......	4,306,446	44,282		34·14		
1810......	5,862,073	96,725	20,000	34·79		
1820......	7,862,166	176,825		33·76		
1830......	10,537,378	315,830	12,000	32·83		
1840......	14,195,805	859,202		30·64		
1850......	19,553,068	2,244,602	90,000	29·10		
1860......	26,922,537	4,138,697	70,000	31·91		
1870......	33,589,377	5,507,229		23·37	25·37	Civil war.
1880......	43,402,970	6,679,943		31·05	29·05	
1890......	54,983,890	9,249,547		24·53		

The census of 1870 is now generally believed to have been an underestimate, owing principally to the difficulty of obtaining returns from the South so soon after the war. The rate of increase for that decade ought therefore to be a little more than 23·37, probably about 25·37; and this would lower the percentage of the next decade to about 29·05, instead of 31·05.

Following down the column of native increase, we find that from 1750 the rate remains at a little over 33 per cent for twenty years, until reduced by the Revolution to 28·81. But after the Revolution it returns again to 33·33 in the next decade, then rises to 34·14, and then to 34·79. In the next decade, 1810 to 1820, it falls suddenly about one per cent, and in the next falls one per cent again; and in the next, which is 1830 to 1840, falls more than two per cent to 30·64, which is much lower than it had been at any time in the previous eighty years, except during the decade which contained the Revolution. The falling continues, with one or two slight revivals, as we follow the column, until in the decade 1880 to 1890 it has reached the very low figure of 24·53 per cent—more than four per cent lower than during the Revolution.

It is to be observed that the first serious fall begins after the year 1830, the point which all observers have fixed upon as the time when the effects of immigration began to be palpably felt.

If we look at the number of foreigners for the year 1830, we find them to have been 315,830—almost as many as there had been in the three previous decades. In the next decade they more than double, and in the next they almost treble, with the rate of native increase steadily declining.

It is also rather significant that the first break and decline of the native rate occurs after the year 1820, when immigration had begun to attract so much attention that the Government decided to take statistics of it.

These coincidences of the decline of the native increase with the increase of immigration are so exact that they can hardly have been accidental. There is, to say the least, a strong suspicion of cause and effect. And if it should be asked what is the exact nature of that relation of cause and effect, the question may be concisely answered in the words of General Francis Walker, superintendent of the tenth census and now President of the Massachusetts Institute of Technology:

"The access of foreigners, at the time and under the circumstances, constituted a shock to the principle of population among the native element. That principle is always acutely sensitive alike to sentimental and to economic conditions. And it is to be noted, in passing, that not only did the decline in the native element, as a whole, take place in singular correspondence with the excess of foreign arrivals, but it occurred chiefly in just those regions to which the newcomers most freely resorted."

That the arrival of the foreigners was a shock to the natives is very clearly shown in the formation of the Native American or Know-Nothing party, and the riots and violence which followed for a period of twenty years. The foreigners came to work for lower wages than the native and drove the native from his place. For a hundred years the native had been accustomed to a standard of living which was remarkably high. This was particularly true of the New England and Middle States, where all classes had every incentive in their surroundings to produce large families. They felt that they owned their country, and were proud of it. They were the creators of their own destinies and the architects of their own fortunes. They built up homes and families. They were sure there would always be enough for all, and that their children would have to enjoy as good, if not better, conditions.

"Then came the foreigner, making his way into the little village, bringing, small blame to him, not only a vastly lower standard of living, but too often an actual present incapacity even to understand the refinements of life and thought in the community in which he sought a home. Our people had to look upon houses that were mere shells for human habitations, the gate unhung, the shutters flapping or falling, green pools in the yard, babes and young children rolling about half naked or worse—neglected, dirty, unkempt. Was there not in this sentimental reason something strong enough to give a shock to the principle of population?"

The native of that time was utterly unable to compete in dirt and degradation with the low Irish and European peasantry. He lost heart and interest; in many cases he sank to the level of his competitor; and even when he did not actually sink in his personal habits, he had not the same high incentives as before.

It is a remarkable fact and should be remembered that in New England, which received scarcely any immigration between 1640 and 1820, the greatest growth of population ever known in America took place. The New-Englanders overflowed their borders, and settled a large part of western New York, the Western Reserve of Ohio, the Wyoming Valley of Pennsylvania, and hundreds of towns and counties in the far West. Some years ago the number of people of New England origin was estimated at a third of the whole population. The place of strongest nativism was the place of the most rapid growth.

Washington was much impressed in 1796 with the overflow of the New-Englanders. "Their numbers are not augmented by foreign emigrants; yet from their circumscribed limits, compact situation, and natural population, they are filling the western parts of the State of New York and the country on the Ohio with their own surplusage." (Works, vol. xii, p. 323.)

Madison was in favor of immigration, but in 1820 he could not help noticing the wonderful increase of New England without the aid of the foreigner. "It is worth remarking that New England, which has sent out such a continued swarm to other parts of the Union for a number of years, has continued at the same time, as the census shows, to increase in population, although it is well known that she has received but comparatively few immigrants from any quarter." (Works, vol. iii, p. 213.)

It has been suggested that the correspondence in time between the increase of immigration and the decrease of the rate of growth does not necessarily imply a relation of cause and effect, because it can be accounted for by the fact that advanced civilization always lessens the rate of childbearing and the rate of increase of population. France is pointed out as an instance where the rate of growth has become very low because of the fashion the French have acquired, even in the middle classes, of restricting the size of their families.

The illustration, however, is not altogether fortunate for those who use it. The French annual rate of increase, it is true, sank very low during the four or five years previous to the Prussian War, being only seven per thousand inhabitants in 1870. But since then it has steadily risen, and in 1890 was thirty-seven per thousand.* In fact, France is an excellent illustration to show how mere ideas and opinions affect the growth of population, and how the rate of increase may be depressed by discontent or disaster, or raised by the desire to conquer an old enemy or by the success of a new form of government.

But is it true as a general proposition that advanced civilization decreases the rate of population? There is a feeling among many people, who have not thought much on the subject, that the more animal-like we become, the more we multiply, and that the lower types of civilization necessarily increase more rapidly than the higher. But this is very far from the truth.

Savages and uncivilized races are not, as a rule, of very rapid increase. They often recede and whole tribes of them become extinct. If we look at the whole world, it is the uncivilized populations that are disappearing. Before the coming of the English to the United States the red men had held the country with all its natural fertility and resources for hundreds of years, and yet had not been able to increase themselves to a million. During the middle ages, from the year 500 to 1500, a period of a thousand years, we find the population of Europe in all stages of barbarism and low civilization, and yet the increase of population was very slow. In the year 500 Europe was supposed to have something over 40,000,000 people. In the year 1500 the highest estimate is 70,000,000. Thus in a thousand years the population had not doubled. But after the year 1500, under the influence of the Reformation and modern civilization, the population doubled in three hundred years.†

Another excellent illustration to show the effect of modern civilization is the growth of the English people.

1480	3,700,000
1580	4,600,000
1680	5,532,000
1780	9,561,000
1880	35,004,000

* Mulhall's Dictionary of Statistics (1892), article Population, p. 442.

† Seaman's Progress of Nations (First Series), p. 550. See also Worcester's Problem of Religious Progress, *passim*, and Mulhall's Dictionary of Statistics.

The English, it will be observed, never succeeded in doubling themselves in any hundred years until 1780 to 1880, when they almost quadrupled.

Civilization, then, does not appear to be a very serious hindrance to rapidity of growth; and the reason is evident. As compared with barbarism, it produces a larger food supply, greater variety of it, better houses, better sanitary arrangements, better health, longer life, and stronger reasons for wanting to live and wanting to enable others to live. The people of the middle ages lacked skill in producing the comforts and necessaries of life, their sanitary arrangements were shocking and their lives despondent. They were visited with plagues and epidemics which have not now been known for four hundred years. Their minds were clouded with dreadful delusions, superstitions, and terrors which produced the "dance of death" and the continual slaughter of witches. A large proportion of their children died, and even adult life was short.

Long living and many who live long is as important an element in the increase of population as numerous births. All the children born in the United States in the year 1891, who die before they are eight years old, will not increase the population either in numbers or effective strength so much as one man born in that year who lives to be thirty. The man, independently of his greater usefulness, will be counted as an inhabitant in three censuses; the children will be counted in none.

Paupers, savages, and other people of low life are often supposed to multiply very fast because they seem to be so reckless in the number of children that are born to them. But the same shiftlessness which brings the children into the world surrounds them with conditions that destroy them. Negroes are supposed to be very prolific; but the death-rate among them in cities is almost double the death-rate among whites; and the death-rate among negro children is more than double the death-rate among white children. The woman of the slums, who was recently reported to have said that she ought to know something about the nurture of children because she had buried fourteen of her own, was doubtless a person of excellent intentions; but she has not done so well for the republic as some less boastful mother who has raised one son to maturity.

It is often thoughtlessly asserted that modern city life decreases population. But, as compared with ancient city life, it very much increases it. Previous to the year 1790, in all large cities, the death-rate always exceeded the birth-rate. In London the death-rate was often double the birth-rate. Immigration from the rural districts and not their own power of reproduction kept these cities from decay. Our modern cities contain certain districts that are called slums. But the old cities were all slums. The great increase of modern city life is due not to the degeneracy of the race, as is often foolishly supposed, but to improved sanitary conditions and improved health. The modern city grows by its own productive force as well as by immigration and has ceased to be a death trap for the people.

Rapid increase of population is due to cleanliness, thrift, intelligence, prosperity, contentment, and happiness, because these things preserve and lengthen life. As a rule, civilized people are apt to be blessed in these particulars even when their birth-rate is somewhat low. But it is not true, as is often supposed, that the more civilized have necessarily a low birth-rate. Ireland and Greece are countries of an inferior order of civilization, and their birth-rates are respectively 27·7 and 24 per thousand inhabitants; while the birth-rate of England is 33·3 per thousand, and of Holland 34·8.

But we must not rest the question on mere generalizations. Civilization includes many things and is a broad term. Increase of population is accomplished by different causes, and not in every instance by the same cause. Each instance should be considered in all its surroundings before any general principles are applied. Mere sentiment, opinions, and ideas often affect the growth of population as much as the price of corn and meat. The failure of the French to increase rapidly is generally believed to be caused by an almost morbid desire on the part of French parents to start their sons in life with a fortune and give their daughters a dowry on their marriage. The size of these portions becomes a matter of pride, and great importance is attached to them even among the middle classes. The fewer the children the larger the portions. This condition is generally believed by modern French statesmen to have been brought about by the law of 1793 which restricted the freedom of leaving property by will and compelled parents to divide their estates evenly among their children. On the other hand, the English feeling is just the reverse of this. The Saxon race has always been remarkable for its love of facing life single-handed, and battling with the chances of the world. English parents of all classes have seldom any hesitation, and often a pride, in bringing up more children than their fortune will enable to live with ease. The thought that the eldest child will have all their money and the rest have to begin life anew, or that all will have to make their own way in the colonies, which would fill a French family with horror, is rather pleasant to English parents.

Any one who will read the history of the Know-Nothing movement in pamphlets, speeches, and deeds of that time can hardly fail to be convinced that hundreds of thousands of native Americans were rendered despondent, hopeless, and desperate by what they saw around them. Men do not fight in mobs and destroy churches and houses and form themselves into complicated secret orders for nothing. Whatever we may think of their mistakes of policy and rashness, there is no question that the native Americans received a severe shock, not only to their sentiments and feelings, but to their opinions and principles. The nation that they supposed was their own seemed to be given over to others. Their high patriotism, their pride and interest in their country were wounded and hurt. Nor was the wound any the less severe because the majority of those who received it were of the class in life that is not trained to express its feelings in writing.

What else was there in the general condition of affairs in the United States between the years 1830 and 1860 which would cause the rate of native growth to decrease? It could not possibly have been the growth of luxurious habits of living. There were none at that time. Any we possess have been acquired within the last twenty years, and most of them within the last ten years. The country at that period, so far as concerned room for development, was as new as it had been in 1750. Our people still lived in a fringe along the Atlantic seaboard. The buffaloes were ranging the prairies east of the Mississippi. The whole valley of that river was practically unsettled. The West was a great unknown. There was no crowding; and as for opportunities, they were greater than ever before. The arts of life and the comfort and health of living were all improving. Manufacturing industries were springing up. Commerce was increasing, new inventions were being perfected, occupations were becoming more numerous and varied, the people were happy, prosperous, jubilant in their successful nationality, and in 1830 railroads began. All things which enable population to increase were present, and population had been increasing rapidly until suddenly, coincident with the great increase in immigration, the rate fell, and has been falling ever since.

From that period down to the present hour all the facilities of business have improved, new occupations have been created, the medical and surgical sciences have improved, their improvement is more generally distributed, sanitary conditions are better, and as a consequence the average human life has been lengthened by two years.

After the civil war came to an end in 1865 the same condition existed. The West was still unsettled. The Union Pacific Railroad was not finished until 1869. The next ten years, with increasing facilities for reaching all parts of the country, gave the grandest opportunity for rapid growth that was ever known. Yet not only the rate of the native whites kept falling, but the rate of the whole population, with the greatest immigration added, kept steadily falling.

What shall be said of the last decade, 1880–'90, when the increase of the whole population, with a still greater immigration added, has fallen to a rate which is four per cent lower than the rate of the native whites during the Revolution ? Is this a crowded country ? We have sixty-five millions in a territory which every one admits can easily support four hundred millions. Is this a luxurious, worn-out, jaded country ? Where, how, and by what ? Possibly among a fraction of the population in a few great cities. But they do not constitute the country. Look at the small towns, the great country districts, the masses of the people, and where are the signs of the luxury that enervates ? Fashionable society has grown in recent years; but even admitting that it has grown to the fullest possible extent, and that it is guilty of all the folly with which it is charged, it has not yet become one fortieth part of the population.

Spain is said to be an old, worn-out nation, but during the ten years from 1880 to 1890 she increased the annual rate of her growth from 35 per thousand to 54 per thousand. Even France, though her rate had fallen very low in 1870, has steadily increased it in the last twenty years, and raised it from 7 per thousand inhabitants in 1870 to 37 per thousand in 1890. England has steadily increased her rate in the last twenty years. So has Russia, whose rate is very high, being 105 per thousand in 1870, 130 in 1880, and 140 in 1890. Holland, a very old and closely settled country, has increased her rate in almost the same proportions, 80 per thousand in 1870, 118 in 1880, and 135 in 1890. Belgium's rate is not far behind.*

Of all these countries none are superior to the United States in natural fertility and resources. Most of them are much inferior, and have a larger proportion of people to the square mile. The United States has only 21·31 to the square mile; † but Russia has 42, Spain 86, Great Britain 184, France 320, Holland 350, and Belgium 530.

If we are right in believing that the lowering of the rate of native growth was due to the increase of foreigners, then immigration has not materially increased, but, on the contrary, has somewhat decreased the American population. If the native population had kept up an increase per decade of only 34 per cent, which was less than it had in the twenty years 1790 to 1810, and immigration had ceased, the white population would

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* Mulhall's Dictionary of Statistics, article Population, p. 442.

† The average of 21·31 per square mile for the United States is calculated on the total land area, exclusive of Alaska and Indian Territory.

now be more numerous than it has become with the assistance of immigration.

If we take the native white population of 5,745,348 in the year 1810 and give it an increase each succeeding decade of 34 per cent, with 28 per cent for the decade that included the civil war, we have for the year 1890 57,048,753, which is 3,064,863 in excess of the 54,983,890 total whites as given by the census of that year. In other words, the natives multiplying at less than their old rate would outnumber the present native and foreign white population by over three millions.

The rate of 28 per cent for the decade that included the civil war is lower than the rate of native increase during the Revolution, and the Revolution lasted seven years, while the civil war lasted only four. The rate of 34 per cent for the other decades is also quite conservative. For twenty years, when immigration was at a minimum, the natives had exceeded this rate, and as their rate was steadily rising there is every probability that they would soon have exceeded 35 per cent, and reached 36 or more before 1890. An average rate of 35 per cent, with 28 for the civil war, would have given 60,098,117 whites in 1890, which is 5,114,227 in excess of the total whites as reported by the census, and lacks only about two millions of equaling the whole aggregate population of black, white, Chinese, Japanese, and civilized Indians.

The estimates of Jefferson and others by which they prophesied a great increase for the future were based on rates much higher than this. The country was new, with ample room for development, and growing more and more prosperous. European countries with dense populations and inferior natural resources have increased their rate within that time, and why should not the United States?

Some of these old countries increase their rate in spite of the fact that thousands of emigrants are leaving them every year. We have a new country, not half developed, with immigrants pouring into us, and yet our rate has been steadily falling for sixty years. Since 1830 the rate of increase of the whole aggregate population, black, white, Chinese, Japanese, and civilized Indians, together with all the immigrants that have been poured upon us and the accessions from the new territories, Louisiana, Florida, Texas, New Mexico, and California, has seldom been appreciably higher, and is in most cases considerably lower, than the old rate of increase of the native whites from 1750 to 1830, when immigration was at a minimum. All the immigrants and all their increase can not make up for the loss of the old rate of increase of the natives.

The following table shows that in only two decades, 1840 to 1850 and 1850 to 1860, was the rate of increase of the whole population higher than it had been among the natives alone before 1830. In the first of those decades, 1840 to 1850, the rate was abnormal because the Mexican War brought us a sudden large accession of black and white population from the conquered provinces of Texas, New Mexico, and California. The rate in the second decade, 1850 to 1860, was also abnormal. The people who were not counted in California in the census of 1850, owing to the burning of part of the returns, were counted in 1860, and increased the rate for that decade:

	Aggregate population.	Per cent of increase.	Correction for census of 1870.
1830	12,866,020	33·55	
1840	17,069,453	32·67	
1850	23,191,876	35·86	
1860	31,443,321	35·57	
1870	38,558,371	22·62	24·62
1880	50,155,783	30·07	28·07
1890	62,622,250	24·85	

During the last twenty years immigration has reached enormous proportions. For the decade 1870 to 1880 the arrivals at ports, without counting those that came in over the Canadian and Mexican borders, were 2,834,040, and for 1880 to 1890 the same sort of arrivals were 5,246,613.* Added together they make for the twenty years 8,080,653, which is more than half of the total immigration since 1820. Yet with this enormous influx the rate of increase of the whole population has sunk lower and lower; and the twenty years which saw this huge immigration saw the lowest rate of increase since 1750.

From the year 1750 to 1830 the native population without the assistance of immigration never increased less than 33·17 per cent each decade except during the Revolution, when it went down to 28·81 per cent. But now, with a larger immigration than was ever known, the increase of our aggregate population is only 24·85—almost 4 per cent lower than the rate of increase of the native whites during the Revolution.

THE mopane tree of eastern Mashonaland, Africa, is described by W. A. Eckersley, of the railroad surveying party, as rarely attaining a height of more than twenty-five feet. "When first its leaves make their appearance they are bright red; this soon changes to a rich autumnal brown; passing through some further shades of that color, they finally assume a green of equal brilliance to the spring leaves of some of our English trees. Masses of these trees in the various stages of change form a remarkably picturesque effect; the strong contrast in which the brilliant reds and greens stand out against the background of the blue-gray granite is particularly striking."

* Report of Superintendent of Immigration (1892), pp. 13, 30.

INSECTS' EGGS.

By M. V. BRANDICOURT.

JOHANNES SWAMMERDAM, a Dutch naturalist, who was the first to examine insects with a microscope, and whose investigations were published in 1757, gave some curious details concerning the eggs of insects.* "Some are oblong," he said, "others ovoid or round. There are also angular, pyramidal, striated, and granular eggs, etc. They are no less various as to colors, and we find them white, yellow, red, blue, green, and pied with different colors so singularly combined that it is almost impossible to describe them exactly. In consistence, some are soft, others hard; some membranous, others covered with a coat like parchment or with a real eggshell; some are covered with a kind of froth, others with hairs."

Swammerdam described with many details the eggs of the *Nepa cendrea*, a little fresh-water hemipter, which he called the water scorpion (Fig. 10). They are yellow and nearly of the same shape as the seed of the blessed thistle, slightly elongated, and rounded at the lower end. On the upper part they are provided with seven or eight slender branches, or hard threads, of which the point is red and the middle whitish. These appendages or threads, arranged in a circle around the circumference of the summit of each egg, form a kind of open egg cup, which receives the end of the next egg in its cavity. Thus these appendages of the first egg hold the lower end of the second, and so on.

The eggs of the *Lepidoptera* have considerable resemblance to the seeds of plants (Figs. 1, 2, 3, 4). "Those of the larger and smaller cabbage butterflies have the shape of a pyramid, of a height three or four times the diameter of the base, and the base is stuck to a leaf. The eggs are usually formed by eight rounded ribs, separated by flutings running from the summit to the larger end. On each of these sides may be seen an infinite number of flutings parallel to the base. The eggs of the great tortoise butterfly are nearly spherical, and are smaller in diameter at the base, or the part by which they are attached to the plant, than at the summit, whence eight equally distant crests descend along the body of the egg, forming ribs which diminish imperceptibly in height and disappear before reaching the end." †

These eggs resemble those of a night moth which attaches its

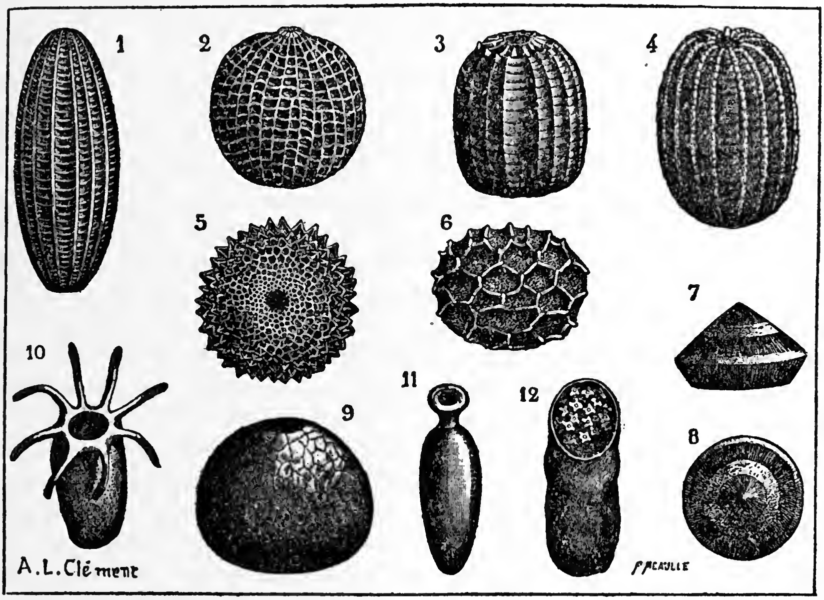
* *Histoire naturelle des Insectes* (Natural History of Insects). Translated from the *Biblia Naturæ* of Johannes Swammerdam. Paris, 1758.

† *Histoire naturelle des Insectes* (Natural History of Insects). By De Tigny. Paris, 1815.

eggs to the branches of trees. They hold there with such strength that they leave a scar on the bark, and even interfere with the nutrition of the branch. They are remarkable for being shaped like the stones that are cut for the construction of arches, and, "being larger at the summit than at the base, so that they join exactly, they arrange themselves in an arcade."

Some butterflies have eggs of very elegant shape, resembling a kind of little knob, fluted and girt with a small purple circular band.

The eggs of the dragon fly are elongated; at the upper end are a kind of flowerets like those of the louse nit. The gnat's



Figs. 1 and 2, eggs of the large and of the small cabbage Pieris; Fig. 3, egg of the Tristan butterfly (*Papillo hyperantus*); Fig. 4, egg of the admiral (*Vanessa atalanta*); Figs. 5 and 6, eggs of Polyommatus; Figs. 7 and 8, eggs of *Dicranura vinula*, profile and front views; Fig. 9, egg of *Pygaera tricephala;* Fig. 10, egg of water scorpion (after Swammerdam); Fig. 11, egg of gnat; Fig. 12. nit of the louse (after Swammerdam, greatly magnified).

egg is like a skittle, the larger end of which is rounded, while the other end terminates in a short neck, like those of some liquor flasks (Fig. 11). The eggs of the ephemera can be observed only under the microscope, on black or blue paper. They are plano-convex and oblong. The membrane that envelops them has a nebulous appearance under the microscope. The eggs are white, like the inner coating of thin shell.

The *Euryanthus horribilis* of New Guinea, on the other hand, an orthopter of the singular tribe of the phasmids, which is twelve or fifteen centimetres in length, lays eggs, it is said, as large as those of a humming bird.

The blowfly has an oblong, angular egg, with lozenge-shaped compartments forming a kind of network. They are very white and composed of two distinct envelopes, of which the outer one is a real shell like that of a hen's egg, and breaks as easily.

The egg of the ant is uniform, smooth, tight and bright, without any division. When the larva has come from it, only a very thin membrane is left, which rolls up and is reduced to an imperceptible point; and even if the egg does not hatch, it is still so small as to escape the eyes. This is why these eggs are so little known, for what is commonly and improperly called the egg is really the larva, and is endowed with life and motion. These eggs, or rather these larvæ, of ants are very much sought after by barnyard fowl. An old woman of Paris gained a very comfortable income by selling them at the Jardin d'Acclimatation to feed the pheasants. She collected them in the woods of the suburbs, indifferent to the bites she received from the old ants. Her trade extended from June till the end of September. Ants' eggs are considered a choice dish in some countries. They are spread upon a slice of bread and butter, and sauces considered excellent are made with them. They are esteemed as a costly food in Siam, within the reach only of well-to-do people. They are the object of an important trade in some countries of northern Europe, where they are cooked in boiling water, and yield a kind of vinegar or formic acid.

The eggs of certain aquatic insects resembling noctonectæ (*Corixo femorale* and *Corixo mannaria*, Geoffroy, and *Noctonecta Americana*) are eaten in Mexico. They are usually found deposited on the reeds and rushes of the lakes, especially of Lake Tezcuco. The egg-laden reeds and rushes are cut, dried, and beaten over cloths, to detach the myriads of eggs which are fastened on them. The eggs are very carefully cleansed, and are, after that operation, winnowed, put up in sacks like flour, and sold as material for cakes. This novel aliment, which is called *hantlé*, and is really water-flea bread, is the object of considerable trade in the markets of Mexico. It has a pronounced fishy flavor, and was used by the natives prior to the conquest. The eggs of another species (*Corixa esculenta*), which resemble manna, are eaten in Egypt, and form an element of very choice dishes.

The eggs of insects resist considerable variations of temperature. The most rigorous cold of our winters is fatal to the eggs only of the most delicate species; and the eggs can likewise resist the most intense tropical heats.—*Translated for the Popular Science Monthly from La Nature.*

SKETCH OF DAVID DALE OWEN.

DAVID DALE OWEN was born at Braxfield House, near New Lanark, Scotland, June 24, 1807. He was the fourth son and sixth child in a family of eight children. All but the first born, a son, lived to adult age. His father, Robert Owen, the celebrated philanthropist, was a native of North Wales.

Robert Owen, after working in the drapery business in London and elsewhere, entered into partnership with a mechanic, at eighteen years of age, in the manufacture of cotton-spinning machines. A year later he took a position as superintendent of a mill employing five hundred hands, and at twenty-two years of age he became a partner in an old-established spinning concern of Manchester. Having become attached to Miss Anne Caroline, the eldest daughter of David Dale, proprietor of large mills at New Lanark, near Glasgow, he arranged with his partners to buy the works of the father, and soon after obtained for himself the hand of the daughter. They were married in 1797. Undertaking the management of the works ("government" he called it), he steadily improved the condition of the factory hands, which had been there as elsewhere bad to a degree now almost incredible. Some of his measures were opposed by his partners, and led to several dissolutions of partnership through which he retained the management, but he was forced to retire in 1829 when fifty-eight years of age. In spite of what he spent for the workers, Owen always made the business pay well. For several years beginning with 1815, he worked for the passage of Acts of Parliament beneficial to factory operatives. Becoming convinced that social reform could be best secured through communism, he bought from the Harmony Society a tract of thirty thousand acres, and the buildings of their settlement at New Harmony, Ind. The Harmony Society was prosperous but wished to change its location. Coming to America in the spring of 1825, he organized a community of about nine hundred persons on a provisional plan. He returned to Scotland to look after his business, leaving his two oldest sons at New Harmony.

William Maclure, of Philadelphia, a man of means and devoted to philanthropy and the advancement of science, took part in founding the community. He heard of Owen's scheme on returning to the United States after an attempt to found an agricultural labor school in Spain, and believed that it would afford favorable conditions for carrying out his cherished idea of an educational institute founded on rational principles. He accordingly bought a large tract of land in New Harmony and vicinity, and removed thither his library and collection of minerals, which were extensive, and his valuable scientific apparatus. He induced Gerard Troost, C. A. Lesueur, and Thomas Say, also Joseph Neef, the Pestalozzian, to come into the community with him, to act as instructors in the institution proposed. When the society was divided into a manufacturing and educational, and an agricultural branch, Maclure became the leading spirit in the educational division.

Owen visited New Harmony a second time in the winter of 1825-'26. His third visit was made in the spring of 1828, and by that time so many troubles had arisen that the community was disbanded. The failure of the undertaking was due to the one great cause that makes all communistic enterprises impracticable in the present age—the imperfections of human nature. In the same year Mr. Owen went to Mexico, on the invitation of the Government, to put his ideas into practice there, but effected nothing because the Government insisted that the state religion of the proposed community should be Roman Catholic. Some experiments were afterward tried by him in Great Britain, and he continued to advocate his views with voice and pen until his death, in 1858. His followers received the name of "Owenites." He published a considerable number of writings, including an autobiography.

David Dale Owen's early education, which was received from a private tutor, included the English branches, the rudiments of Latin, and a course in architectural drawing. He was also trained in the use of carpenter's tools in the mechanical department connected with his father's mills. He was for a time a pupil in the grammar school, or academy, at New Lanark. His father, while traveling on the continent of Europe, had visited the celebrated educational institution of Emanuel von Fellenberg, at Hofwyl, Switzerland, and was so much pleased with the system pursued in it—neither moral, physical, nor intellectual development being neglected—that he sent there first his two oldest sons—Robert Dale and William—for a three years' course, and after their return sent David and his younger brother Richard, in 1824, also for three years. The studies of the more advanced classes were partly elective, and David Dale and his brother chose chemistry, drawing, and modern languages in addition to the prescribed mathematical and literary course.

David Dale and Richard returned to Scotland in September, 1826, the former being then nineteen years old. They entered the classes in physics and chemistry conducted by Dr. Andrew Ure, author of the Dictionary of Arts, Manufactures, and Mines, at Glasgow, where their mother then resided. Their father was absent at New Harmony. For that place the two younger sons set out in November, 1827, going by a ship from Liverpool to New Orleans, thence up the Mississippi by steamer, reaching the settlement on the Wabash early in January, 1828.

During the next three years they kept up and increased their knowledge of chemistry by repeating the experiments of Dr. Ure's course. Desiring to extend his knowledge of chemistry and geology, David Dale Owen in 1831 returned to Great Britain. He had as a companion Henry D. Rogers, and they both lived at the house of Owen's father in London while attending the lectures of Dr. Turner at the London University.

After about a year abroad Owen came back to the United States. Soon after his return he was stricken with Asiatic cholera, which was epidemic in this country in the summer and fall of 1832, but was fortunate enough to survive the attack. Wishing to increase his knowledge of anatomy and physiology as an aid in the study of paleontology, he entered the Ohio Medical College, in Cincinnati, and was graduated in the spring of 1836. He devoted the summer following his graduation to gaining practical experience in field geology. To this end he accompanied at his own expense Dr. Gerard Troost, who was then engaged on the State Survey of Tennessee.

Dr. Owen married, March 23, 1837, Caroline C. Neef, the third daughter of that pioneer of Pestalozzian education in America, Joseph Neef.

Dr. Owen had been appointed State Geologist of Indiana and immediately after his marriage he entered upon the duties of this position. He made a preliminary reconnoissance in 1837 and 1838, his report upon which was published immediately after its completion and reissued in 1859. Geological science being little understood in the West when this document first appeared, a brief introductory exposition of the leading formations was given in it, after which the rich deposits of coal, iron, and building stones within the limits of the State were described.

The Hon. James Whitcomb, then Governor of Indiana, was soon afterward appointed Commissioner of the General Land Office, and Congress having ordered a survey of the Dubuque and Mineral Point districts under the direction of his bureau, he selected Dr. Owen, with whose ability he was well acquainted, to conduct this examination. These districts comprised eleven thousand square miles of the Northwest Territory, now included in the States of Wisconsin and Iowa, and the object of the examination was to enable the commissioner to reserve from sale those sections found to contain mineral wealth. But a short time was allowed for the work, hence it became necessary to organize a large force. The difficulties involved in such a rapid prosecution of the survey are indicated in the report presented by Dr. Owen to the commissioner, April 2, 1840. "In one month from the day I received my commission and instructions," he says, "(to wit, on September 17th), I had reached the mouth of Rock River; engaged one hundred and thirty-nine subagents and assistants; instructed my subagents in such elementary principles of geology as were necessary to the performance of the duties required of them; supplied them with simple mineralogical tests, with the application of which they were made acquainted; organized twenty-four working corps, furnished each with skeleton maps of the townships assigned to them for examination, and placed the whole at the points where their labors commenced, all along the line of the western half of the territory to be examined. Thence the expedition proceeded northward, each corps required, on the average, to overrun and examine thirty quarter sections daily, and to report to myself on fixed days at regularly appointed stations: to receive which reports and to examine the country in person, I crossed the district under examination, in an oblique direction, eleven times in the course of the survey."

It was in the spring of 1840 that William Maclure died. As administrator of his estate, his brother Alexander engaged Dr. Owen to assort the very extensive collection of minerals and fossils which Mr. Maclure had made in the course of his geological exploration of the United States and his travels in this country, Europe, and the West Indies. Specific suites were to be distributed to certain schools and colleges, and the remainder was to be retained by Dr. Owen as the nucleus of a museum. These directions were duly carried out. With regard to the portion remaining in Dr. Owen's hands The American Geologist * states: "To this latter Dr. Owen subsequently added largely, by purchase from Dr. Krantz, of Germany, illustrative fossils of every period; among others an ichthyosaurus, from the Lias of Würtemberg, larger than the one in the British Museum. Another interesting and valuable specimen was a nearly complete skeleton of a gigantic megatheroid animal (the Megalonyx) which he exhumed near Henderson, Ky. The entire collection some years after Dr. Owen's death was purchased by the Indiana University, and unfortunately nearly all consumed by fire, when the new university building, including the museum, laboratory, and library, was destroyed."

Dr. Owen was again called into the service of the Government in 1847, being appointed United States Geologist and directed to make a survey of the Chippewa land district. His Preliminary Report, made in the following year to the Hon. R. M. Young, then Commissioner of the Land Office, was a document of one hundred and thirty-four octavo pages, and was accompanied by three hundred and twenty-three lithographs from his own sketches, and numerous maps, diagrams, etc.

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* Sketch of the Life of David Dale Owen, M. D., August, 1889, to which source acknowledgment is due for the greater portion of the material entering into the present article.

The scope of his examination was then enlarged so as to embrace a fuller survey of portions of the Northwest Territory, lying mainly within the present States of Wisconsin, Iowa, and Minnesota. This task required five years of field work and a final year of laboratory and office work, ending with the year 1852. A large appropriation was made by Congress for illustrating and printing Owen's report, all the details of publication being committed to him. The result was a finely illustrated quarto volume of six hundred and thirty-eight pages, many of the illustrations being from the original drawings of Dr. Owen, who had great facility in sketching. In this volume he applied for the first time the medal-ruling style of engraving to cuts of fossils.

In an article on Geological Surveys in Missouri Mr. Arthur Winslow says of Owen's reports up to this time: "These reports supplied the guiding lines along which later stratigraphic work in the Mississippi Valley was done. Without attempting here to present the history of this work, its bearing upon the future work in Missouri calls for brief mention. In the Indiana reports Owen makes a separation of the rocks, in harmony with the English classification, into—1. Bituminous coal formations. 2. Mountain limestone. 3. Grauwacke. 4. Crystalline and inferior stratified rocks. In the succeeding reports, as the results of wider observation and more thorough study, the classification was changed and differentiated until, in the final report, we find a classification which, not only in its general features, but in many of its details, is still adhered to in Missouri."

From 1854 to 1859 Dr. Owen was occupied with the geological survey of Kentucky, having been appointed State Geologist by Governor Powell. The results of his explorations were published as the work progressed, and compose four large octavo volumes. Dr. Robert Peter, of Lexington, Ky., performed the chemical work of the survey and made a special report upon it.

Toward the close of his labors in Kentucky, in October, 1857, Dr. Owen was commissioned to conduct a geological survey of the State of Arkansas. His principal assistant in the Kentucky survey, Mr. E. T. Cox, filled the same position in the new work. The chemical assistant on the latter survey was Dr. Elderhorst, author of a work on the blowpipe. Various incidents in his several surveys prove Dr. Owen to have been a man of indomitable perseverance. Once, while on the Red River of the North with a Canadian *voyageur*, the fowling-piece used by the latter for procuring game was discharged in such a way as to lodge a number of shot in Dr. Owen's shoulder. But he did not permit the accident to delay him an hour. Again, the summer occupied with the field work of the Arkansas survey, a considerable part of which was necessarily spent in the rich and malarious bottom lands, proved very detrimental to his health, bringing him home in the autumn with a hue denoting serious derangement of the liver. Yet he not only persevered in his explorations, but occupied himself in winter with laboratory work, usually until midnight. He did not desist even when suffering acutely from his last illness, but dictated the closing portions of his report until within forty-eight hours of his death. Between Dr. Owen and Governor Conway, who had given him the Arkansas appointment, there always existed the most cordial good feeling, and the latter provided every facility for the prosecution of the survey. Toward the end of 1860 postal communication between the North and South was considerably interrupted, for the breach which culminated in civil war was already opening. Yet the Governor, at considerable pains, succeeded in sending safely to New Harmony several thousand dollars due from the appropriation, and required for the publication of the second volume of the report. Dr. Owen had died, and the issuing of this volume, for which he had left full instructions, fell to his brother and administrator, Prof. Richard Owen. The latter also executed a second survey of Indiana, for which his brother had been appointed in 1859, with the understanding that Richard should do as much of the work as might be necessary.

The labors above outlined resulted in undermining the originally good constitution with which David Dale Owen had been endowed. Malarial fever, complicated with rheumatic attacks which threatened the heart, terminated his career of usefulness November 13, 1860. He left a widow, two sons, and two daughters. Dr. Owen's character was marked by integrity and amiable simplicity; his kindness and liberality were well known, and his scientific work was always conscientiously performed. His fondness for chemistry led him to build at a cost of ten thousand dollars a laboratory fully equipped, which served as a material evidence of his good taste in architecture. His architectural taste was further evinced in the artistic design which he submitted for the Smithsonian Institution building. He also tested many varieties of building stone before the selection of material for that structure was determined.

His artistic skill enabled him, besides richly illustrating his reports, as above noted, to leave good portraits in oil of members of his family. He transmitted to London views of the fossil *Sigillaria* found erect *in situ* twelve miles from New Harmony, with a description, which were presented to the British Association for the Advancement of Science by Sir Roderick Murchison. He subsequently conducted Sir Charles Lyell to the locality while the latter was his guest at New Harmony in his second visit to the United States.

PROFESSIONAL INSTITUTIONS.

VIII.—TEACHER.

By HERBERT SPENCER.

TEACHING implies knowledge of things to be taught; and as, for various reasons, the priest comes to be distinguished by his possession of knowledge, from him more especially is it to be obtained. Moreover, being released from life-sustaining activities, he has more time than others for giving information and enforcing discipline.

A deeper reason for this primitive identity of priest and teacher may be recognized. Though during early years each youth gathers, in miscellaneous ways, much which is properly to be called knowledge, and which serves him for guidance in ordinary life, yet there is a kind of knowledge, or supposed knowledge, particularly precious, which does not come to him through the irregular channels of daily experience. Equally in savage tribes and among early civilized peoples, ghosts and gods are believed to be everywhere, and always influencing men's lives for good or evil; and hence of chief importance is information concerning the ways in which conduct may be so regulated as to obtain their favors and avoid their vengeance. Evidently the man who knows most about these supernatural beings, the priest, is the man from whom this information of highest value is to be obtained. It results that the primitive conception of the teacher is the conception of one who gives instruction in sacred matters.

Of course the knowledge thus communicated is first of all communicated by the elder priests to the younger, or rather by the actual priests to those who are to become priests. In many cases, and for a long time, this is the sole teaching. Only in the course of evolution along with the rise of a secular cultured class, does the teacher as we now conceive him come into existence.

Necessarily in early stages of all evolving aggregates the lines of organization are indefinite. In groups of the uncivilized we can not expect the function of educator to have become distinctly marked off. Still we soon detect that inculcation of secret and sacred things which, as above indicated, constitutes the earliest kind of teaching: the "mystery men" being the instructors. Says Bernau concerning the Arawaks:—

> "The son of a conjurer, as soon as he enters his twentieth year, or even sooner, is made acquainted by his father with the art of conjuration, and enjoined the greatest secrecy concerning it."

And whether the neophyte be a descendant or not, there is always this injunction of silence respecting the communicated information, which invariably has reference to dealings with supernatural beings; so that, from the very first, there is shown the rise of an esoteric cult such as the priesthoods of early historic peoples show us.

But in groups of savages we may trace an extension of this sacred teaching, or rather part of it, to all young men on their arrival at the fit age. The Australians, for example, have everywhere an initiation ceremony during which the youth, circumcised after a fashion, or in other cases having a tooth knocked out, is thereby dedicated to a supernatural being supposed to be present, as in the case of Daramūlŭn, who is doubtless the hero of the tribe: the dedications being obviously akin in spirit to those of more civilized peoples. On these occasions the medicine-men are the operators and instructors.

The more advanced of the uncivilized, whose medicine-men have gained in some measure the character of priests, furnish better evidence. We have the case of the New Zealanders, among whom, according to Thomson, one of the duties of the priests is to instruct children in the songs and traditions of the people—to instruct them, that is, in the sacred lore of the tribe. Then in Africa, where the social organization is more developed, we meet with a more definite form of priestly tuition. Bastian tells us that in Congo the fetich-priest yearly collects the boys who have arrived at puberty, and leads them into the forest, where they remain six months, forming a sort of colony under the control of the priest. During this time they undergo circumcision. Then in Abyssinia and in Madagascar we find the teaching function of the priest shared in by a non-priestly class—a step in differentiation.

Peoples, past and present, in sundry parts of the world, who have reached higher stages of civilization, yield fragments of evidence which I string together in as orderly a way as is practicable. Writing of the Mexicans, Torquemada says that the whole education was in connection with the temples. Very many boys were sent there to be educated from the fourth year of their age until their marriage. Clavigero tells us the same thing. Of the priests of Yucatan we read:—

"They instructed the sons of other priests, and also the younger sons of the lords, who were given to them from childhood when they appeared to be inclined to that office. The sciences which they taught were the computation of years, months, and days, festivals and ceremonies, the administration of their sacraments, etc., etc."

Of existing peoples the Japanese may be first named as supplying us with a relevant fact.

"The secular teacher's vocation can scarcely be said to have existed prior to the days of the founder of the Tokugawa dynasty. . . . The bonzes [priests] of Japan are to be credited with being mainly instrumental in spreading a knowledge of the rudiments of education throughout the length and breadth of the Empire."

In his *Embassy to Ava* Syme writes:—

"All kioums or monasteries are seminaries, in which boys are taught their letters and instructed in moral and religious duties."

To like effect, from a work entitled *The Burman*, by Shway Yeo, we learn that—

"When a boy has reached the age of eight or nine years he goes as a matter of course to the Pohngyee Kyoung [Monastic School]. It is open to all alike—to the poor fisherman's son as well as to the scion of princely blood."

And the Catholic missionary Sangermano testifies similarly: implying, also, that this education given by the priests is nominally in preparation for the priesthood, since the students all put on "the habit of a Talapoin" during the period of their education. The Mahometans, too, yield evidence. At the present time in Cairo the university is in a mosque.

Illustrative facts taken from the accounts of extinct and decayed civilizations in the Old World, may be next grouped together—some of them mere hints and others sufficiently full.

Concerning ancient India, Dutt states that education consisted of learning the Vedas, and that in the later as in the earlier periods it was under the priests. He also says:—

"There were Parishads or Brâhmanic settlements for the cultivation of learning . . . and young men went to these Parishads to acquire learning."

To this there must be added the significant fact that in the Epic Period (*ca.* B. C. 1400 to 1000)—

"Besides these Parishads, individual teachers established what would be called private schools in Europe, and often collected round themselves students from various parts of the country. . . . Learned Brâhmans who had retired to forests in their old age often collected such students round them, and much of the boldest speculations in the Epic Period has proceeded from these sylvan and retired seats of sanctity and learning."

Taken in conjunction with the preceding statements this last statement shows us how teaching was in the beginning exclusively concerned with religious doctrines and rites, and how there eventually began to arise a teaching which, in some measure detached from the religious institutions, at the same time entered upon other subjects than the religious.

A kindred, if less elaborated, system existed in ancient Persia.

"It is pretty clear that the special training of boys for future callings went hand in hand with their religious education, and that it was chiefly regulated according to the profession of the father. . . . It was evidently also no uncommon practice to commit children to the care of a priest for training and instruction in the same manner as the Indian Brahmins were wont to do."

Respecting Babylonia and Assyria Professor Sayce, describing the social life there, says:—

"The libraries were established in the temples, and the schools in which the work of education was carried on were doubtless attached to them."

"The 'house of males' into which the young men were introduced, seems to have been a sort of monastic establishment attached to the great temples of Babylonia."

Of educational arrangements in Egypt the like is said by various authorities—Brugsch, Erman, and Duncker.

"Schools were established in the principal towns of the country; and human and divine wisdom was taught in the assemblages of the holy servants of the gods."

"The high priest of Amon, Bekenkhonsu, tells us, that from his fifth to his seventeenth year he was 'chief of the royal stable of instruction,' and thence entered the temple of Amon as an under-priest."

"The colleges at these temples [Thebes, Memphis, and Heliopolis] were the most important centers of priestly life and doctrine."

That absence of a priestly hierarchy in Greece which, as before pointed out, interfered with the normal developments of other professions. interfered also with the normal development of the tutorial profession. The temples and their surroundings were indeed places for special culture of one or other kind, mostly having some relation to religious observances. But this form of priestly teaching did not grow into any general system taking in the lay members of the community. Referring, by contrast, to education in the *gymnasia*, Mahaffy writes:—

"The older fashion had been to bring up boys very much as we bring up girls, keeping them constantly under the eye of a special attendant or teacher . . . teaching them the received religion and a little of the standard literature, inculcating obedience to the gods and to parents."

As happened in Persia during its phase of militant activity, physical culture and culture of the mental powers useful in war took precedence of other culture.

"The old system of advanced education, which ordained that from the age of eighteen to twenty Athenian youths . . . should remain under State supervision, and do the duty of patrols round the outlying parts and frontier forts of Attica, receiving at the same time drill in military exercises, as well as some gymnastic and literary training," became in time modified to one in which "most of the gymnastics and military training was left out."

But intellectual culture as it increased fell into the hands not of the priests but of secular teachers. "Those philosophers who did not, like the Stoics, despise teaching youths, . . . set up their schools close beside these gymnasia."

Still more in Rome, where the course of evolution was so much modified by the intrusion of foreign elements and influences, was the normal genesis of the teacher interfered with. Always when militancy is extremely predominant, mental acquisition, regarded with no respect, is not provided for: instance the fact that in Japan, "during many centuries previous to Iyéyasŭ's time, the very numerous warrior-class like the Knights of Mediæval Europe, despised a knowledge of letters as beneath the dignity of a soldier, and worthy only of the bard and priest." And it was thus in Rome.

"The economic arrangements of the Romans placed the work of elementary instruction in the mother-tongue—like every other work held in little estimation, and performed for hire—chiefly in the hands of slaves, freedmen, or foreigners, or in other words chiefly in the hands of Greeks or half-Greeks."

This condition of things will be comprehended when we remember firstly that the normal genesis of teachers from priests is due to the fact that in early stages priests are distinguished by their superior knowledge; secondly that the priests in Rome were not thus distinguished, since the subjugated Greeks were more learned than they; and thirdly that all attributes of conquered men are liable to fall into contempt.

On passing northward to the peoples of pre-Christian days and to those of early Christian days, we are again shown the primitive identity of priest and teacher and the eventual separation of the two. Elsewhere saying of the Celts that their training, wholly military, aimed to produce endurance, agility, and other bodily capacities, Pelloutier writes:—

"Pour entretenir les peuples dans la dépendance, et pour être toujours consultez comme des Oracles, les Ecclésiastiques vouloient être les seuls Savans: et de l'autre, les Celtes, qui regardoient tout travail, tant du corps que de l'esprit (Procop. Gotth. L. I., cap. 2, p. 311) comme une chose servile, abandonnoient de bon cœur toutes les Sciences à leurs Druides, qu'ils consideroient non seulement comme des Savans, mais encore comme de véritables Magiciens. Les études des Nations Celtiques se réduisoient donc uniquement à apprendre par cœur certains Hymnes qui renfermoient leurs Loix, leur Religion, leur Histoire, et en général tout ce qu'on vouloit bien que le peuple sût.", (To keep the people dependent upon them, and in order that they might always be consulted as oracles, the Ecclesiastics wished to be the only men of knowledge; and, on the other hand, the Celts, who regarded all labor, whether of body or mind (Procop. Gotth. L. I., chap. 2, p. 311), as servile, readily left all the sciences to their Druids, whom they held to be real magicians as well as men of knowledge. The studies of the Celtic nations were therefore reduced simply to learning by heart certain hymns in which were embodied their law, their religion, their history, and, in general, all that it was desirable the people should know.)

And congruous with this is the statement of Pliny concerning the British:—The druids "taught their pupils, and harangued to them concerning their doctrines; they made public speeches to the people, and instructed them in morality."

Almost extinguished during early centuries of our era, such culture as survived was to be found only in ecclesiastical institutions, and out of them grew up afresh. As Hallam says:—

"The praise of having originally established schools belongs to some bishops and abbots of the sixth century. They came in place of the Imperial schools overthrown by the barbarians. . . . The cathedral and conventual schools, created or restored by Charlemagne, became the means of preserving that small portion of learning which continued to exist."

Mosheim, describing the Church of the sixth century, further tells us that in the cathedral schools the clerical teacher "instructed the youth in the seven liberal arts, as a preparation for the study of the sacred books;" and that in the monasteries "the abbot or some one of the monks instructed the children and youth that were devoted to a monastic life." These last facts verify the statement, made at the outset, that primarily instruction, whether given to lay or clerical youth, concerned itself directly or indirectly with religious propitiation: the avowed purpose, as expressed by the Council of Vaison, being to make the young "attach themselves to holy books and to know the law of God."

Subsequent centuries of wars and social derangements witnessed a decay of these ecclesiastical teaching institutions, notwithstanding efforts from time to time made by popes and bishops to reinvigorate them. But, as was to be expected, when there began to arise lay teachers, there arose clerical resistance. Then, as always, the priestly class disliked to see the instruction of the young falling into other hands. In France, for example, the Chancellor of Ste. Geneviève, who granted licenses to teach at the Paris University, used his power sometimes to exclude able men, sometimes to extort money, and had repeatedly to be restrained by papal injunctions. So, too, was it in Germany.

"All the professorial posts in the Universities were in the hands of the clergy, until the end of the fifteenth, and even into the sixteenth, century."

In Heidelberg, 1482, "a layman was for the first time, after a severe struggle, allowed to become a professor of medicine."

"The general admission of lay professors to clerical offices did not take place until 1553."

Our own country presents like evidences. In old English days "parish churches were often used as schools," says Pearson. And, according to Sharon Turner,—

"The clergy were the preceptors of those who sought to learn . . . to them the moral and intellectual education of the age was intrusted. . . . Thus the Irish monk Maildurf, who settled at Malmesbury . . . took scholars to earn subsistence."

So it was, too, in subsequent days. We read in the same two authors that after the Conquest—

"The numerous clergy scattered up and down through England had a direct interest in promoting education. They eked out their scanty stipends as tutors and schoolmasters."

"One of the first fruits of the revival of literature in England, was the universal establishment of schools. To every cathedral, and almost to every monastery, a school was appended. . . . Few persons of any note appear to us among the clergy, during the century after the conquest, who did not during some part of their lives occupy themselves in instructing others."

In exemplification may be named, as distinguished teachers belonging to the priesthood during the Anglo-Saxon period, Bede, Alcuin, Scotus Erigena, and Dunstan. And after the Conquest, as teachers sufficiently conspicuous to be specified, come Athelard of Bath, John of Salisbury, Alexander Neckam, Roger of Hoveden, Duns Scotus.

But here as elsewhere the secularization of teaching slowly went on in sundry ways. Early in the fifteenth century laymen here and there left money for the founding of schools. Warton, writing of the early part of the sixteenth century, says:—"The practice of educating our youth in the monasteries growing into disuse, near twenty new grammar schools were established within this period." At the same time there was initiated a slow change in the character of our universities. Beginning as clusters of theological students gathered round clerical teachers of wide reputation, they, while growing, long continued to be places for clerical education only, and afterward simulated it. Almost down to the present day acceptance of the legally-established creed has been in them a condition to the reception of students and the conferring of distinctions; and they have all along preserved a teaching and discipline conspicuously priestly. We have residence in colleges under a *régime* suggestive of the monastic; we have daily attendance at prayers, also monastic in its associations; and we have the wearing of a semi-priestly dress. But gradually the clerical character of the education has been modified by the introduction of more and more non-religious subjects of instruction, and by the relaxation of tests which a dominant ecclesiasticism once imposed. So that now the greater part of those who "go to college," do so without any intention of entering the Church: university teaching has been in a large measure secularized.

Meanwhile the multiplied minor teaching institutions of all grades, though they have in the majority of cases passed into the hands of laymen, still, in considerable measure, and especially throughout their higher grades, retain a clerical character. The public schools in general are governed by ecclesiastics; and most of the masters are, if not in orders, preparing to take orders. Moreover, a large proportion of the private schools throughout the kingdom to which the wealthier classes send their sons, are carried on by clergymen; and clergymen in multitudinous cases take private pupils. Thus the differentiation of the teaching class from the priestly class is even now incomplete.

As significantly bearing on the evolution of the teacher, let us further note that at the present moment there is going on a struggle to reacquire that clerical control which a secularized system of public education had in chief measure thrown off. Even when established a quarter of a century ago, this public education was not completely secularized, since certain biblical lessons were given; and now a strenuous endeavor is being made to add to these biblical lessons certain dogmas of the Christian creed established by law, and so to make the teachers of Board Schools to a certain extent clerical teachers. Nor is this all. Clerics have striven and are still striving, to make the public help them to teach Church dogmas in Church Schools. At the present time (June, 1895), the Primate and clergy at large are fathering an Act which shall give them State-funds without State-control. With an arrogance common to Priesthoods in all times and places, no matter what the creed they say to the State—"We will say what shall be taught and you shall pay for it."

No more here than elsewhere do we meet with an exception to the segregation and consolidation which accompany differentiation; though, partly because of the more recent separation of the teaching class from the clerical class, this change has not been so conspicuous.

The tendency towards integration of the teaching class, and marking off of them from other classes, was first shown among theological teachers. At the University of Paris—

"half-learned persons, who had scarcely any knowledge of the elements of theology, took upon themselves the office of public teachers. The consequence was, that the theological teachers of better reputation united themselves, and formed a regular society; and they had sufficient influence to establish the rule, that no one should be allowed to teach without their approbation and permission. This of course led to an examination of the candidates, and to a public trial of their ability, and to a formal ceremony for their admission to the dignity of teachers or *doctors*."

In our own universities the like has happened. Knowledge, first of established Christian doctrine, and then of other things held proper for teachers of Christian doctrine to know, and then examinations testing acquisition of such kinds of knowledge, have served to create a mass of those qualified, and to exclude those not qualified: so forming a coherent and limited aggregate. Though dissenting sects have insisted less on qualifications, yet among them, too, have arisen institutions facilitating the needful culture and giving the needful clerical authorizations.

Only of late have secular teachers tended to unite. Beyond the various training colleges which instruct and examine and authorize, there are now sundry professional associations. Of a general kind come the Teachers' Guild and the Scottish Educational Institute. Then of more special kinds come the Head Masters [of Public Schools] Conference; the Association of Head Masters of Intermediate Secondary Schools; the Association of Head Mistresses; the College of Preceptors; the Association of Assistant Masters; the National Union of Teachers.

So, too, with the appliances for maintaining a general organization of all concerned in education—schoolmasters, assistants, colleges, and the various unions above named. This professorial class, like other professorial classes, has journals weekly and monthly, some general and some special, representing its interests, serving for communication among its members, and helping to consolidate it.

WHY THE SEA IS SALT.

By G. W. LITTLEHALES.

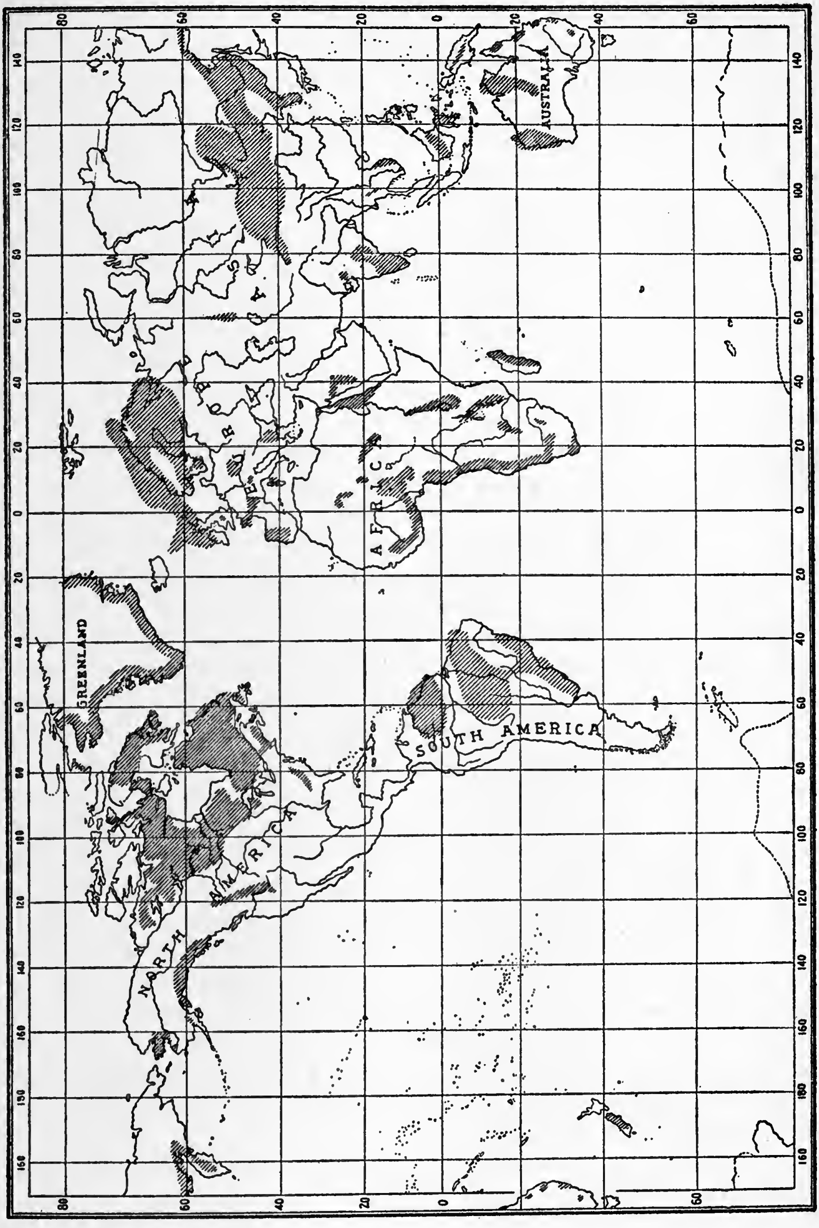
FROM the first chapter of the first book of Moses, called Genesis, we learn that, as between water and land, the ocean had the first place in terrestrial existence, for it is there stated that on the third day in the calendar of the creation the waters under the heavens were gathered together and the dry land appeared. Both from a chemical and a geological standpoint it appears that the waters of the ocean were salt from the beginning. Dr. T. S. Hunt, one of the ablest writers on the physical history of the globe, in his chemical and geological essays, referring to that period when the earth was in a molten state and surrounded by an envelope of gases and of vapor of water, states: "There would be the conversion of all the carbonates, chlorides, and sulphates into silicates, and the separation of carbon, chlorine, and sulphur in the form of acid gases which, with nitrogen, vapor of water, and a probable excess of oxygen, could form the dense primeval atmosphere. The resulting fused mass would contain all the bases as silicates, and must have resembled certain furnace slags or volcanic glasses. The atmosphere, charged with acid gases which surrounded this primitive rock, must have been of great density. Under the pressure of a high barometric column condensation could take place at a temperature much above the present boiling point of water, and the depressed portions of the half-cooled crust would be flooded with a highly heated solution of hydrochloric and sulphuric acids, whose action in decomposing the silicates can easily be understood. The formation of the chlorides and sulphates of the various bases, and the separation of silica, would go on until the affinities of the acids were satisfied, and there would be a separation of silica taking the form of quartz, and the production of sea-water holding in solution, besides the chlorides and the sulphates of sodium, calcium, and magnesium, salts of ammonium and other metallic bases. The atmosphere, being thus deprived of its volatile chlorine and sulphur compounds, would gradually approximate to that of our own time, but would differ in the greater amount of carbonic-acid gas."

And the meteorologist Abbe, in the course of remarks made before the Philosophical Society of Washington in 1889, expressing the propriety of wholly rejecting the idea that the earth was once a molten globe, stated: "The study of geological climate during and since the formation of Azoic metamorphic strata has led me to adopt the conclusion that surface geology, like volcanic, does not demand excessive temperatures; it seems to me most reasonable to assume that the surface was never much warmer than 250° F., but to allow that this temperature may have prevailed at the close of the Archaic epoch.

"At this temperature all the water of the ocean would exist only as vapor and clouds in the atmosphere. The steady, hot rain from the atmosphere would rapidly disintegrate the surface rocks. Small seas and lakes of water saturated with alkalies and *salts* would at once begin to form the rocks that we know as metamorphic and archæan. The covering thus formed would contribute to diminish the rate of cooling of the interior mass, thus allowing the atmosphere to cool down to its present condition and deposit the most of its moisture."

In the rocks formed earliest after Archæan time, to which geological age only crystalline rocks devoid of fossils belong, there are found aquatic relics of organisms with calcareous skeletons which when living bore a close generic relation to organic forms which are confined to oceanic waters at the present time. Among these early inhabitants of the sea were corals, crinoids, sea urchins, and starfishes, and many others there doubtless were which, although they require the saline constituents of the sea to live upon, had no calcareous skeletons, and consequently have not been preserved in a fossil state. The remains are found deposited in the lower Silurian as well as the Devonian, Carboniferous, Jurassic, and Cretaceous formations.

But apart from these deductions concerning the saltness of the primeval ocean there is direct evidence that the waters of the sea in the early part of Paleozoic time were highly saline, for there were deposited from the waters of the Silurian sea saliferous strata which constitute the Onondaga salt group and the Trenton and Chazy limestone series, in which the relics of marine organisms largely abound, to prove that they result from the sediment deposited by the ocean in that age.



THE LANDS OF THE EARTH AT THE END OF ARCHAEAN TIME.

LAND.

Throughout all geological time the sea has also received salt from the continents, for the rain, falling upon the land, filters through the layers of saliferous soil and, springing to the surface through some natural duct, finds its way to the sea with its burden of salt. But when the waters of the ocean are evaporated to form clouds and rain, the salt is left behind, so that ever more and more salt is being transferred from the land; and this ceaseless transfer has been going on since the first brooks and rills gathered together to form the rivers of the primeval lands. This process of salinification, which is identical with that which takes place in every lake and inland sea, like Great Salt Lake and the Dead Sea, into which streams flow but from which none emerge, has often been looked upon as a sufficient cause for the existing saltness of oceanic waters, for the ocean occupies a great closed basin into which many thousands of rivers flow, but from which none take their source. It must not be overlooked, however, that there is direct evidence to show that in early geological ages, when the continents were small and before the rivers were numerous or large, the waters of the vast ocean of those times were salt.

The salts of the sea have fed, throughout all time, countless living things which have thronged its water and whose remains now form the rocks of continents or lie spread in beds of unknown thickness over 66,000,000 square miles of the 143,000,000 square miles of the ocean's floor; they have lent the substance to build the fringing reefs of the land and all the coral islands of the sea, and there are at present, on the basis of an average salinity of three and a half per cent, in the 290,700,000 cubic miles of water which make up the oceans, 90,000,000,000,000,000 tons, or 10,173,000 cubic miles, of salt. This is sufficient to cover the areas of all the lands of the earth with a uniform layer of salt to a depth of one thousand feet.

It seems that the sea was made salt in the beginning as a part of the grand design of the Creator to provide for the system of evolution which has been going on since the creation. Many distinct species of living organisms exist in the sea as a result of its salinity, and their remains have largely contributed to the growth of continents. The three great factors in accounting for the system of currents in the ocean, by which it becomes the great heat distributer of the globe, are changes of temperature, the winds, and salinity. The last mentioned becomes an important factor through the immediate and essential differences of specific gravity and consequent differences of level that it produces in different parts of the ocean through the action of evaporation and rainfall.

If, through the fall of rain upon a portion of the ocean or through the action of evaporation in the surrounding parts, the waters of that portion become lighter than the rest down to a certain distance below the surface, two different kinds of motion will immediately occur. The lighter water will be lifted by the surrounding heavier waters till there is no difference in pressure between its lower boundary and the surrounding waters at the same depth; but, as its pressure at all levels above this lower boundary will now have become greater than that of the surrounding heavier waters, it will instantly begin to displace and overflow them. This movement of the lighter water will require considerably more time than the movement of the heavier water by which it was lifted and continues to be lifted as its level sinks by lateral diffusion, because the sum of the differences of pressure which caused the lifting of the lighter water was, in the first place, greater than the sum of the differences that caused its lateral diffusion. Secondly, the differences of pressure that caused the first movement must extend all the way to the bottom, whereas those which cause the latter extend no deeper than the lighter stratum itself, and, even within the extent of that, have their chief effect confined to the superficial strata.

On the other hand, when the equilibrium of a mass of water is disturbed by causes that do not diminish the specific gravity, the disturbance must extend down to the bottom, and the differences of pressure at all levels beneath the surface must be equal. The equilibrium is then restored by a general movement of the whole mass, which movement is sensible in inverse proportion to the mass that is set in motion. This is the essential cause for the difference in strength between the currents observed in salt and fresh waters, for, of all the current-producing causes which act in fresh waters, only the one resulting from variations of temperature can sensibly affect the specific gravity, while the specific gravity of sea water, besides being much more affected by variation of temperature, is still further influenced by the fresh water which rains upon the surface of the ocean. If the whole basin of the ocean were filled with fresh water and exposed to the most extreme meteorological influences, the currents produced would not be nearly equal either in size or strength to those now observed in the waters of the ocean.

So the saltness of the sea is involved in all the great subjects into which the ocean currents enter. Having contributed to the growth of the continents, it has in a like degree peopled them by influencing human migrations through the streams of the ocean upon which the race of man was spread to the distant archipelagoes at a time when there were only rudimentary means for struggling against the forces of Nature. Besides its influences in geology and anthropology, it is concerned to a marked extent in the climate of the earth and of the sea, and in their botany and zoölogy.

A NATURAL PAPER MILL.

By VIRGIL G. EATON.

DIGGING out here in my back pasture lot, so I may find water for my cows when next summer's drought comes on, I have discovered one of the oldest paper mills in the world—a mill that was in good working order when Alexander went east for other nations to subdue, and one which had whole quires and reams in stock when men lived in caves and the human families exchanged calls with the monkeys. The land here is drift clay, which, mixed with sand and duly baked, makes fine building brick, and which raises such fine timothy hay that the new tariff does not bother me a mite. It is blue clay clear down for twenty feet, when it strikes an old sea brush of dark gravel plentifully filled in with clam, quahog, and scallop shells. Below this are coarser gravel and bowlders, and then comes the ledge, a heat-scorched, flinty clay slate that is almost crystallized in many places. For several miles the land is as level as a house floor, and here the rainfall hesitates so long about choosing a direction in which to run that the larger part stays where it falls until the warm sun licks it up to form more clouds to make more rain. Then such portions of the land as are not covered with sward or some form of vegetation crack open, and the millions of innocent tadpoles perish from thirst before they know what fun it is to wear legs and breathe atmosphere. Draining this land is out of the question, because in order to do it I should have to dig a ditch four miles across my neighbor's property before the water could escape; and while this might be a very praiseworthy act, it would most surely take all the money I have, and my fellow-farmers would reap the reward equally with myself. Wells are also impossible here, because the frost throws out the walls in two years; and as cattle can not drink out of an artesian-well pipe, I am digging a small pond to hold the rainfall.

The place I have selected is a gentle depression in the generally level land. It is about ten rods in diameter and is walled around by a natural clay embankment varying in height from two to five feet. An opening in the wall lets the water in from one side, while a miniature cañon allows it to escape in the opposite direction. Rushes, flags, and sedges stand knee deep in the waters close to the shore, and a few lilies, with leaves like arrowheads, dot the pool, which is otherwise given over to frogs, newts, and aquatic insects. Into the bowels of this wizard's caldron I am digging and scraping in hopes I may keep enough of the surface water in store so that the suns of August shall not leave my pasture dry. Working here, daubed with the muck and the clay from which the race is made, I have found the aged paper mill about which I started to tell.

This particular paper mill—for there are dozens of them on my land and thousands of them on the tract—is in the bed of the rill which feeds the reservoir I am making. The rivulet soaks down across the pasture at a cripple's gait, going out of its way to extemporize shallow ponds here and there, and finally, after swelling up a little to surmount the ring of clay wall, topples over into the pool, which, from its size and conformation, I think is a scar or dent that still remains from some stranded iceberg that grounded here millenniums ago, and dissolving, left the hole in my field which I am trying to enlarge. The land is very dry at present, and looking in the bed of the extinct feeding mill I see it is carpeted with a grayish-brown matting that has a sheen like gossamer silk, and which crackles like stiff paper when struck with my spade. It stretches up the channel for rods and follows the windings very closely. I tear off some from the dead grass stalks, and when I hold it up to the light I find it is very good paper, thin, fairly strong, and in places semitransparent. Under this coat is another, and still another, so when I put my spade down the full length of its blade I find I can not reach through it all. A hand glass shows it is full of zigzag and irregular ribs, like the wings of a fly. These are the coarser portions of the paper, but the whole fabric is made of the same material, which is simply the shredded and digested woody fiber of the coarse grasses and rushes growing by the brookside. For centuries past these have flourished in the summer time until killed by the frost. The snow came, beating down the dead herbage, and before spring the whole was bedded in ice. Gradually the rill gnawed its way through the ice cap and the water began to sweep past the dead grass, now lying horizontally in the current. Slowly, atom by atom, the pith, gum, starch, and silex in the grasses were washed away, leaving only a fine and complexly mingled meshing of woody fiber where once were rushes, foul meadow, and blue joint. Then the brooklet receded before the warmer rays of a gaining sun, and a green scum, composed of infusoria and numberless low-grade microscopic plants, formed above the slackened water, filling all the spaces in the pulp network already in place. This settled with the water until stopped by the stumps of the broken grass, and then for a few weeks the stream ran under the canopy until it dried up altogether, and spiders hunted their prey concealed by a shade of natural paper. Again the grasses came up and grew and died. The snow of the next winter, which beat them down, pressed the underlying paper flat into the bed of the brook, and again the paper mill was making ready for a new output. Year by year this went on, no matter who was President or what London bankers charged for exchange. Shredded by ice and frost all winter, washed from impurities during the spring, and dried in sunlight in the early summer, the paper was completed and ready to store away when the grasses were high enough to shade the ground.

Thus the work went on all the year and all years until the present large supply is on hand. Before now I have been told, and indeed I have read in cyclopædias, that the wasps were the earliest paper makers, and that wasp nests were the first paper the world ever saw. This is evidently an erroneous idea. Grasses and rushes came on this planet long before wasps or bees, and coarse grasses with water and sunlight have perhaps been in partnership in the paper business since long before the coal age in America. Out here on my farm I can trace the history of this mill back to a time long before Adam walked in his garden, and I have every reason to believe there were other and similar mills in operation eons or cycles previous to the time mine began its work.

It is an interesting study to take up this latest issue of the great serial record and glance over the events which it noted right here during last summer. Of course a full story of the field's doings is not told, but I find enough to keep me busy and cause me to search for more. The tale is not twisted or distorted by reporters' imagination in order to make it read well, neither is it marred by typographical errors, causing the reader to guess at what was the writer's intention. The matrix was good and the impression was perfect all over the sheet. Writers of the realistic school, like Zola and Howells, can take lessons from this author, for here are the remains of the conflicts and tragedies narrated pressed flat upon the paper and terribly in evidence to vouch for every detail. Modern newspapers, with all their boasted push and enterprise, can never hope to equal this aged annual which dates its first number back to two thousand years before Methuselah began to grow whiskers.

Records of the whole season are found on this paper, telling the story of what has been going on in the animal world as plainly as if it were printed with life photographs and for sale on the street. Here are a half dozen "wiggler boats" that once served as skins for mosquito larvæ. When the wigglers grew large and were ready to quit the waters these cases cracked open along the back, and out stepped the mosquitoes, armed and equipped to prey upon the summer visitors. Near by are two legs and portions of the wing cases of a big locust. It is hard to tell whether he died a natural death or perished from violence. On looking at the fragments more closely, however, faint threads may be seen here and there, showing that he succumbed to some artful spider. The web proper is gone, the spider can not be found, but there is the story all told inside of half an inch's space. Farther on are the feathers of a bird, evidently a sparrow, which were probably torn out by a ravenous hawk. Yes, here is a spatter of blood on the paper that the rains have failed to erase and will never wash out, though that paper is buried for years. Across the middle of the sheet is where an earthworm has traveled, and near at hand is the track of a mole, its mortal enemy. The mole followed the worm, and the footprints mar the straight channel made by the annelid all the way. A broad wavy line in one corner shows where a snake has been along, seeking for stray bugs, and over all the slimy tracks of the slow but industrious snails shine like mica. In addition to these, I find the fragments of a cabbage butterfly's wing with the powder still clinging in places; a few hairs of a muskrat, loosened, perhaps, by a predatory mink; several dead dragonflies, as stiff as mummies; the head of a dead ant, with his big eyes staring at me as if in reproach; the cases of two caddice worms; and bits of severed twigs and grass and leaves and bark innumerable. I have found all these sitting here and looking at the paper I have torn up and which has not surface enough to cover the top of my desk; but the tale it tells is the history of the whole summer with its loves and hates and mirth and music—simply the story of one summer printed in pictures on paper, and issued by Nature to file away in her great library of past events.

Below the top pages are the other books of this valuable collection. Every sheet represents a year. Possibly, in seasons where two dry spells with an intervening period of continued rainfall occur, there may be two sheets of paper issued in a year; but then, again, there have been very wet years when no paper at all could be made, so it is safe to count on one sheet a year. Taking this as the basis of my calculations, I dig out a bit of the record on the point of my spade about midway to the bottom and count up how many sheets I cut through in going down an inch. The sheets are very fine and closely pressed, so I find trouble in counting, but after several trials I feel sure the average is fully three hundred sheets to an inch, which would make thirty-six hundred sheets to every foot in depth. Now, my spade blade is a foot long, and below this is as much more, and that takes me away back of any historical record now extant. So here I have a paper factory that is more than seven thousand years old, and the same blue clay and sand and shells were under it then that are there now. Yet my paper mill was started in modern times when the glacier works were on the surrounding hills no plainer than they are to-day.

Beyond doubt this little handful of crumbling, grass-imbedded, peaty pulp I now hold in my hand was made and filed away at a time when the mastodon came along here for food and the big American elephant shook the earth with his heavy steps. If I had time and patience, what a story this old library of primitive paper could tell me! It would be the tale of the world, who lived on it, how they lived and how they died, the story of storm and freshet and tornado, of drought and fire and famine, and the family record of every insect, mammal, and bird which has visited this field for the past seven thousand years. The proofs of the photographer fade and go out to nothing, the images of the spectroscope die with the light which created them, and the dormant words in the phonograph lisp and stutter with age and much using; but Nature's record book, which is always open and always getting new additions, holds fast to every fact, no matter how trivial it may seem, and will keep them all there in evidence until the senile earth wrinkles up, like a sun-dried lemon, and floats through space a cold and shriveled husk. This paper mill, I have found, old as it is, measures but one beat of the pendulum on the great clock of geologic time, a clock that was wound up millions of years before man came on earth, and will continue to run for millions of years after the last human being has gone.

A heavy rainfall came on before I had finished my digging, and when I visit my paper mill again it is flooded with water. Both work and study are useless here at present, and I pass an hour watching the pool, and noting how the added water has increased the activity of the aquatic animals that make it their home. All the wigglers in wigglerdom are out zigzagging themselves to the top of the water to stick their star-shaped noses up for a bit of air, and then falling to the bottom again to feed on the decaying muck. The pond seems alive with them, and the frogs are having a feast, eating wigglers by the dozen at every swallow. My ducks come waddling up from the house, and enter the pond for a swim; but, catching sight of the frogs, they conclude to abandon their bath and have a frog dinner. For the next ten minutes the water is a splashing, boiling sea, lashed into waves by fleeing frogs and pursuing ducks.

THE report of the British Association's Committee on the Teaching of Science in Elementary Schools represents that while much improvement has been made in the character of the teaching, difficulty still exists in getting it done by experiments and in a truly educational way, rather than as a series of useful but isolated facts. School teachers are generally enthusiastic in their endeavor to obtain a knowledge of science when classes are organized for their benefit. Progress is making in the number of subjects taught in elementary schools and the number of pupils receiving instruction.

Correspondence.

THE VALUE OF VEGETABLE FOODS.

Editor Popular Science Monthly:

SIR: I have just read Dr. Benjafield's lecture, in the September number, on Fruit as a Food and Medicine. I have read the Popular Science Monthly for twenty-five years, or rather from the very first number, and have always found it filled with very valuable and intensely interesting matter; but the above article I consider, from a hygienic standpoint, rather superior to anything I have read anywhere for a long time.

I am well aware of the great value of fruits as food and medicine. I prefer a ripe Baldwin apple to any other fruit grown or sold in this country. A deep-red Baldwin is the finest. Its color indicates that it is grown in the sunlight, which makes it chemically superior to one grown in the shade, which is more apt to be of green color. As the doctor says, *lemon juice* is of great value. My spring medicine for many years has been the juice of one lemon in as much, or a little more, water—no sugar—taken every morning for a week or ten days. I usually take it fifteen or twenty minutes before breakfast. It corrects biliary tendencies, and acts as a fine tonic and appetizer.

I have found apples to have a fine tonic effect on the stomach; one good apple will usually give me a fine appetite in ten minutes. I usually eat two or three good-sized apples at every meal; they constitute a *large part of the meal*, not an embellishment at the end of it.

I have found, since using apples largely, that the physical power of endurance under labor, either mental or physical, is very much increased; also a gain in flesh. This I attribute largely to the fact that apples assist the digestion and assimilation of food of other kinds. Chemists record that apples contain a larger percentage of nitrates and phosphates (food for brain and muscle) than any other fruit.

Care should be taken in the selection of the fruit to be used. Most of the fruits sold in the market in the early fall are not well ripened. Apples, peaches, pears, and other fruits grown in southern latitudes are gathered before they are ripe and shipped north, where they bring a high price before the northern crop is ripe. This green fruit is ripened on the cars and boats, and in cellars, warehouses, and stores, where it is shut out from the sunlight, and where the air oftentimes is not of the purest. Fruit ripened in such places is very inferior to that ripened on the tree where it grew. Fruit grown in northern sections is often gathered quite unripe, and, marketed early in the season, it brings a high price. This green fruit has not been chemically elaborated in the sunlight and fresh air on the parent stem, the only way it can obtain the proper elements in proper combination.

Of course, this green fruit is better than none, but fruit can not be perfect unless ripened as Nature intends it should be.

I was lately reading the reports of apples exported from this country to England and other countries. If my memory is not at fault, I think the number of barrels exported in 1894 and 1895 was in the vicinity of half a million. We ought not to export a barrel; the people of this country are suffering because they have not consumed them all.

There is another article of food of which we do not consume enough—namely, *baked beans*. Many people complain that they can not eat them. Well, cooked as they are in many families, they can not and ought not. Our physiological text-books have for a good many years taught that persons of sedentary habits do not require a diet that feeds and strengthens the muscles so much as those who perform muscular work. Well, perhaps not quite as much, but a great fault with the majority of people in this country is, that they do not consume enough food which feeds the muscles, brain, and nerves —i. e., nitrates and phosphates. In the first place, food can not be well chewed without muscular action; secondly, the stomach is required to exercise muscular activity as a part of the digestive process; thirdly, the peristaltic action of the bowels is indispensable; fourthly, the heart is one of the most if not the most powerful muscle in the human body; it never ceases working from the moment life begins until it ends. How can we expect this most important organ to go on year after year performing hard muscular work without being nourished by such food as muscles require? In my opinion, the many cases we hear of nowadays of heart failure are simply cases of heart starvation. We consume too much fat-forming food, and the result is a shrinking and weakening of the muscles of the heart and other important organs. The muscles of the heart shrink away and fat is substituted in place (fatty degeneration). Whatever a person's occupation may be, a good supply of muscle-making, brain and nerve-making food should be daily eaten. Baked beans—properly baked —contain over twenty-five per cent of nitrates for muscles, and fully four per cent of food for brain and bones; but they must be thoroughly cooked. I would not care to eat them cooked less than twelve hours.

Beans should not be eaten unless one is really hungry—the appetite sharp.

Of course, there are many other articles of food which are good muscle, brain, and nerve feeders, and as a people we ought to consume more of them. I do not say that all people can eat baked beans as I do, they act as a tonic and strengthen the digestive powers in my case. I think most people can eat more of them than they do, and if properly cooked would soon find them almost indispensable. Baked peas stand next in value as a muscle and nerve food.

Before closing I wish to allude to apples again. I like them raw, but sauce is delicious made in the following way, by which method the apple loses less of its valuable qualities than in any other method of cooking them:

First, pare thin and quarter the apples, place in a stewpan over a hot fire, put in a few spoonfuls of water, just to keep from burning on the bottom—more than that injures the flavor; cook as quickly as possible; cover over when cooking, so that steam will cook the top. I have found that with a hot fire from eight to twelve minutes will cook them. Add a quantity of sugar before quite done and eat warm. When done; the apple will remain in quarters, and hardly have changed color. A fine red Baldwin apple cooked in this way and eaten before cold is delicious and very healthy. C. A. Hoppin.

Worcester, Mass., *September* 2, 1895.

INDIVIDUALITY IN THE NESTS OF THE ENGLISH SPARROW.

Editor Popular Science Monthly:

Sir: One of the great factors in natural selection is individual variation. The English sparrow in its struggle for existence has to contend with cats, boys with blowguns, and the hostility of a large class of people who believe it to be a nuisance. The strength and stability of a nest in which the young are to be reared are important features in the life of the brood, and it is interesting to note the variations in the form, style, and material of the nests, in this connection. Mr. John Robinson, of Salem, has communicated to me the following observations he has made concerning this subject:

"In June, 1893, a sparrow's nest was removed from the vine (*Ampelopsis virginica*) growing on the southern end of East India Marine Hall, Salem, composed exclusively of the twigs of *Tamarix chinensis*, a tree of which species was growing in the yard below the nest. The twigs were about five inches long, and, being young and tender, were easily bitten off by the birds. Over three hundred shoots were thus used in this one nest. A little hay was used as a foundation in this nest and in each of the others to be described.

"In May, 1894, all the nests in the vine, of which there were perhaps twenty, were taken down about the 1st of the month. About the 15th of the month four nests, all made after the cleaning at the 1st of the month, were taken down. Each had a slight foundation of hay. One was composed of feathers, no doubt collected in a neighboring yard where hens were kept. About a quart of these feathers were in the nest. A second was composed entirely of twine, picked up in the streets and yards near by. A third was made exclusively of strippings of fine bark from cedar posts, and very likely obtained from the lumber dealer's storage yards on Derby Street, not far away, or perhaps from some newly set fence nearer at hand. Another nest was filled with fluffy cotton wool, such as is used in bed puffs. In each case there was nothing else used except the hay foundation and the materials named."

Edward S. Morse.

Salem, Mass., *October* 26, 1895.

Editor's Table.

THE BORDERLAND OF NONSENSE.

THAT mental stimulation may produce marked physical results is a proposition which few would be found to deny or even to question; but it is an unfortunate thing when this simple and limited truth is converted into a pretext for virtually denying the laws of physical causation, where human beings are concerned. Yet, if there is one gospel which a large class of persons hear more gladly than another, it is that the laws of matter are illusory and those of mind or spirit alone substantial and valid. Hence the numerous schools which, under various names, and with more or less pecuniary success, are attempting to make faith, emotion, hallucination do work which, so far as it is within the range of possibility, belongs to a well-devised system of physical, or combined physical and mental, treatment. It looks sometimes as if, according to the well-known Latin adage, the people really did wish to be deceived; and the upholders of sound doctrine and sane methods are doubtless tempted at times to be discouraged. The thing to do in such a case is to look away from the causes of discouragement and renew the battle against delusion and imposture with more energy than before, knowing that some good must come of every manifestation of the true nature of things.

We have no quarrel, as may already have been gathered, with those who maintain that some use may be made of a wise direction of thought and a healthy stimulation of mental interest in combating various forms of physical ailment. Every competent physician does what he can to "keep up the spirits" of his patient; and the common wisdom of mankind has recognized that mental conditions have in many cases much to do with questions of health and disease. A "*mens sana*" is, we have not the least doubt, a powerful aid toward the maintenance of a "*corpus sanum*"; but, when this has been to the fullest extent admitted, it remains none the less true that the body is subject to the laws of matter, and that a given affection of our bodily organization will modify in the most important manner the action of our mind. In this respect man has no superiority over the brute: the physical causes which affect the latter affect man equally, and sometimes in greater measure, the equilibrium of the human constitution being perhaps, on the whole, less stable than that of the lower creatures. We may say of man and the lower animals what Shylock says of Jew and Christian that they are "fed with the same food, hurt with the same weapons, subject to the same diseases, healed by the same means, warmed and cooled by the same winter and summer." That man has the higher mentality does not in the slightest degree exempt him from the operation of physical laws, though it does enable him to surround his life with safeguards, and in a general way pursue and secure his well-being by methods which no other species can understand or imitate.

All this may seem to most of our readers very commonplace and obvious, but nevertheless there is need to repeat even such truths as these when we find some pages of a scientific periodical* devoted to the advocacy of contrary doctrines. "Man," we read, "is a soul which, through an inherent tendency toward articulate manifestation, has picked up a little plastic material and erected it into an animated statue. This same dust has been, and will be, used over and over again to express other and different grades and qualities of life; and therefore it can have no distinctive character or identity of its own." It seems a great pity that man being "a soul" should require the help of a little characterless "dust" in order to arrive at "articulate manifestation." How is it, we feel inclined to ask, that so poor a quality of dust should be able to render so mighty a service to a soul? It is also a question what kind of existence a soul enjoys, when, for want of what the dust can supply, "*pulveris exiqui munera*," as Horace hath it, it as yet possesses no power of "articulate manifestation." But perhaps, before we trouble ourselves with such ques-

* See New Science Review, July, 1895.

tions as these, it might be well to ask who stands sponsor for the theory that man is a soul with a power of "picking up plastic material," and by what series of observations it is claimed that the theory has been proved. To such an inquiry we hardly think any very satisfactory answer could be returned. The theory is certainly not entertained by another writer who contributes an article on The Brain in the Light of Science to the same magazine in which we find the article now commented on, and who pointedly rejects the idea that there is "something called 'intelligence' inhabiting the brain, but apart and entirely distinct from its structure."

That such views are fraught with practical danger is evident on further examination. The writer to whom we are referring will not allow that a draught can *cause* one to take cold. It can only be the occasion of taking cold; the real cause is the individual's "susceptibility." Continuing, he says: "A dozen persons are equally exposed to a contagion or malaria. Only half of them take it. Subjective conditions made the wide difference between opposite results." Again we are disposed to ask for the authority for such a statement. It is very positively made, but that it admits of any kind of proof we doubt. What we do know is that *physical* conditions affect the result in such a case. The various forms of inoculation that are constantly being practiced afford proof that, independently of all subjective conditions, diseases can, with a large measure of certainty, be either communicated to, or warded off from, a given individual by the infusion of some suitable preparation into the blood. That subjective conditions have no more to do with the case than "the flowers that bloom in the spring" is shown by the fact that the most precise results can be obtained from operations on inferior animals such as rabbits and mice. Diphtheria is being controlled in the most remarkable manner by the antitoxine treatment; and it has lately been shown that a transfusion of serum from an individual who has shown a lack of susceptibility to a given disease will tend to produce immunity to that disease in another. The writer we have quoted states in an offhand manner that susceptibility is a matter of "subjective conditions," but these experiments prove that it is a matter of physical constitution; for it will hardly be contended that "subjective conditions" are transferred from one individual to another with a little serum.

The writer, it is true, does not advise people to sit in a draught and "resolve not to take cold." He says that "temporary surface thinking, though good, if in the right direction, can hardly transform one to a perceptible degree; that radical invigoration can only come from a sustained and focalized attitude of mind, which is attained through the firm holding of positive ideals." Then, if we firmly hold positive ideals, and so get a sustained and focalized attitude of mind, we can sit in as many draughts as we choose with perfect impunity. This or nothing is the teaching of these sentences. But how are we to know whether our mental attitude is sufficiently sustained and focalized to justify us in sitting in draughts? Is there not danger lest experiments should be prematurely made? An old Scotchman in the last century, when hard drinking was the rule, said that he had never known of any man dying of drink, but that he had known a good many who had died in training for it. So it might be in this matter of training for sitting in draughts. The supreme adepts might be immune, but those whose minds were not yet adequately focalized might succumb. And then, after all, why go to all this trouble of focalization, etc., when it is just as easy, generally speaking, *not* to sit in a draught? It seems to us that in point of simplicity materialistic teaching has, in this matter at least, a decided superiority over the spiritualistic. The believer in the laws of matter says: "If you sit in a draught, particularly when you are heated and perspiring, you will be in danger of catching cold, which *may* take the form of pneumonia, pleurisy, lumbago, or something else both dangerous and painful; therefore don't sit in a draught if you can possibly help it." The spiritual philosopher says: "Don't sit in a draught unless you are sure of your subjective conditions. Draughts do not cause illness; it is your susceptibility does that, and it should be your aim to get rid of such susceptibility by pursuing ideals and getting your attitude of mind properly focalized." A poet already quoted, who gives us many a shrewd hint, tells of a philosopher who, while gazing at the stars, walked into a well; and we should be inclined to dread some not altogether dissimilar catastrophe for the devotee of this exalted doctrine.

It is a great mistake, we are told, to say, "*I* am cold," "*I* am ill," "*I* have hurt myself." The proper phrases to use are not given, but it is implied that, if we would express the truth, we should say, "The plastic material which I, a soul, have picked up is cold, ill, etc." The body is the wicked partner that gets into these scrapes, and we should remind ourselves continually that the soul has no complicity in such misdoings. A man "may mentally say to himself—even mechanically at first until the habit is formed—I, the real *ego*, am well, I am strong, I am pure, I am perfect, disregarding adverse physical sensations." Ordinary common sense tells us that "adverse physical sensations" ought not to be disregarded, but on the contrary ought to be taken as warnings that we have violated in some way the laws of our physical nature. If we have an acute indigestion caused by taking food excessive in quantity or unsuitable in quality, we should, according to the above teaching, meet the emergency by eulogizing our soul for its strength, its purity, and its perfection, for its oneness "with the divine spirit of wholeness." Not occupying so exalted a plane as the advocate of mental healing, we should be disposed to consider the occasion a very unsuitable one for eulogizing the soul. If the soul does not direct or control the voluntary actions of the body, it is hard to see what good it is; and if our soul has allowed us to make a beast of ourselves, it would be better, it seems to us, to tell it some home truths. It is really almost too ridiculous to say that if a man gets drunk he is to "disregard adverse physical sensations," and sing a pæan, however huskily, to his *ego*; yet, where is the line to be drawn?

But again, what degree of triumph over physical phenomena may we expect to achieve? It was promised to the early believers in Christianity that they should be able to take up serpents with impunity, and that if they drank any deadly thing it should not hurt them. Is something like this the goal of the system we are discussing? Once take the position that the material is the unsubstantial, and all the foundations of our everyday life give way. The "plastic material" which the soul appropriated in order to acquire "articulate manifestation" loses all definite properties; and how that would answer the purposes of the soul is a very obscure question. As we have hinted in our headline, the whole theory under discussion lies on the borderland of nonsense except when it crosses the line. The only saving truth it contains—and that is by no means its property—is that man is a rational creature, that his mental life is very closely connected with his physical life, and that the proper ordering of his thoughts and aims is, therefore, a matter of prime importance for his happiness. All the same, he requires a stable world to live in—one the laws of which will not permit him to be wayward or reckless, but which, while making ample return for worthy effort, will visit with penalties not to be averted, "adverse sensations" not to be conjured away by any tricks of self-hypnotization, every departure from the path of knowledge and self-control.

THE ANTHROPOLOGICAL VIEW OF CIVILIZATION.

We commented in our last number upon the interesting address delivered by the President of the American Association for the Advancement of Science, and we have now before us an address of equal interest and perhaps of greater practical importance from the president, Dr. Flinders Petrie, of the Anthropological Section of the British Association. Dr. Petrie is widely known as one of the most learned Egyptologists of the present day, and as professor of that study at University College, London. He has spent many years in actual research in Egypt, and has thus been brought into close and varied contact with different sections of the Egyptian people. During the period of his stay in that country systematic efforts were being put forth to civilize the people according to European ideas, and, as a commencement, to teach them how to read and write; and he has been able to study the process in its practical results. In addition to his special accomplishments, Dr Petrie is a man of wide culture and of a vigorous habit of mind, and one therefore whose views are deserving of careful and respectful attention.

He discusses for us, in his address, the meanings which, from the standpoint of anthropology, should be assigned to those often vaguely used words "race" and "civilization." We must pass over his remarks on the first of these terms, though they are both interesting and original. In regard to the latter the position he takes is that wherever there was a human society there civilization is to be found. "Civilization," he observes, "really means simply the art of living in a community, the checks and counter-checks, the division of labor, and the conveniences that arise from common action when a group of men live in close relation to each other." In other words, the term has a relative, not an absolute meaning; and the practical question which confronts the so-called higher races in certain cases is whether it is desirable to replace, or attempt to replace, the relative civilization of a given lower race—or one which they regard as such—by their own more advanced modes of life.

This brings us to the most important part of Prof. Petrie's discourse. "Every civilization," he says, "is the growing product of a very complex set of conditions depending on race and character, on climate, on trade, and every minutia of the circumstances. To attempt to alter such a system, apart from its conditions, is to attempt the impossible. No change is legitimate or beneficial to the real character of a people, except what flows from conviction and the natural growth of the mind." Such conviction and such mental growth are not to be had if we present unassimilable ideas and ideals. Our intentions may be excellent, but the results will be none the less deplorable, if we ignore the limits which Nature and history have set to our efforts. "We talk complacently," says the professor, "about the mysterious decay of savages before white men." There is nothing mysterious about it; we change their environment, we subject them to new laws, force them to adopt new habits, give an unwonted direction and exercise to their mental faculties, subject them in a hundred ways to a psychological strain which they are unable to stand, and the result is that they wither just as we should do if we were similarly treated. Of all systems, that which the Anglo-Saxon race seeks to impose upon the weaker peoples with which it comes into contact is the most oppressive. "Scarcely a single race," the professor emphatically declares, "can bear the contact and the burden." In regard to the Egyptians, he gives his own experience. "Some of the peasantry are taught to read and write, and the result is that they become fools. I can not say this too plainly: an Egyptian who has had reading and writing thrust upon him is, in every case that I have met with, half-witted, silly, or incapable of taking care of himself. His intellect and his health have been undermined and crippled by the forcing of education."

Is it impossible, then, for the more advanced races to lend any real assistance to the less advanced? It is, if the only idea of assisting them is to Europeanize them; but not, if the more rational idea is adopted of a gradual education along wholly natural lines, with due regard to conditions both present and antecedent. "Our bigoted belief," says Prof. Petrie, "in reading and writing is not in the least justified when we look at the mass of mankind. The exquisite art and noble architecture of Mykenæ, the undying song of Homer, the extensive trade of the bronze age, all belonged to people who neither read nor wrote. The great essentials of a valuable character—moderation, justice, sympathy, politeness and consideration, quick observation, shrewdness, ability to plan and prearrange, a keen sense of the uses and properties of things—all these are the qualities on which I value my Egyptian friends, and such qualities are what should be evolved by any education worth the name." The most valuable educative influence is example, if only it be of the right kind; and if the higher races could, in their dealings with the lower, show that they were steadily actuated by a purer and higher morality, they would insensibly modify for the better the institutions and customs of the latter.

The words in which Prof. Petrie describes the characteristic results of education in the best sense, and also his remarks on the effect of forcing education on minds unfitted for it, may well afford matter for reflection, not only in connection with the treatment of lower races, but with the working out of problems nearer home. In answer to the question, "What can be the harm of raising the intellect in some cases if we can not do it in all?" the professor says, "The harm is that you manufacture idiots." Now, seriously, are we quite sure that our own educational methods does not in some, nay in many, cases tend to the manufacture of idiots? Does every young man, or every second, or even every third, young man who goes through college come out of it intellectually—to say nothing of morally—stronger than he went in? When we read of the reckless and riotous insubordination that sometimes marks "commencement" days, we can not help wondering whether the right kind of material has been gathered within the college walls, or whether, if the material is all right, the course of instruction and discipline has been what it should have been. But, this consideration apart, has the public learned to recognize in the average college graduate a very intelligent, helpful, and self-helping young man? Or does just a suspicion of greater or less silliness and incapacity attach to the type? That many bright young men emerge from college it would be foolish, even on the general doctrine of probabilities, to doubt, seeing that a young man, if he possesses any brightness, has so good a chance in this country of being sent to college; but what, we ask, is the effect on those who have no bent toward learning, but who go to satisfy a social exigency or to fill up a certain number of vacant years? We fear that Prof. Petrie might in his haste pronounce some of them manufactured idiots not unlike the Egyptians he had seen spoiled by overmuch reading and writing.

But, taking a wider view, are we sure that even the public-school education which we force on all children alike is always an aid to true intelligence and civilization? Such as it is, it enfeebles, we greatly fear, rather than strengthens the brains of some who are subjected to it, and who are not intellectually fit for the abstractions with which it largely deals. The whole subject requires to be carefully studied apart from all prepossession, prejudice, and sentiment. We have been forcing education for a long time with all the power of the state, but whether the average intelligence of the community has risen in response to our efforts is a question which it would not be safe to answer offhand. We do not hesitate to say that to us it appears as if our methods of education were being insensibly adapted to a lower and lower grade of general intelligence. In the matter of arithmetic, particularly, it seems to be assumed that something like idiocy is not only the starting point in the pupil's mind but a condition of considerable duration. Forty years ago no such elaborate means were resorted to as seem necessary to-day to get a few elementary principles of numerical logic into a child's mind; and it is a grave question whether in the attempt to devise a system of teaching adapted to the most degraded type of mind we are not running some risk of impairing the development of minds of a higher order. Exceeding bitter, we know, has been the cry of many a parent at the tedious drill and senseless repetitions imposed upon his children and the consequent needless lengthening by two or three years at least of the period of school education. The philosophy of the whole thing is apparent in the light of Prof. Petrie's remarks. The state is, to a not inconsiderable extent, engaged in the manufacture of idiots.

The discussion which followed the president's address was remarkable in one respect, and that was that among the speakers—all men of distinction—not one laid any stress, as would certainly have been done a generation ago, on the importance of Christianizing the lower races. It seemed to be assumed that Christianity, as a doctrine and to some extent as a moral system, involved too radical a change of ideas to be profitably adopted by heathen tribes, unless in a very gradual manner. The president himself pointed out that the apostle Paul had not seen it necessary to prohibit slavery, polygamy, or even gladiatorial shows. And yet the preaching of Paul prepared the way for "the greatest readjustment of the moral sense that the world has ever seen." We should learn from this to have patience with the imperfect usages of the heathen of our day, and not insist on their rising at once to the full height of an advanced Christian morality. It is impossible to doubt that the address of Prof. Petrie will have a powerful effect in promoting rational views on the important questions with which he dealt. It was not the utterance of a partisan, a zealot, or a narrow specialist, but of a man who spoke from well-matured conviction and a broad basis of knowledge. Had the meeting of the British Association given us nothing more than this, it would have made no slight contribution to the cause of enlightenment and true civilization.

Scientific Literature.

SPECIAL BOOKS.

MAN has ever been curious about the origins of things. In the childhood of the race he wondered where the wind came from and the water in the streams, how the sun and moon were made, what caused the thunder and the lightning, and how the first plants, the first animals, and the first human beings came to be. Later the origin of arts and customs, the rise of tribes and peoples, the production of material substances, and a host of similar problems engrossed his attention. Two ways of answering these questions have been relied upon by him at different times. The first was by speculation, and produced beautiful myths, fantastic cosmogonies, quaint folklore, or pseudo-sciences, according as the genius of one people differed from that of another. The second way depends upon research, and has reached its highest development in the investigations of modern science. Its inquiry into the past has given us a wealth of archæological lore such as is embodied in two volumes now before us. In one of these Prof. *Mason** has set forth the results of a study of industry among primitive peoples, revealing the manner in which the tools, devices, and processes used in the arts must have originated. The arrow and spear heads, knives, hammers, and axes of primitive man are the precursors of a host of striking and cutting implements. Several kinds of drills have been found in use by savage tribes. The screw, the pulley, and the wheel and axle are known to savages only in a rudimentary way, but the lever and the wedge are largely used by them. Modes of kindling and caring for fire make an interesting chapter, a notable feature in which is the evolution of the bellows. The use of stone is commonly thought of as characterizing primitive arts, and this idea is embodied in the name "Stone age." This is a misconception, for, as Prof. Mason points out, where one tool of stone was used there were many constructed of the more easily worked materials, wood, bone, shell, horn, and hide. We do not find them in ancient graves and mounds, simply because their materials are much more perishable than stone. Hence, while stone-working furnished wide scope for invention in

* The Origins of Invention. By Otis T. Mason, Curator of the Department of Ethnology in the United States National Museum. Pp. 419, crown 8vo. London: Walter Scott, Ltd., 3*s*. 6*d*. New York: Imported by Charles Scribner's Sons. Price, $1.25.

primitive times, the working of wood did no less. The potter's art originated early, and the forms of primitive pottery are an ever-pleasing surprise to the archæologist and the technographer. The same is true of the textile industry. In producing implements of war and the chase invention made important advances in primitive times, and material is not lacking to show how facilities for travel and transportation, both by land and sea, arose. Coming to the end of the volume, we are impelled to query why the author made his index so scanty, and why he divided it in the inconvenient German fashion.

The other of the two books referred to above is concerned with the art of writing.* The important aid which this art gives to man's progress by preserving the experience of each generation to guide all that follow makes it well worthy of separate treatment. The art of transmitting intelligence proceeds from objects serving as reminders through picture writing to phonetic writing with an alphabet. The author has presented this course of development especially as it is shown among the native races of North America, from the Innuit in the north to the Mayas and ancient Mexicans in the south, among whom all stages are represented. Illustrations are frequently drawn also from the Egyptian and other Oriental peoples. It is easy to see how objects can be represented by pictures, and savage races have shown themselves very clever in representing action by the same means. Thus in many of the Ojibwa records going, or running, is represented by drawing either the sole of the foot or the lower part of the legs. In the Mexican codices a distinction between running and walking is denoted by placing the legs in the correct position in each case. The sign for eating or food among several peoples consists of a human figure with the hand placed to the mouth. Lines proceeding from the mouth of either a human or animal figure denote the use of the voice. Adding the figure of the heart within the outline of the human body makes the voice lines mean singing. Similarly wavy lines from the ears denote hearing. To distinguish an object used as a proper name, a human figure or the head alone is placed below it with a line from the mouth to the name object. Such signs gradually become conventionalized and reduced to simpler forms. When the name or sound suggested by one object comes to be joined with another such sound to denote a word having only a phonetic relation to the names of these two objects, then the ideograms become phonograms. Further progress in this direction converts the phonograms into alphabetic characters. At the discovery of America the writing of the Mexicans and Mayas was rapidly approaching the syllabic stage. The only phonetic alphabet actually devised by aboriginal Americans is that of the Cherokee, Sequoya, but this uses the forms of the Roman letters variously modified, and hence is not an independent creation. Dr. Hoffman's volume contains four plates and over a hundred smaller figures, and is adequately indexed.

The world is beginning to realize that "Peace hath her victories no less renowned than war," and in consequence its appetite for butchery seems to be abating. A set of books called the Century Science Series, that has been

* The Beginnings of Writing. By Walter James Hoffman, M.D. Anthropological Series. Pp. 209, 12mo. New York: D. Appleton & Co. Price, $1.75.

undertaken under the able editorship of Sir Henry E. Roscoe, will contribute to this result by showing that the laboratory and the explorer's camp have their heroes as well as the battlefield. Sir Henry contributes the opening volume to the series, taking as his subject his eminent British predecessor in the field of chemistry, *John Dalton.** Dalton's great contribution to chemistry is the atomic theory, and it may be fairly ranked as the corner stone of the science. He also established important laws concerning the behavior of gases and made valuable meteorological researches. In depicting the scientist, Sir Henry does not let us lose sight of the man. He shows us Dalton as the Cumbrian Quaker lad, with his northern dialect and mild though unpolished manners; then as the young schoolmaster and the tutor, careful of his scanty resources and no less so of his time; afterward as the plain and unpretending man of science, ever ready for a pipe and a chat with the friends of old times, but with no faculty for being agreeable to persons who did not interest him. Having, when a young man, bought a pair of silk stockings as a present for his mother, supposing them to be of orthodox drab, he was greatly astonished to hear them pronounced "Varra fine stuff, but uncommon scarlety." It was in this way that his eyes were opened to the defect of his vision, and he at once proceeded to make the first scientific study of color-blindness. Dalton had the frame of a northern yeoman, high but not extraordinary mental powers, and—*perseverance.* To this last quality rather than to genius he ascribed whatever of value he accomplished, and in this respect he seems to have judged correctly.

Is the story of the *Herschels* † especially dramatic, or is it Miss *Clerke's* talent as a narrator that makes her contribution to the Century Series a remarkably fascinating volume? William Herschel's laying down the baton of a musical director to become an astronomer is dramatic enough, and so is his sister's dutiful abandonment of a career as a vocalist to serve as his assistant. William had been trained in music by his father, who was bandmaster in a Hanoverian regiment; he had proved a bright boy at school, and when he went to England at nineteen years of age was a young man of pleasant address, "who spoke English perfectly, played like a virtuoso, and possessed a curious stock of varied knowledge." Miss Clerke has made a continuous story of his life, intertwining the thread of his musical and that of his scientific vocation, where these are contemporaneous, with that of his personal history. A chapter devoted to Caroline tells of her early years as a family drudge and her quarter century of retirement after her brother's death, supplying also some additional details of her co-operation in his labors. The sketch of Sir John Herschel is given in much the same style as that of his father. While mainly occupied with his observations in the southern hemisphere and other astronomical labors, it tells also of his work in physics and mathematics, and his writings—not omitting his verse. The volume contains a portrait of each of its subjects.

To those who imagine that the name *J. von Liebig* ‡ stands merely for a manufacturer of meat extracts, who may still be conducting his works

* John Dalton and the Rise of Modern Chemistry. By Sir Henry E. Roscoe. Pp. 216, 12mo. New York: Macmillan & Co. Price, $1.25. London: Cassell & Co. Price, 3*s.* 6*d.*

† The Herschels and Modern Astronomy. By Agnes M. Clerke. Pp. 224, 12mo. New York: Macmillan & Co. Price, $1.25. London: Cassell & Co. Price, 3*s.* 6*d.*

‡ Justus von Liebig: his Life and Work. By W. A. Shenstone. Pp. 219, 12mo. New York: Macmillan & Co. Price, $1.25. London: Cassell & Co. Price, 3*s.* 6*d.*

somewhere in Germany, Mr. *Shenstone* has a message. He wishes them to know who Liebig was, what he did, and why all chemists and all those who are versed in the history of science admire and esteem him so greatly. To this end our author has taken especial pains to set forth Liebig's applications of chemistry to the arts, even at the expense, as he concedes, of doing "something less than justice" to the great German's labors in pure science. Liebig was the son of a color-maker, who was able to give him a university education, but this was of little benefit to him in becoming a chemist. His private studies, supplemented by admission to Gay-Lussac's private laboratory, prepared him for his profession. Mr. Shenstone enumerates four great departures in which Liebig took the lead. First, he devised the process now followed in analyzing organic compounds, and with this as an implement he determined the composition and discovered cheaper and safer ways of making many substances important to science and industry. Second, he showed that plants derive their nourishment not so much from the humus as from the inorganic salts in the soil and the carbon dioxide of the air, and went on to formulate rules for the making and application of fertilizers and for the practical conduct of other agricultural operations. His third great work was closely connected with this. It related to physiological chemistry, taking up the office of the food of animals in producing tissue, maintaining the animal heat, etc. Liebig's fourth great departure was introducing the laboratory method of teaching chemistry. This alone would have won him high fame. Mr. Shenstone does not dwell upon Liebig's private life, but gives an insight into his combative but generous character when telling of his collaboration with Wöhler and with Dumas, also in the chapter on his later years. Accounts of the work of Faraday, Maxwell, Lyell, Davy, Pasteur, Darwin, and Helmholtz are announced as in preparation, and if they are executed as acceptably as the earlier volumes, this series will be a notably attractive and instructive one.

The multiplication of untechnical, familiar books about flowers, whether of the garden, field, or forest, is a good sign. It shows that more and more people are growing interested in the subject, and that those who have not had opportunity to take a course in botany, or whose time, or eyes, or patience are not sufficient to enable them to plod through the mass of minute details involved in the technical identifications of the manuals, want to know what they are and what their relationships. Mr. *Mathews*, author of *Familiar Flowers of Field and Garden*,* enjoys a point of observation farther north than do most of the others who have given us books of this kind, writing from Campton, N. H., on the edge of the Franconia Mountains. There he has a garden in which most of the western and southwestern wild flowers are cultivated, while the wild flowers of New England grow in the fields and woods around. With these he spends much time; and in this book he attempts to introduce them to the reader by name and familiar description and picture, and to supplement the introduction by a little friendly gossip based on personal experience. These flowers are treated according to the seasons and months in which they appear; while

* Familiar Flowers of Field and Garden, described and illustrated by F. Schuyler Mathews. Pp 308, 12mo. New York: D. Appleton & Co. Price, $1.75. London: Kegan Paul, Trench, Trübner & Co.

the illustrations—simple portraits, generally reduced as befits the size of the page—are from drawings made on the spot. The author seems to hesitate when he differs from Dr. Asa Gray, but he need not. If he has seen the Atamasco lily in bloom in May, while Gray had not the opportunity so to see it; if he finds a certain aster, supposed to be peculiar to southern New England, common in New Hampshire; if he finds colors and shadings which Gray knew not, or has a clearer vision of their distinctions; or if he knows other facts or has seen other qualities in flowers which Gray did not, he is able to add to knowledge, it is his duty to tell of it, and he deserves thanks. An alphabetical index at the end of the book gives the names, colors, and localities of familiar flowers of the United States, with a floral calendar.

GENERAL NOTICES.

The *Haandbog i den Systematiske Botanik* of Dr. *E. Warming* has long been recognized as an original and important contribution to the literature of the subject. The present translation, by Prof. Potter,* from the third Danish edition and from Dr. Knoblauch's German edition, has been enriched by numerous additional notes kindly furnished by the author. Besides Dr. Knoblauch's revision of the fungi, the bacteria have been revised by Dr. Migula, the Florideæ rearranged after Schmitz, and the Taphrinaceæ after Ladebeck. Instead of rearranging the orders of the Angiosperms according to the systems more familiar to English readers, the sequence in the Danish original is retained. One of the principles of this arrangement is thus defined by the author: "Each form which on comparative morphological considerations is clearly less simple or can be shown to have arisen by reduction or through abortion of another type having the same fundamental structure, or in which a further differentiation and division of labor is found, will be regarded as younger, and as far as possible, and so far as other considerations will admit, will be reviewed later than the simpler, more complete, or richer forms." In an appendix are given an outline of some of the earlier systems of classification and a more complete account of that of Hooker and Bentham. A full index is provided.

* A Handbook of Systematic Botany. By Dr. E. Warming. With a Revision of the Fungi. By Dr. E. Knoblauch. Translated and edited by M. C. Potter, M. A., F. L. S. With 610 Illustrations. Pp. 620, 8vo. London: Swan, Sonnenschein & Co. Price, 15*s*. New York: Macmillan & Co. Price, $3.75.

The plan and general character of Prof Vines's *Student's Text-book of Botany* were explained in our notice of the first half volume in the Popular Science Monthly for July, 1894. This work is completed in the second half volume,* now before us. The subject of classification is continued, beginning with Group IV, *Phanerogamia* (or *Spermophyta*)—the preceding groups including the *Thallophyta*, *Bryophyta*, and *Pteridophyta*—and completed, and the physiology of plants is considered. The province of physiology is defined by the author as being "the study of those phenomena which, taken together, constitute the life of the plant; in other words, while morphology is concerned with what plants are, and histology with their structure, physiology deals with what they do." The performance of their functions by the organs of the plant being materially affected by various external conditions, "the object of physiology is not only to distinguish and study the various functions and to determine the relation between them and their internal structure and the external forms of the organs performing them, but also to determine what are the external conditions by which the performance of the external functions is affected, and the modes in which these conditions exert their influence." A very complete index is given in two parts, "Classification and Nomenclature," and "Morphology, Anatomy, and Physiology."

* Student's Text-book of Botany. By Sydney H. Vines, M. A., D. Sc., F. R. S. With 469 Illustrations Pp. xvi+431-821, 8vo. London: Swan, Sonnenschein & Co. Price, 7*s*. 6*d*. New York: Macmillan & Co. Price, $2.

The chief features of our strange south western region—its pueblos and cliff-dwellings, its Zuñi, Navajo, and other native inhabitants, its plateaus, buttes, and canyons, and foremost of its natural features the Great Canyon of the Colorado River—have been made familiar of late by the reports of many explorers. To Major *J. W. Powell* * belongs the credit of making the first extended exploration of the Great Canyon and the region through which it passes. This he did in the years 1869 to 1872. His report of the scientific results then obtained and a brief popular account of the exploration have been published. He has now prepared a full history of the expedition, with descriptions of the scenery, of the Indians and their customs, of the ruins and relics, and other subjects of interest in the region traversed. The volume is fully illustrated, its list of illustrations occupying more than five pages, and it is printed on heavy paper with wide margins.

Prof. *W. O. Crosby's Tables for the Determination of Common Minerals*, which appeared in 1887, has now reached a third and enlarged edition. In the new issue provision has been made for the more ready and accurate testing of streak, hardness, and specific gravity. Twenty-five additional species have been included with the two hundred in the original tables, supplementary tables comprising one hundred of the less common minerals have been added, and a synopsis of the classification of minerals has been inserted. These additions, the author believes, will reduce to a minimum the necessity of reference to comprehensive works.

It appears from the *Sixth Annual Report of the Missouri Botanical Garden* that the course of instruction in gardening was completed by one student in 1894, and another left before the end of his course to take a position at the Pennsylvania State College. In response to many applications it was decided to admit paying pupils in addition to the six on scholarships. The Shaw School of Botany and other branches of the garden's work were carried on as usual. Appended to the report are five papers on botanical subjects, illustrated with fifty-six plates, and the volume contains also several views of attractive spots in the grounds.

The Second Annual Report of the Iowa Geological Survey embraces an account of the work done in 1893 by the survey and is accompanied by several special papers. Among the subjects specifically treated are the cretaceous and certain other deposits within the State, glacial scorings, and buried river channels. The Composition and Origin of Iowa Chalk is discussed by Samuel Calvin, the State Geologist. The geology of two counties is described by the assistant geologist, Charles R. Keyes, who has also written several of the other papers.

The Cause of Warm and Frigid Periods is discussed by *C. A. M. Taber* in a little book of eighty pages (Ellis, Boston). From an experience of twenty years spent in whaling voyages in early life the author has been brought to ascribe great influence to winds and the surface currents of the sea in modifying climate. He has carefully examined the extant theories concerning the glacial period, and gives his reasons for not finding any of them entirely satisfactory.

A Brief Descriptive Geography of the Empire State, by *C. W. Bardeen*, consists of a systematic and concise but attractive description of the natural and political features of the State of New York, sadly marred by a great lot of cheap, smudgy pictures. Teachers who have any regard for the artistic sense or the eyesight of their pupils will let this book severely alone. (Bardeen, 75 cents.)

To the series of English classics edited by A. J. George and published by D. C. Heath & Co. have been added *Webster's First Bunker Hill Oration* (20 cents) and *Burke's Speech on Conciliation with America* (30 cents). Mr. George is of the opinion that the annotating of English literature for students has often been injudiciously done. Accordingly, instead of placing a surfeit of biographical, historical, and critical material under the eyes of the pupils, he has shown where this matter may be found, thus giving them valuable intellectual exercise in getting it and preventing mental dyspepsia from bolting unmasticated facts.

M. *Stanislas Meunier*, of the *Jardin des Plantes*, Paris, has been for many years engaged in the study of what he calls *Comparative Geology*, which he defines as having the

* Canyons of the Colorado. By J. W. Powell. Meadville, Pa.: Flood & Vincent. Pp. 400, quarto. Price, $10.

same relation to the geology of the earth as comparative anatomy to the anatomy of man. His special application of it is to the geology of the planets compared with that of the earth. The fruits of his studies are now embodied in a book bearing that title, which is published by Félix Alcan, Paris, in the French International Scientific Series. Though the materials for such a study may at first sight seem lacking, M. Meunier has found enough, in the results of telescopic and spectroscopic and other observations, particularly of the moon and Mars and the examination of meteorites, to make possible a fairly distinct outline, and to prompt further inquiry into this field.

In the *Report of the Commissioner of Education for 1891–'92* most of the statistics are relegated to the second volume, while the first volume is devoted mainly to essays on special subjects. Among the more extended of these are an account of the modes of training teachers employed in Germany, Austria, and Switzerland, by the able educational writer Dr. L. R. Klemm; also a description of German universities translated from a book prepared for the German educational exhibit at the Chicago Exposition, and a suggestive paper on preparation for the civil service in France and Prussia, by W. F. and W. W. Willoughby. James C. Boykin contributes an essay of nearly a hundred and fifty pages on Physical Training, half of which consists of a history of the subject from the siege of Troy to Dio Lewis, while the rest is of greater practical value, consisting of descriptions of various modes of training in present use, with illustrations and statistics. Coeducation is treated by A. Tolman Smith, who supplements his discussion with a large number of opinions of educators and a bibliography. The summer schools have now become so important that a history of them comes in very appropriately here. It was prepared by W. W. Willoughby.

The treatise on *Rocks and Soils*, by *Horace Edward Stockbridge*, has come to a second edition (Wiley). The author, who held a professorship in the Imperial College of Agriculture at Sapporo, Japan, when the first edition appeared, is now President of the Agricultural College of North Dakota. Numerous changes and additions have been made in the new edition, which may be found by a comparison with the former edition.

Home Geography for primary grades, by *C. C. Long* (American Book Company, 25 cents), is a thoughtfully arranged introduction to the study of this science. The aim is to give the child object lessons by the use of the surrounding landscape; by directing his attention to some neighboring hill, impress the idea mountain upon him; some small level space indicates a plain; a brook represents a river, a pond or lake the ocean, etc. The idea is a good one, and is well carried out.

How the Republic is Governed, by *Noah Brooks* (Scribners, 75 cents), consists of a brief consideration in small compass of the fundamental principles which direct our actions as a nation. Among the special topics are The Federal Constitution; The Government of the United States in its Three Departments—Legislative, Executive, and Judicial; National and State Rights; the Indians; Patents and Copyrights; Pensions; Declaration of Independence, and the Constitution.

Another attempt to solve the problem of gravitation is made by Mr. *Robert Stevenson* in his paper, *A New Potential Principle in Nature—Elasticity a Mode of Motion.* His principle comprises kinetic energy in the line of motion of a body, and kinetic stability tending to prevent displacement transverse to that line. The latter acts partly as a force of restitution to the original direction, with the resultant of causing a curvilinear motion. The author conceived his idea while he was a student of Sir William Thomson.

Notes on the Geology of the Island of Cuba is based upon a reconnoissance made by the author, Mr. *Robert T. Hill*, for Alexander Agassiz. Mr. Hill spent about a month on the island, accompanied by some American engineers who were familiar with the country, and who, by reason of their knowledge, were of great assistance to him. Going into the interior to Villa Clara, to acquaint himself with that region, he examined the features of the older nucleal area of Cuba; then made a thorough study of the cut of the Yumuri River at Matanzas, and of the limestone formations of the vicinity; investigated the geology of Havana; and made a north and south section across the island from Havana to Batabanos. Going to Baracoa, he examined the country west of Yunque Mountain and east to Cape Maysi. Having completed his work of an original examination of the phenomena, uninfluenced by preconceived hypotheses, he read what others had written of Cuba, and was pleased to find a general agreement between their views and his. The notes are published by the Harvard Museum of Comparative Zoology.

Self Culture is the name of a monthly magazine devoted to the interests of the Home University League, edited by *Edward C. Towne* and published by the Werner Company, Chicago and New York. Among the subjects of articles in Vol. I, No. 2, are: Eli Whitney, a Shakespeare of Invention; The Supposed Electrical Character of Vitality; The Principle of Evolution in Nature; Primitive Man; The Story of the Plague in History; The Genius of Shakespeare; Diphtheria and the Schools; and Athletic Exercises in Universities. (Price, 30 cents; $3 a year.)

Under the title *The Essential Man*, an argument in support of the belief in immortality is presented by *George Croswell Cressey* (Ellis, 75 cents). Among the circumstances which he deems indicative of a future life are the great difference between the mind of man and the material forces, the fact that no force is ever destroyed, the eventual cessation of all physical life on the earth, and the general diffusion of the doctrine in one form or another.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Delaware College. Tests of Sorghum Varieties. By C. L. Penny. Pp. 24.—Iowa: Agricultural College. No. 28. Nine articles. Pp. 8.—Nebraska: The Conservation of Soil Moisture by Means of Subsoil Plowing. By T. L. Lyon. Pp. 8, with Plates.—North Dakota: Weather and Crop Report for September, 1894. Pp. 17.—New York: Rules concerning Gratuitous Chemical Analysis. Pp. 3.—Strawberries, Raspberries, etc. Pp. 20.—Ohio: Report for 1894. Pp. 12 + xlii.

Becker, George F. Reconnoissance of the Gold Fields of the Southern Appalachians. Washington: Geological Survey. Pp. 85.

Bolton, H. W., Editor. The Pulpit Herald. A Monthly Magazine. Vol. I, No. 1. October, 1894. Chicago: F. W. Clement & Co. Pp. 40. 20 cents; $2 a year.

Baker, Frank Collins. The Naturalist in Mexico. Chicago: David Oliphant. Pp. 145.

Columbia College School of Mines. General Information, 1895–'96. Pp. 28.

Cornish, Vaughan. Practical Proofs of Chemical Laws. London and New York: Longmans, Green & Co. Pp. 92. 75 cents.

Correspondence School of Technology, Cleveland, O. Announcement for 1895–'96. Pp. 59.

Cramer, Frank. On the Cranial Characters of the Genus Sebastodes (Rock Fish). Leland Stanford, Jr., University, Palo Alto, Cal. Pp. 38. 35 cents.

Crawford, F. Marion. Constantinople. Illustrated by E. L. Weeks. New York: Charles Scribner's Sons. Pp. 79. $1.50.

Defender, The. Tariff Facts for Speakers and Students. New York: American Protective Tariff League. Pp. 158. 10 cents.

Diller, J. S. Mount Shasta a Typical Volcano. American Book Company. Pp. 32. 20 cents.

Dreher, Julius D. Education in the South. Some Difficulties and Encouragements. Pp. 35.

Eccles, A. Seymour. The Practice of Massage. Its Physiological Effects and Therapeutic Uses. London and New York: Macmillan & Co. Pp. 377.

Ethnologisches Notizblatt (Ethnological Notices). Published under the Direction of the Royal Museum für Völkerkunde of Berlin. No. 2. Illustrated. Pp. 160, with Plates.

Godard, Harlow. An Outline Study of United States History Syracuse, N. Y.: C. W. Bardeen. Pp. 146. 50 cents.

Green, Mary E., M. D. Food Products of the World. Chicago: The Hotel World. Pp. 260. $1.50.

Guerber, H. A. Myths of Northern Lands· American Book Company. Pp. 319. $1.50.

Grimes, J. Stanley, Chicago. The Radiate Theory of the Cause of Gravitation. Pp. 9.

Hale, E. M., M. D. Hydrostatic Heart Therapeutics. Chicago. Pp. 16.

Holbrook, Dr. M. L. Physical, Intellectual, and Moral Advantages of Chastity. New York: M. L. Holbrook & Co. London: L. N. Fowler & Co. Pp. 120. $1.

Iowa Geological Survey. Lemuel Calvin, State Geologist. Third Annual Report, with accompanying Papers. Des Moines. Pp. 467, with Maps.

Jordan, David Starr, and others. The Fishes of Sinaloa. Palo Alto, Cal.: Leland Stanford, Jr., University. Pp. 48, with Plates.

Lloyd, John Uri. Etidorhpa, or the End of Earth. Cincinnati: John Uri Lloyd. Pp. 376. $4.

London, W. J., and McLennan, J. C. A. Laboratory Course in Experimental Physics. New York and London: Macmillan & Co. Pp. 302. $1.90.

MacDowall, Alex. B. Weather and Disease. London: The Graphotone Company. Pp. 83.

McClatchie, A. C. Flora of Pasadena and Vicinity. Pp. 44. 25 cents.

Morley, Edward W. On the Densities of Oxygen and Hydrogen, and on the Ratio of their Atomic Weights. Smithsonian Institution. Pp. 117.

New York Academy of Sciences. Transactions, Vol. XIV, 1894–'95. J. F. Kemp, Recording Secretary; and Catalogue of Exhibits, March 13, 1895. Pp. 281, with 49 Plates + 54.

Ostwald, Wilhelm. The Scientific Foundations of Analytical Chemistry. Translated by George McGowan. London and New York: Macmillan & Co. Pp. 207. $1.60.

Progress in School Reform. New York: Good Government Club "E," 145 East Eighth Street. Pp. 53, with Tables.

Progress of the World. Monthly, Vol. I, No. 1, October, 1895. New York: Progress of the World Company, 156 Fifth Avenue. Pp. 156. 10 cents; $1 a year.

Richards, Frank. Compressed Air. New York: John Wiley & Sons. London: Chapman & Hall. Pp. 203.

Risteen, A. D. Molecules and the Molecular Theory of Matter. Boston and London: Ginn & Co. Pp. 223. $2.

Romanes, George John. Darwin and after Darwin. II. Post-Darwinian Questions; Heredity and Utility. Chicago: Open Court Publishing Company. Pp. 344. $1.50.

Salazar, A. E., and Newman, Q. Estudios Ijiéniquos del Aire (Hygienical Studies of the Air). Santiago, Chile. Pp. 20, with Plates.

Scott, E. G. Reconstruction during the Civil War in the United States of America. Boston and New York: Houghton, Mifflin & Co. Pp. 482. $2.

Sizer, Nelson. How to Study Strangers, by Temperament, Face, and Head. New York: Fowler & Wells Company. Pp. 367. $1.50.

Smithsonian Institution. An Account of its Origin, History, Objects, and Achievements. Pp. about 20, with Plates.—The Exhibit of the Institution at the Cotton States Exposition, Atlanta, 1895. Pp. about 80.

Stevens, W. Le Conte. Recent Progress in Optics. Salem, Mass.: The Salem Press. Pp. 22.

Stoddard, Charles Augustus. Cruising among the Caribbees. New York: Charles Scribner's Sons. Pp. 198. $1.50.

Stuver, E. Asexualization for the Limitation of Disease, and the Prevention and Punishment of Crime. Rawlins, Wyoming. Pp. 16.

United States Life-Saving Service, Annual Report of Operations, 1894. Washington: Government Printing Office. Pp. 470.

Whiteley, R. Lloyd. Organic Chemistry. The Fatty Compounds. New York and London: Longmans, Green & Co. Pp. 285.

Winterburn, Florence Hull. Nursery Ethics. New York: The Merriam Company. Pp. 241.

Wright, Carroll D., United States Commissioner of Labor, and Gould, E. R. L. The Housing of the Working People. (Eighth Special Rep rt of the Commissioner of Labor.) Washington: Government Printing Office. Pp. 461.

Fragments of Science.

Constituents of Ocean Bottoms.—In his summary of the results of the Challenger Expedition, Dr. Murray classifies marine deposits as littoral, shallow water, and deep sea. Such deposits are, in origin, either land-derived or pelagic—that is, of the ocean. The land-derived deposits edge the shores, for the finest river mud is rarely met with as far as three hundred miles from the coast, and particles so large as to be called sand remain close to it. Regarded in this light, the whole ocean beyond the three-hundred-mile belt of "territorial waters" possesses a distinct individuality, invaded by no material of land origin except the mud and boulders carried by drifting ice, the dust which settles out of the air, and scraps of floating pumice from volcanic eruptions. In a few patches less than seventeen hundred fathoms deep, far from land, the remains of relatively large and delicate shells which lived on the surface abound at the bottom, mixed with innumerable shells of dense, nearly microscopic foraminifera and a little clayey matter, the whole receiving the general name of pteropod ooze, from the characteristic shells of pteropods which occur in it. In deeper waters no pteropod or other delicate shells are found, and the calcareous meal of foraminifera, closely resembling softened chalk, is called globigerina ooze, from the particular genus of surface-living organism which occurs in largest proportion. At greater depths globigerina ooze is found in which the microscopic shells appear much corroded; and finally, in the deeps or areas more than three thousand fathoms below the surface, the deposit is almost free from carbonate of lime, and forms a stiff red clay composed of decomposed volcanic or atmospheric dust and those constituents of shells that are not readily dissolved by sea water. The process of formation has been clearly shown. Over the whole surface the same shell-bearing creatures die in myriads; their bodies fall continuously as a gentle calcareous snow shower through the water, which slowly dissolves them. The large thin shells vanish first, and only reach the bottom in shallow water; the dense spheres of the pinhead and smaller foraminifera resist longest, and only the insoluble residue reaches the greatest depth. Thus the excess of carbonate of lime dissolved in the deepest layers of the ocean is readily explained. The red clay forms so slowly that particles of metallic dust from exploded meteorites, which are covered up by the surface accumulations everywhere else, form an appreciable proportion of its substance. In places where silicious organisms like sponges and radiolarias are numerous on the surface, their glassy spicules form a considerable ingredient in the red clay, which, when the proportion reaches a considerable value, is called radiolarian ooze. Again, in the cool and less saline water of the southern ocean, and in other cases where the water is freshened, the microscopic, silica-sheathed, self-moving plants known as diatoms swarm in such vast numbers that the deposit consists in very large degree of their shells. When the proportion reaches one half it is described as diatom ooze. The red clay covers about fifty-one million square miles of the ocean floor; globigerina ooze is spread over about fifty million square miles; and diatomooze occupies a belt encircling the globe in the southern ocean, with a total area of about ten million square miles. These three kinds of deposits are thus believed to spread over a surface twice as extensive as all the land of the earth. The terrigenous or land-derived deposits occupy about nineteen million square miles, and one of the strongest arguments for the existence of an antarctic continent is the fact that they border the belt of diatom ooze on the southward wherever it has been passed.

Tenacity of Old Rituals.—While exploring an ancient cemetery near Cuzco, Peru, Mr. George A. Dorsey observed a curious ceremony performed by the Quichua Indians which illustrated to him the tenacity with which the old rites are held, and the manner in which recognition of living spirits of the dead and sacrifice to them still prevail. The men had been unwilling to assist him in disturbing the tombs of the dead, because they contained the remains of their ancestors, to remove which would be sacrilege, but were drafted into his service by a peremptory order from the prefect. On approaching the tombs the men knelt and pronounced in unison an invocation which began with a recital to the spirits of the chiefs as sons of the great Pachacamac of the doctrine of the Trinity and continued with the address: "Chiefs, sons of the sun, we have not come to disturb your tranquil sleep in this your abode. We have come because we have been compelled by our superiors; toward them may you direct your vengeance and your curses!" Then they made offerings of coca, aguardiente, and chicha, and called on a lofty, snow-capped mountain, Sancahuara, to witness the truth of their invocation.

A New Bear.—A new bear is mentioned by William H. Dall, in Science, as having been observed frequenting the vicinity of the glaciers of the St. Elias Alpine region. It is regarded by the Indians and hunters as distinct from both the black and the brown bears of Alaska. It is not large, no skin being more than six feet long, is shy, and not so fierce as the other bears. Its general color resembles that of the silver fox. The fur is not very long, but is remarkably soft; and it has a rich bluish-black under fur, while the longer hairs are often white, at least in the distal half. The dorsal line, the back of the ears, and the outer faces of the limbs are jet-black. The sides, neck, and rump are black and silver. The under surface of the belly and the sinuses behind the limbs are grayish white or pure white. The bright tan color of the sides of the muzzle and the lower fore part of the cheeks is invariable, and has not been seen by Mr. Dall in any other American bear. The structure of the claws is adapted to the climbing of trees. Mr. Dall believes that it is at least a well-defined local race, and proposes for it the racial name of *Emmonsii*. The Sitka fur dealers call it the glacial or blue bear. The Indians speak of another animal, unknown to naturalists, as inhabiting the higher mountains of the mainland. It is described as resembling the mountain goat, with horns nearly as long, but almost straight.

Agriculture on City Lots.—A satisfactory report upon the working of the experiment tried in Detroit in 1894, of engaging the poor and unemployed of the city in the cultivation of vacant lands and lots, is published by the Sterling Publishing Company, New York. About four hundred and fifty acres, or seven thousand city lots, were divided into quarter- and half-acre tracts, and about three times as many applications for allotments were received as could be granted. The crops were planted, cultivated, and harvested by the people themselves, under the supervision of the committee; about nine tenths of the pieces were well taken care of. The committee estimate that the potato crop averaged about fifteen bushels per lot, giving fourteen thousand one hundred and seventy-five bushels in all; and large quantities of beans, turnips, and other vegetables were raised and daily consumed, of which no record was made. The estimated value of the crops produced was from twelve to fourteen thousand dollars, to say nothing of the potatoes that were eaten before they had attained any considerable size. The entire cost to the committee was thirty-six hundred dollars, a sum that was made up by subscriptions. "Should the experiment be continued, it is best to get tracts of as many in a piece as possible, and, if poor land, to collect the sweepings of the streets to be put upon the land in the spring or carry it upon the land from time to time as collected to enrich the soil. . . . It is believed that with the experience gained this year, the plan could in many respects be improved and the cost greatly reduced by beginning it in time. The committee finds that about one third of an acre is sufficient land for a family to raise enough potatoes to last them through the winter and furnish vegetables through the summer." It should be recollected that the experiment was tried under many disadvantages. It was a step in the dark; vacant city lots are in appearance the most unproductive soil imaginable; the planting was not begun till late in June, and the season was one of the worst for garden crops which the country had had for many years. Yet the success was great. A like success is claimed for a similar experiment tried in Buffalo, N. Y., in 1895. Many problems of economy, morals, and good taste would be solved if the system should become general and permanent.

Onyx Marble.—The stone called onyx marble, which is much used now in ornamental articles of furniture, is really a calcareous or lime rock, which has been deposited as a travertine or tufa from water in which it was held in solution. Water, while it can not alone dissolve lime rock, can take up considerable quantities of it when it holds carbonic acid in solution, but must drop it again when the carbonic acid has escaped. Both these processes are of common occurrence, and hence, in the springs where they are going on, tufas or travertines are formed. We know this much of what takes place, but we do not know, says Mr. George P. Merrill, in his paper on this subject, just what are the conditions governing the compactness and condition of crystallization of the deposit—why in some cases it should be susceptible of an enamel-like polish, and in others should be light and tufaceous. Onyx marble is also found in caves as a constituent of the stalagmites and stalactites which grow there, and much in the same way as in the springs. Water charged with carbonic acid percolating through the roof of the cave brings down dissolved limestone, hangs in drops to the roof, is evaporated or loses its carbonic acid, and leaves a calcareous deposit to be enlarged by continuous accretions. It rarely happens that all the water evaporates from the ceiling of the cave. Some of it usually falls to the floor, whence it is in its turn evaporated and leaves there a continually growing deposit—a stalagmite. As the water in percolating through the roof dissolved only the pure lime carbonate, or took up only a trace of impurity, these stalactitic and stalagmitic deposits are of purer lime, refined and recrystallized under new conditions. It follows almost from necessity from their mode of origin that the beds of onyx marbles, both spring and cave deposits, are as a rule far less extensive and regular in their arrangement than are the ordinary stratified and imbedded marbles. Spring action is more or less intermittent, and the place of discharge, as well as the character of the deposit, is variable. The deposit usually takes the form of a comparatively thin crust, conforming to the contours of the surfaces on which it lies. The various layers thicken and thin out irregularly, and are often lenticular in cross-section. Sound and homogeneous layers of more than twenty inches in thickness are not common. A marked and beautiful feature of the onyx marbles in general, and particularly of those which originate as spring deposits, is the fine, undulating parallel bands of growth or lines of accretion shown on a cross-section, which are due to its mode of origin through successive depositions upon the surface. The stone owes its chief value for decorative purposes to its translucency, fine venation, and color. Sometimes the original hues have become enhanced by oxidation and through the development of reticulating veins of small size, into which percolating waters have introduced new coloring substances or locally oxidized the protoxide carbonates which seem to form the chief colouring constituent. The finer grades of stone of this type are obtained from few and scattered localities, and, except those that are of cave origin, generally, so far as the author has observed, the most eminently desirable for ornamental purposes are from hot and arid countries and regions not far distant from recent volcanic activity.

Giant Mountain Plants.—Two Swiss botanists, MM. Sommier and Sevier, who have recently explored the Caucasus, tell of the discovery of a mountain flora of giant herbaceous plants, of which little was known before, and which they designate as *macro-flora*. At the altitude of about fifty-eight hundred feet some plants reach a size which they never attain in the valleys. A campanula, which does not exceed about two feet below, grows to about six feet at that height, with an unpliable stem. The large, kidney-shaped leaves of a valerian are borne at the end of petioles so rigid that they can be carried as parasols. These fields resemble the pampas, and the rocks are hidden in a growth of large plants of different kinds. The luxuriance of this vegetation is ascribed by the authors partly to the extraordinary fertility of the soil, from which the accumulated mold of ages has never been removed; while, as a second way of accounting for them, they are regarded as survivals of the grand flora of some former geological age.

A New Race of Ancient Egyptians.—The continued explorations of Mr. W. Flinders Petrie on the west side of the Nile below Thebes have resulted in the discovery of what he regards as a hitherto unknown race of men, who probably lived in Egypt about five thousand years ago. In the near neighborhood of sites yielding potteries of the best known Egyptian dynasties he found the remains of a town, with cemeteries of which about two thousand graves were excavated, in which there was not a single Egyptian object or the trace of the observance of any Egyptian custom. The bodies, instead of being mummified or buried at full length, were contracted, with heads to the south and faces to the west. They were of fine physiognomy, without prognathism; of remarkable stature—some being more than six feet high—and of development of legs indicating a hill race; with brown and wavy but not crisp hair, aquiline nose, and long, pointed head. No hieroglyphics or characters suggesting writing were found, beyond a few scratches on vases. Their vessels were perfect in form—all hand-made—yet their art was of the rudest. A picture in monochrome on one of the vases represents a boat with two cabins, rowed with oars, bearing the ensign of five hills, with ranges of hills on either side, and ostriches striding along. A game of ninepins was found, in which the pieces are formed of stone, with balls of syenite about the size of peas. The people used green paint made from malachite for marking their eyes, and many of the slate palettes on which this was ground were found. Their funeral rites appear to have included a kind of ceremonial cannibalism. They are supposed to have lived about the time from the seventh to the ninth dynasties. In the same region, in a spot exactly resembling the river gravels of England and France, large quantities of similar palæolithic remains were found.

Signs of the Times.—In an article under the above title, by Edward Atkinson, in the August number of the Engineering Magazine, is the following comment on the recent celebration of the opening of the ship canal at Kiel: "There is something rather grotesque in the picture which the nations have made at the opening of the ship canal at Kiel. The object of that canal is mainly to promote commerce, to facilitate exchange, to bring to the occupants of a rather poor soil in middle Europe a necessary supply of food and fibres from other parts of the world, and also a necessary supply of the crude products of the non-machine-using nations for conversion into finished goods for home use and export. In order to celebrate the opening of this peaceful way for commerce, there gathered a collection of naval bulldogs, each for the time muzzled, but in many instances with growl barely suppressed. In a rough-and-ready way one may estimate the cost of this fleet of one hundred great armor-clad ships of war, with twenty-five lesser vessels, at approximately $200,000,000, which is probably four or five times the cost of the peaceful water-way, the opening of which they were called together to celebrate. The United States was represented by one battle ship and, I believe, by one of our two 'commerce-destroyers,' so called. The two armored ships so named cost nearly $7,000,000—a sum nearly equal to the entire endowment of Harvard University—while the annual expense of keeping the two in commission is nearly as great as the pay roll of the same university. The only commerce of any importance upon which these destructive ships of war could exert their force would be that of Great Britain and Germany, our two largest foreign customers for the excess of our farm products, which would rot upon our fields if we could not sell them for export. Any commentary upon these grotesque conditions would perhaps be superfluous. As time goes on this waste of preparation for war will be stopped in more than one way. First, because no ship can carry armor which will defend it from the latest type of guns. Next, because no land force can stand in the face of guns discharging over six hundred shots per minute, warranted to kill at more than a mile. But lastly, as to European states, because the limit of taxation has been reached. New taxes can not be invented and new sources of revenue can not be discovered which will warrant even the maintenance of existing armies and navies."

Two Wild Vegetables of Merit.—T. W. Card, of the experiment station at Lincoln, Nebraska, calls attention, in *Garden and Forest*, to two wild vegetables which he thinks merit the attention of cultivators.

One of these, which is already gathered from the fields and used to a considerable extent in the West, is the wild lettuce; there are two species common on the plains, *Lactuca canadensis* and *L. Ludoviciana*. They are chiefly used for greens, and fill an important place for this purpose, as they come in advance of spinach, and when no other greens are offered in the market. The other plant is the ground plum or buffalo pea of the plains (*Astragalus crassicarpus*). This is found abundantly in the draws or low grounds of the unbroken prairie. The plant is a perennial, apparently perfectly hardy, and very productive. The fruit resembles gooseberries in size and general appearance. It is borne in numerous clusters, very early in the season. When cooked like string beans the fruit forms a very acceptable dish. The chief point which recommends the plant for cultivation is the time at which the fruits are ready for use, some of them ripening as early as May 7th.

Protecting Iron and Steel against Rust.—Gesner's method, described in *La Revue Scientifique*, consists in forming on the surface of the metal a double carbide of hydrogen and iron. A bar thus coated can be bent through an angle of forty-five degrees without disturbing the layer. The process is as follows: The surface to be coated is first thoroughly cleaned from rust. A couple of gas retorts are placed alongside each other and raised to a temperature of from 600° to 700° C. The articles to be treated are then placed in these retorts for about twenty minutes, after which a current of hydrogen is passed through the retorts for forty-five minutes. A small quantity of naphtha is then introduced, the supply being maintained for ten minutes. It is then stopped, the current of hydrogen being kept up fifteen minutes longer, when it is stopped and the retorts are allowed to cool to 400° C., and when this temperature is reached the doors can be opened and the finished product removed. The coating thus given has a bluish color.

The Microscope in Metallurgy.—Micro-metallography—the examination of samples of iron and steel by looking at etched or polished sections through a microscope—is rapidly taking its place in the routine work of metallurgical laboratories. It has been developed from petrography. Dr. Sorby, an Englishman, who in 1864 submitted some photographs of opaque sections of various kinds of iron and steel to the British Association, seems to have been among the first workers in this field. The process of preparing the specimens is complicated and somewhat tedious, but the results fully repay the worker. By means of these methods steel has been found to contain five main constituents: Pure iron, *ferrite*; carbide of iron, *cementite*; sorbite, of uncertain composition; *martensite* and *froostite*; the latter marks the transition of soft iron into hardened steel. Sorbite, froostite, and martensite appear to be solidified solutions of various forms of carbon in divers forms of iron, for it seems clear that metallographic work on steel brings into prominence the existence of allotropic forms of iron. An exhaustive monograph on the progress of micro-metallography during the past ten years, by M. F. Osmond, may be found in the *Bulletin de la Société d'Encouragement*, vol. x, p. 480, 1895.

Audibility of Fog-horn Signals.—Some time ago there appeared a description of some experiments which went to prove that around each siren there is a zone, about one and a half nautical miles broad, within which fog signals can not be heard, although they are distinctly heard outside that zone. These statements have been recently confirmed by a series of experiments which are noted in Nature. In one of these the vessel steamed with the wind straight toward the lightship from a distance of four and a half nautical miles. At a distance of two miles and three quarters the sound became faintly audible, and suddenly increased in loudness at two miles and a half, retaining the same intensity up to two miles distance. From one and three quarters to one and a half mile the note was scarcely audible, but then it immediately increased to such an extent that it appeared to originate in the immediate neighborhood of the vessel. The steamer at this point reversed its course, and the fluctuation over this part of the course was found to be the same, except that it was even more strongly marked. The vessel was again reversed, and at half a mile the sound disappeared entirely, to reappear at a quarter of a mile from the lightship; after which it gradually and steadily increased in intensity until the latter was reached.

The Ideals of Modern Medicine.—We take the following from President Sir T. Russell Reynolds's address before the recent meeting of the British Medical Association in London: "The outcome of what I have been saying is this: that the scattered fragments of knowledge and guesses at truth of many years have been gathered into a focus during the past twenty-five years; that the vegetable life extracting from the mineral world the materials it needs for growth and production of powerful agencies for good in the form of food and medicines, and for evil in the form of poisons, has given itself up to the growth of animal life, with its much more complex organs, and for cure of ills once thought beyond the reach of human aid; but that, thanks to man's scientific ardor and industry, it has again shown itself to be our servant, our helper, and our protector. These are not dreams of the study, they are facts of the laboratory and of daily life; and in using that word 'life' again, I must endeavor to emphasize still more forcibly upon you my urgent belief that it is to living agencies and their employment that we must look for help in the care of infancy, the conduct of education—moral, mental, and physical—the training up of character, as well as of limbs; that it is the guidance of living functions, in the choice of living occupations, be they either of hard work or of amusement. It is to these we must appeal if we would see the *mens sana in corpore sano*; and then it will be to these that we may confidently look for help, when the inroads of age or of disease are at hand, often to cure us of our trouble; or if not, to give us rest and peace."

City Government.—The corporation of the city of London is one of the most ancient bodies in England, and its record shows a constant succession of capable men and a uniform policy. It was in existence before Parliament, and it has seen the downfall of more than one royal house. The secret of its success has lain in the fact that municipal dignity has always been confided to the hands of men of business, who had shown their capacity to manage private affairs of great magnitude before they were intrusted with those of their neighbors. Their training had been such as to remove them as far from the hide-bound conservatism of the official as from the destructive reforming energy of the professional politician. As an instance of the methods employed may be cited the fact that perfect and exact records, with the exception of three years, of every penny spent on London Bridge since 1831 are in existence and in splendid preservation. These facts, which we take from Engineering, differ so extremely from those brought to light by the recent reform investigations in American cities as to seem worthy of notice.

Pithecanthropus Erectus.—At the recent meeting of the zoölogists at Leyden, an interesting discussion occurred over some bone fragments (a femur, the upper part of a skull, and two teeth) upon which Dr. E. Dubois, the naturalist, bases his new species *Pithecanthropus erectus*, an intermediate stage between the anthropoid apes and man. Prof. Virchow contended that the four fragments did not belong to the same animal. Prof. O. C. Marsh was inclined to support many of Dr. Dubois's conclusions. Prof. Rosenberg thought that the peculiarities by which Dr. Dubois made his new species occurred in human bones, and in some few cases all of them combined. Prof. Rosenberg acknowledged, however, the great value of the discoveries, because, even if the bones were human, they proved that Tertiary man existed in Java; the origin of man being thus pushed further back toward the earlier Tertiary period.

MINOR PARAGRAPHS.

The work of the President White School of History and Political Science, which was instituted at Cornell University in 1887 on the gift of his historical library by ex-President A. D. White, naturally falls into the two great divisions suggested by its name. The instruction in history further divides itself into the subdepartments of ancient and mediæval, modern European, and American history; and that in political science into politics, social science and statistics, and political economy and finance. The teaching corps consists of four professors, an associate professor, an assistant professor, an instructor, and an examiner. Five fellowships have been instituted, and degrees are conferred of Master of Arts, of Philosophy, of Letters, or of Science.

The system of tests for the detection of color-blindness described by Dr. William Thomson in The Popular Science Monthly for February, 1885, is used on railroads controlling 38,786 miles of track, and other systems are used on roads controlling 15,579 miles—making 51,793 miles protected. After considerable experience Dr. Thomson proposes some improvements to be used in connection with his color-stick or as a substitute for it. The new test consists of a large green and a large rose test skein, and forty small skeins, each marked with a concealed number. The stick is dispensed with, because it gives a too fixed arrangement and not enough confusion. One of the test skeins being laid out, the candidate is directed to select, from the twenty skeins of similar color exposed with it, those having the shades nearest to it; and the accuracy of his vision is determined by the exactness of his selection and his avoidance of the confusion skeins. The red test skein and its confusion colors are omitted.

The Russian thistle, the latest imported agricultural pest, is described in a bulletin of the University of Illinois Agricultural Experiment Station as not a thistle nor looking like one, but as a tumbleweed. When mature, its stems are more woody than those of ordinary tumbleweeds, and the spines or little thorns are hard. Sometimes the plants are compact, nearly round; sometimes, when growing close together, they fail to have the rounded form. They may be one, two, or three feet high, and from eighteen inches to six feet across. The leaves, flowers, and seeds are very small. In the later summer the stems have a purple or rose color. The seeds mature after the first of September. The plants and seeds should be destroyed by burning. A bulletin of the Ohio Agricultural Experiment Station on this subject contains some useful remarks on weeds in general.

The Massachusetts Agricultural College at Amherst had in 1894 the largest number of students and the largest graduating class in its history. Gratifying results followed the introduction of the elective system in the studies of the senior year, which were shown in increased interest in study that was communicated also to the other classes. Courses of lectures were delivered by Sir Henry Gilbert, Dr. B. E. Fernow, and Major Henry E. Alvord. The museum has been arranged so as to present a systematic view of the entire animal kingdom, with especial regard to the fauna of Massachusetts. Models of the horse, cow, sheep, pig, and dog, and their organs, have been supplied in the veterinary department, and pathological specimens. It is proposed to devote a part of the grounds of the college to the growth of the trees and plants of Massachusetts.

A summary of the lectures announced for the last summer semester at the German universities is interpreted by Charles N. Judd, in Science, as indicating that logic and the theory of knowledge are absorbing much more attention than any form of speculative metaphysics. Sixteen courses in the nineteen universities are devoted to these subjects. Work is also being done in many places in laboratories and seminaries. Five courses, besides the seminary work, are given on Kant's system. The historical work covers all periods, beginning with Prof. Deussen's investigations in old Sanskrit and Greek philosophy, and extending to the philosophy of to-day.

NOTES.

The sudden disappearance of streams in limestone countries, sometimes to reappear at the surface farther on, is not uncommon. In Yorkshire, England, there are many such streams. The points where they disappear are called "pots." One of the largest of these pots, "Gaping Ghyll," was recently explored by M. Martel of Paris. The stream being temporarily diverted, M. Martel descended by means of a series of rope ladders. He took with him a telephone and a supply of candles. He reached bottom at three hundred and thirty feet, and found a vast chamber about four hundred and fifty feet in length, one hundred and twenty feet in breadth, and ninety to one hundred feet in height.

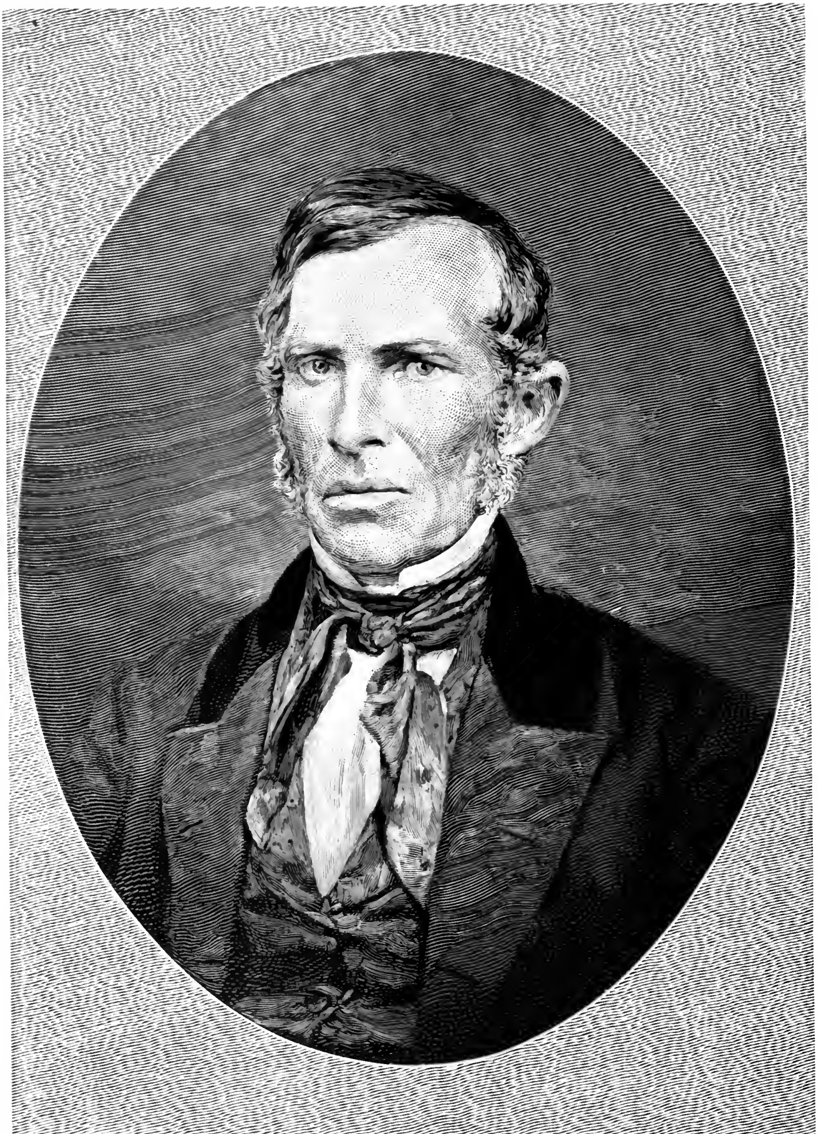
A meeting of the friends and admirers of Mr. Huxley, under the chairmanship of Lord Kelvin, was recently held at the rooms of the Royal Society to consider a national memorial. It was decided to call a general public meeting in the fall. Sir John Lubbock (15 Lombard Street) will act as treasurer. At a recent meeting held at the Charing Cross Hospital Medical School, from which Mr. Huxley received his M. D., the following resolution was passed: That there be a memorial in the form of a Huxley scholarship and medal to be awarded annually at the Charing Cross Hospital Medical School, and that, if funds permit, an annual public lecture dealing with recent advances in science and their bearing upon medicine shall be instituted.

A short time ago, in the theater of King's College Hospital, London, Sir Joseph Lister was presented with a three-quarter length portrait of himself, painted by Mr. Lorimer, A. R. S. A., and also an illuminated and illustrated album containing the names of the subscribers. Dr. W. S. Playfair, who presided, said that the testimonial was simply an offering from his old friends, colleagues, and pupils, as a token of the affection and esteem which they entertained for him.

Dr. E. H. Wilson, bacteriologist of the Brooklyn City Board of Health, recently made some investigations relative to the bacterial content of graveyard soils. He states that the soil of cemeteries contains no more bacteria than the soil of other places; that he found no pathogenic bacteria in the examined soil; and that those which he did find were such as engage in the destructive decomposition of the body, and were hence beneficent instead of harmful.

Mr. Joseph Thomson, the African traveler, who died in London early in August, though not yet forty years old, was one of the most successful and most famous of the explorers of the dark continent. He first went out on the Keith Johnson expedition to the Great Lakes, and on the death of its leader took charge and accomplished its objects. He next had charge of an expedition to Masailand in 1883 and 1884, where he showed admirable tact in dealing with the savage natives and made important discoveries. He afterward negotiated treaties in Sokoto, explored the Atlas Mountains in Morocco, and in 1891 explored the region between Lake Nyassa and Lake Bangweolo. All these things he accomplished without bloodshed. He was the author of three books describing his explorations, of a Life of Mungo Park, and of Ulu, a romance illustrative of life in East Africa.

Dr. Joseph Granville Norwood, who died in Columbia, Mo., May 5th, was engaged in the Geological Survey of Wisconsin, Iowa, and Minnesota, under D. D. Owen, from 1847 to 1851, exploring chiefly the region about Lake Superior; was afterward State Geologist of Illinois, and Assistant Geologist of Missouri, and was from 1860 to 1880 a professor in the University of Missouri. He retired in 1880 as professor emeritus, on account of ill health. In 1847 he described and figured the *Macropetalichthys rapheidolabis* of the Devonian of Indiana—the first fossil fish described in the United States. He was author of some geological reports and several monographs.



EBENEZER EMMONS.

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THE SMITHSONIAN INSTITUTION.

ITS ORIGIN. GROWTH, AND ACTIVITIES.

By Prof. HENRY CARRINGTON BOLTON, Ph. D.

PART I.—ORIGIN OF THE INSTITUTION.

WHEN the packet Mediator, commanded by Captain Christopher H. Champlin, sailed into New York harbor on the 28th day of August, 1838, after a stormy voyage of forty-three days from London, it brought in its hold a legacy from an Englishman to the United States of America, which was intended and destined to benefit all mankind. This precious freight consisted of eleven boxes, containing one hundred and five bags, each bag containing one thousand gold sovereigns. The boxes were carefully landed and stored for safe keeping in the Bank of America; a few days later the gold was sent to the United States Mint at Philadelphia, where it was immediately recoined into American money, yielding $508,318.46. This magnificent sum was the bequest of James Smithson, Esq., F. R. S., to the United States of America.

We propose in these articles to consider the purpose of this bequest, the manner in which the United States administers it, and the benefits to mankind accruing therefrom.

James Smithson was born in France, in the year 1765, of distinguished English parentage; as he himself wrote: "The best blood of England flows in my veins; on my father's side I am a Northumberlander, on my mother's I am related to kings."

Of Smithson's early life little is known. At Pembroke College, Oxford, the young man was an earnest student and showed a liking for scientific pursuits; he was especially proficient in chemistry, and spent his vacations in collecting ores and minerals for analysis. He was graduated on the 26th of May, 1786; and the impulse for scientific research gained at the university influenced all his succeeding years. The highest ambition of an English man of science is to append to his name the honorable initials F. R. S., and to enjoy the privileges accorded to Fellows of the Royal Society. Recommended by Richard Kirwan, the Irish chemist,

James Smithson as an Oxford Student, 1786.

Charles Blagden, the Secretary of the Society, Henry Cavendish, the wealthy and eccentric physicist, and others, Smithson was elected a Fellow exactly eleven months after leaving the university.

During his residence in London he cultivated the society of authors, artists, and men of science. "His mind was filled with a craving for intellectual development, and for the advancement of human knowledge. To enlarge the domain of thought, to discover new truths, and to make practical application of these for the promotion of civilization, were the great ends he had constantly in view." Smithson possessed large means; he never married, and for family reasons preferred to live on the Continent, spending most of his time in France, Italy, and Germany; in his constant journeys he made observations on the climate, physical features, geology, and industries of the regions visited. He formed collections of minerals, and, for convenience of analyzing them, traveled with a portable chemical laboratory.

Living on the Continent, he acquired a cosmopolitan character, and formed acquaintance with the leading *savants* of the time; among his friends and corrrespondents were Gay-Lussac, the chemist; Haüy, the mineralogist; Arago, the astronomer; Biot, the physicist, of France; Berzelius, the chemist, of Sweden; and Davy, Black, Wollaston, Cavendish, Thomson, Smithson Tennant, chemical philosophers, of England. If it is "by a man's position among his contemporaries and competitors that his work may most justly be appraised," Smithson's scientific attainments must be rated very highly.

Between the years 1791 and 1825 Smithson published twenty-seven scientific papers, of which eight appeared in the Philosophical Transactions of the Royal Society and nineteen in Thomson's Annals of Philosophy. These memoirs embrace a wide range of research: the first deals with the curious deposit in bamboo called *tabasheer,* which he proved to be "siliceous earth"; the second was a "Chemical Analysis of Some Calamines," in which he established a new mineral species, afterward named *smithsonite* by Beudant (1832). The larger number of his papers deal with chemistry applied to mineral analysis, but he also discussed the nature of vegetables and insects, the origin of the earth, the crystalline form of ice, and an improved method of making coffee. An examination of these contributions to knowledge shows that he was no mere dilettante in science, and that he carried on his researches in a philosophic spirit for the sake of truth; all his writings exhibit keen perception, concise language, and accurate expression.

Of Smithson's personal traits and social character very little is known; his dislike of publicity, his natural reserve, as well as his residence in foreign countries, separated him from friends who might have given us particulars. It is said that he frequently narrated an anecdote of himself which illustrated his remarkable skill in analyzing minute quantities of substances, an ability which rivaled that of Dr. Wollaston. Happening to observe a tear gliding down a lady's cheek, he endeavored to catch it on a crystal vessel; one half the tear-drop escaped, but he subjected the other half to reagents, and detected what was then called microcosmic salt, muriate of soda, and some other saline constituents held in solution.

James Smithson died at the age of sixty-four years, on the 27th of June, 1829, at Genoa, Italy, and was buried in the Protestant cemetery near that city. His death occurred in the same year with that of Davy, Wollaston, and Young, a fact mentioned by the President of the Royal Society in announcing the loss of members.

About three years before his death, Smithson made a holographic will containing provisions of immense importance to

JAMES SMITHSON. (From a painting by Johnes, 1816.)

American science. After providing for an annuity to one faithful old servant, and a benefaction to another, his will directed that the whole of the income arising from his property of every kind should be paid by his executors to his nephew, Henry James Hungerford; and should his nephew have children the whole of his property was bequeathed to them or their heirs after the death of their father. In case, however, the nephew should die without issue, Smithson provided as follows:

"I bequeath the whole of my property to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men."

The motives which prompted James Smithson to bequeath his fortune to the young republic across the seas are not certainly known. In the year 1818 (or 1819) he had some misunderstanding with the Royal Society, owing to their refusal to print one of his papers, and from that date he published exclusively in Thomson's Annals of Philosophy; it is said that prior to this difficulty he had intended to make the Royal Society his legatee. Having, however, abandoned that plan, he seems to have perceived with a prophetic eye the "germs of rising grandeur" in the free American nation, and to have felt a desire to promote the increase and diffusion of knowledge in the New World.

Whether he was more friendly to republicanism than to monarchy, as some have claimed, is not certain; at all events, by selecting the United States of America as the depository of his trust "he paid the highest compliment to its intelligence and integrity, and testified his confidence in republican institutions and his faith in their perpetuity."

In attempting to fathom the thoughts which directed Smithson's attention to the United States we are met by the surprising fact that he had not a single correspondent or scientific friend in America, nor did he write a line in any of his papers indicating appreciation of the republic.

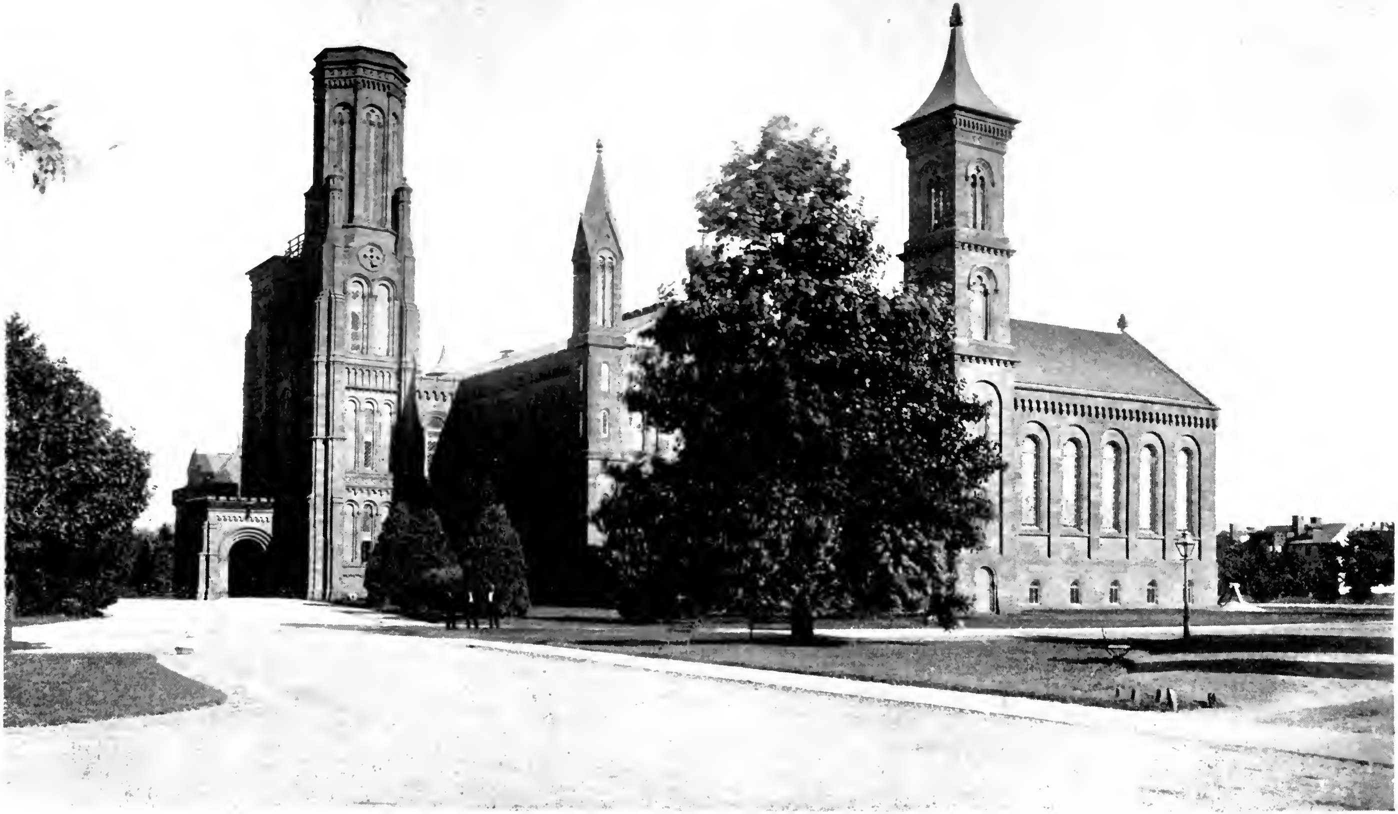
Mr. Hungerford survived his uncle only six years, during which he received the benefits of the will; he led an aimless, roving life on the Continent, and died at Pisa, Italy, June 5, 1835, under the name of Eunice de la Batut, this being the surname of his stepfather, a Frenchman whom Hungerford's mother had married. By this death the United States became entitled to the estate. The first intimation received by the Government to this effect arrived in a communication dated July 28, 1835, from the *chargé d'affaires* of the United States at London to the Secretary of State, transmitting a letter from the firm of attorneys who represented the bankers holding the estate in trust. The estate was estimated at £100,000. In December, President Andrew Jackson sent to Congress a message setting forth the facts in the case and asking for authority to accept the trust; in July, Congress passed an act authorizing the President to appoint an agent to prosecute in the Court of Chancery the right of the United States to the legacy. This simple measure was not, however, secured without great difficulty, being opposed by several active Congressmen. Mr. W. C. Preston, of South Carolina, thought the donation had been made partly with a view to immortalize the donor, and it was "too cheap a way of conferring immortality"; and Mr. John C. Calhoun, of the same State, was of the opinion that it was beneath the dignity of the United States to receive presents of this kind from any one. The bill was, however, supported by the Committee of the Judiciary, to which the matter had been referred, and advocated by Mr. James Buchanan, of Pennsylvania, Mr. Robert J. Walker, of Mississippi, and Mr. John Davis, of Massachusetts.

Under this act President Jackson appointed the Hon. Richard Rush, of Pennsylvania, agent to prosecute the claims of the United States. The selection of Mr. Rush was a very happy one: he had been Comptroller of the Treasury, Attorney-General, minister to England, and minister to France. He displayed integrity and ability, and a persistence which accomplished the end in view with unexampled dispatch. Beyond the usual delays incident to court procedure, Mr. Rush met with no difficulties save one. Madame Théodore de la Batut, the mother of Mr. Hungerford, presented a claim for a life interest in the estate of Smithson; and to expedite matters Mr. Rush agreed to a compromise, granting an annuity, which she enjoyed until her death in 1861.* As soon as the securities were transferred to Mr. Rush, he converted them into gold and shipped it to New York on the Mediator; accompanying the treasure were three boxes containing the personal effects of the testator, including his collection of minerals, library, etc. The money arising from the Smithson bequest was at first invested in State stocks, and on December 10, 1838, President Martin Van Buren announced to Congress the receipt and disposition of the legacy of James Smithson. In 1841, Arkansas having failed to pay interest, through the efforts of Hon. J. Q. Adams the funds were transferred to the Treasury of the United States, to bear interest at six per cent per annum.

Joseph Henry.

Three years had been consumed in securing the legacy, and seven and a half years more were destined to pass before Congress

* The principal retained in England to meet this annuity was paid over to the Smithsonian Institution in 1864. This residuary legacy amounted to $26,210 (gold).



Smithsonian Institution, Washington, D. C.

carried out the wishes of the testator by creating the Smithsonian Institution. To analyze the legislation during this period, to describe the many extraordinary schemes proposed, to merely name the Congressmen who were active in the prolonged discussion, would occupy more space than can be given to this entire article. Presidents Van Buren, Harrison, Tyler, and Polk came and went, each urging Congress to action, but the legislators suffered from the "embarrassment of riches" in a new sense. Among the plans prominently brought forward and considered at length were the following: Senator John Quincy Adams advocated an astronomical observatory; Senator Asher Robbins, of Rhode Island, favored the establishment of a National University; Senator Benjamin Tappan, of Ohio, proposed a botanical garden and an agricultural farm; Senator Rufus Choate, of Massachusetts, urged a grand library; Robert Dale Owen, of Indiana, preferred a normal school with lectureships on scientific subjects; Mr. Isaac H. Morse, of Louisiana, wanted the prizes awarded for the best written essay on ten subjects; and some legislators, wise in their own conceit, opposed every plan suggested. Mr. George W. Jones, of Tennessee, proposed that the whole fund be returned to any heirs at law or next of kin of James Smithson; and a similar disposition of the fund was advocated by Andrew Johnson, of Tennessee, and Mr. A. D. Sims, of South Carolina. It is interesting, in the light of later national events, to note the names of some of those who took part in these discussions: we find side by side the names of Jefferson Davis and Hannibal Hamlin, Andrew Johnson and Alexander H. Stephens, Howell Cobb and Stephen A. Douglas.

Meanwhile memorials from persons and institutions outside of Congress poured in, urging expedition, advocating particular bills and suggesting new plans. At least two societies of citizens sought to gain control of the magnificent fund which Congress was so slow in appropriating; the Agricultural Society of the United States, formed in the District of Columbia, memorialized Congress to apply the Smithsonian fund to its objects; and the National Institution for the Promotion of Science, organized in 1840 by representative men in Washington, sought union with or control of the embryonic establishment bearing Smithson's name. Dr. G. Brown Goode, in his Genesis of the United States National Museum (Report of the United States National Museum, 1891), points out that the President of this National Institution, Joel R. Poinsett, of South Carolina (Secretary of the Navy in 1840), deserves credit for introducing the feature of a national museum into the scheme for the Smithsonian Institution. Indeed, the organization of the Smithsonian Institution finally adopted bears marked resemblance to that of the National Institution both as regards the cast of officers and the objects of the establishment.

But all attempts to merge the interests of the two bodies failed, partly owing to objections to placing the management of the new institution in the hands of a private corporation; meanwhile the National Institution changed its name to National Institute, but after a flourishing existence of five years it lost its power.

Although much deprecated at the time, the slowness with which Congress acted in disposing of Smithson's legacy had its advantages: weak schemes were exposed, public opinion was educated, and the judgment of Congress itself was elevated by the prolonged discussions. The broad provisions of the will, open to the charge of vagueness, gave scope to the variety of views we have named and furnished ground for the delay. It is interesting to note that the act creating the Smithsonian Institution, adopted August 10, 1846, embodies nearly all the best features of the numerous schemes proposed during the ten years which had elapsed.

The act of incorporation was the work of many minds and to some extent a compromise; no one person should receive credit for its provisions, but mention should be made of Senator Benjamin Tappan, Robert Dale Owen, and William J. Hough, who drew up the bill eventually agreed upon. Stripped of legal verbiage and condensed, the bill is as follows:

TITLE.—A bill to establish the "Smithsonian Institution" for the increase and diffusion of knowledge among men.

Preamble: Rehearses the facts as to Smithson's bequest and the acceptance by the United States, and directs that the President and Vice-President of the United States, the Secretary of State, the Secretary of the Treasury, the Secretary of War, the Secretary of the Navy, the Postmaster-General, the Attorney-General, the Chief Justice, and the Commissioner of the Patent Office of the United States, and the Mayor of the city of Washington, during the time for which they shall hold their respective offices, and such other persons as they may elect honorary members, be constituted an "establishment" by the name of the Smithsonian Institution.

Section 2 provides for investment of the Smithson fund and payment of the interest thereon; also appropriates a sum for erection of a suitable building.

Section 3 provides that the business of said institution shall be conducted at the city of Washington by a Board of Regents to be composed of the Vice-President of the United States, the Chief Justice, and the Mayor of the city of Washington, together with three members of the Senate and three members of the House of Representatives, and six other persons, two of whom shall be members of the National Institute. The act then provides for the manner of appointment, the time of service, the filling of vacancies, the election of a Chancellor and Secretary by the Board of

Smithsonian Institution—Interior.

Regents and of an executive committee, as well as for the payment of money needed for conducting the institution; also, an annual report to be submitted to Congress.

Section 4 provides for the selection of a suitable site for a building.

Section 5 provides for the erection of a building of plain and durable materials, of sufficient size for rooms to contain objects of natural history, including a geological and mineralogical cabinet, a chemical laboratory, a library, a gallery of art, and the necessary lecture rooms; also provides for the expense of this building.

Section 6 enacts that in proportion as suitable arrangements can be made for their reception all objects of art and of foreign and curious research, and all objects of natural history, plants, geological and mineralogical specimens, belonging or hereafter to belong to the United States which may be in the city of Washington shall be arranged as best to facilitate their examination and study in the building to be erected; also new specimens to be so arranged; also minerals, books, and other property of James Smithson to be preserved in the institution.

Section 7 enacts that the Secretary of the Board of Regents shall take charge of the building and contents, shall discharge the duties of librarian and of keeper of the museum, and may employ assistants, and provides for their compensation.

Section 8 provides for meetings at which the President or Vice-President of the United States shall preside, and appropriates a sum not exceeding twenty-five thousand dollars annually for the formation of a library.

Section 9 enacts that moneys accrued as interest upon the fund, not herein appropriated, may be disposed of by the Board of Regents as they direct.

Section 10 enacts that one copy of all copyrighted books, engravings, maps, etc., shall be sent to the Librarian of the Smithsonian Institution, and one to the Librarian of Congress.

Section 11 gives to Congress the right to amend any of the provisions of this act.

This act was signed by President James K. Polk, August 10, 1846. It embodies the features of a national museum, a library, with provisions for copyrighted books, an art gallery, and lecture rooms, presumably for scientific courses though no special provision for them is made. It places the executive work in the hands of a Secretary, and the general oversight with care of finances in the power of a Board of Regents, which board includes the highest officials in the Government of the United States.

The opponents of this bill, though defeated, still endeavored to change its character. Eighteen months after its passage, Andrew Johnson, of Tennessee, introduced a bill to change the Smithsonian Institution to "Washington University, for the Benefit of Indigent Children of the District of Columbia," and spoke in favor of remodeling the entire plan so as to convert the institution into a university to include the manual-labor feature, mechanic arts, and agriculture. Mr. Embree wanted at the same time to graft upon the institution a department for collecting and arranging information on agriculture, common-school education, political economy, and the useful arts and sciences, which information shall be published and circulated gratuitously among the people.

Spencer F. Baird.

These attempts to tinker with the act of incorporation received their quietus on August 8, 1848, when the House of Representatives adopted a resolution to the effect that it is inexpedient to change and modify the act in the manner proposed. In 1878, and again in 1894, the act of incorporation was revised and somewhat simplified; the two Regents were no longer to be chosen from members of the National Institute, which meanwhile had died, and other slight changes were made.

Congress having appointed Regents, they organized by electing a Chancellor and temporary secretary. The act of incorporation placed great responsibilities in the secretary's office, and the Regents felt that the advancement of the proper interests of the trust made it essential that the Secretary of the Smithsonian Institution should be a man possessing weight of character and a high grade of talent; that he also possess eminent scientific and general acquirements; that he be capable of advancing science and promoting letters by original search and effort, and well qualified to act as a respected channel of communication between the institution and scientific and literary individuals in this and foreign countries. To this important position the Regents invited Prof. Joseph Henry, of the College of New Jersey, widely known in both hemispheres by his splendid discoveries in electro-magnetism and universally respected as a man by all who knew him. His acceptance of the secretaryship was a most fortunate event for the institution, insuring its high scientific standard, its wise and economical administration, and its superior reputation at home and abroad. Henry's Programme of Organization, presented to the Board of Regents December 8, 1847, is a model of skillful analytical statement, proposing plans for the increase of knowledge and its diffusion among men; in it he laid down broad lines of action and established the foundations on which the existing edifice stands. Henry devoted the rest of his life, thirty-three years, to the development of this programme, and the institution owes to him an everlasting debt of gratitude for his enlightened, pure, and able administration of the trust.

After the plans of Mr. James Renwick, Jr., for a Norman building, had been accepted, its erection in the Mall was conducted slowly, being completed in 1855, at an expense of about three hundred and fourteen thousand dollars. Meanwhile prudent economy in expenditures enabled Henry to add one hundred and fifty thousand dollars of accrued interest to the original fund. A library was begun by exchange and purchase, and materials for a museum collected and housed. Besides these interests, the institution adopted the plan of promoting original research by assisting men of science in their labors; at the same time series of investigation were instituted, explorations conducted, and the results of all these endeavors were published and distributed to all the learned societies and important libraries throughout the world.

S. P. Langley.

Whenever a man was found capable of adding to the sum of human knowledge, the institution assisted him by supplying books not otherwise attainable, instruments of research, specimens of materials, and objects under investigation, and in some instances special grants of money were made for personal expenses. The specimens in all branches of natural history were not confined to the glass cases of the museum, but freely loaned to men engaged in special lines of research; and if the specimens required were not on hand, the institution undertook to obtain and to supply them, the only return asked for being that full credit be given to the name of Smithson. This liberal policy has never been discontinued.

The institution established systematic meteorological observations, it instituted the first telegraphic weather service, published meteorological tables and charts, and became, in fact, the parent of the present Weather Bureau.

The institution early adopted a policy of doing nothing which could be accomplished as well by other means, and of relinquishing undertakings causing a draft upon its finances so soon as other bodies, or the Government, should agree to take them in charge. In pursuance of this wise plan the Secretary and the Regents induced Congress from time to time to make separate appropriations from the public Treasury in support of the National Museum, and of certain branches of work directly ordered by the Government itself. The library soon outgrew its limited quarters, and in 1866 was deposited in the Library of Congress, at a great saving of expense. The meteorological service was likewise transferred in 1874 to the Signal Corps of the United States Army.

For many years the institution conducted explorations in regard to the ethnology of the Indians of North America, and this has developed into an important Bureau of Ethnology, supported by Government appropriations, yet controlled by the Smithsonian.

The botanical collection was transferred to the Department of Agriculture, and the osteological specimens were placed in the Army Medical Museum.

The Smithsonian has been exceedingly fortunate in its executive officers. After the death of Henry, in 1878, Prof. Spencer F. Baird, the eminent naturalist, was called to the secretaryship. He had been United States Commissioner of Fishes for seven years and Assistant Secretary of the Smithsonian for twenty-eight years, and thus brought to the post wide experience as well as administrative ability. Under his care the National Museum was especially augmented, and the publications were issued uniformly on the lines laid down by his predecessor. Of his distinguished services to science we can not here take note; we merely quote two paragraphs from the resolutions adopted by the Board of Regents, November 18, 1887, on the occasion of his death:

"*Resolved,* That the cultivators of science both in this country and abroad have to deplore the loss of a veteran and distinguished naturalist, who was from early years a sedulous and successful investigator, whose native gifts and whose experience in systematic biologic work served in no small degree to adapt him to the administrative duties which filled the later years of his life, but whose knowledge and whose interest in science widened and deepened as the opportunities for investigation lessened, and who accordingly used his best endeavors to promote the researches of his fellow-naturalists in every part of the world.

"*Resolved*, That his kindly disposition, equable temper, singleness of aim, and unsullied purity of motive, along with his facile mastery of affairs, greatly endeared him to his subordinates, secured to him the confidence and trust of those whose influence he sought for the advancement of the interests he had at heart, and won the high regard and warm affection of those who, like the members of this board, were officially and intimately associated with him."

Prof. Baird was succeeded in the office of Secretary by the present incumbent, Prof. Samuel P. Langley, LL. D., known to the scientific world by his masterly researches in solar physics. Under his administration the Smithsonian continues its prosperity with undiminished vigor.

In a second article we shall consider the present status and many activities of this noble institution.

PRINCIPLES OF TAXATION.

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CORRESPONDANT DE L'INSTITUT DE FRANCE, ETC.

I.—THE COMPARATIVELY RECENT TAX EXPERIENCES OF THE FEDERAL GOVERNMENT OF THE UNITED STATES. PART II.

WITH the close of the war a marked change speedily occurred, in the nature of discontent, in the temper of the people in respect to taxation. But this discontent at the outset was restricted almost exclusively to the so-called "internal revenue taxes," and extended in little or no degree to the war taxes imposed on imports; which last, so long as the internal revenue taxes continued to be levied upon every manufactured product, and also upon the separate constituents of such product, were not only wholly justifiable, but absolutely necessary, if the fiscal burdens of the war between the domestic producers and their foreign competitors were to be equalized. In some instances, through oversight or neglect, the tariff taxation was made actually less upon the imported article than was the internal taxation on the domestic product manufactured from it; one illustration of which was, that the charges imposed on the import of Manilla rope were fifty-six dollars per ton, while the internal taxes on the rope manufactured in the United States from the Manilla fiber ranged from forty-eight to seventy-three dollars per ton.

It soon became evident that the country *could* not endure for any great length of time the war system of taxation, and, furthermore, *would* not, when a return of peace had made its continuance unnecessary.* And, pending its modification for the purpose of reduction, a desire to evade the payment of taxes everywhere manifested itself, until it seemed at one time as if the whole country and the Government itself were becoming corrupted and demoralized. For example, the revenue receipts from the income tax, without any change in the law, declined from $72,982,000 in 1866 to $66,014,000 in 1867; and those from a uniform tax on distilled spirits, from about $29,000,000 in 1867 to a little in excess of $14,000,000 in 1868.

It was under such circumstances that the Revenue Commission entered upon its prescribed duties. The work of investigation devolved mainly on its chairman, the second member being debarred by age and feeble health from any active exertion; while the third assumed from the outset that the best and most feasible way of meeting the financial difficulties of the situation was to abandon the "whole system" (of existing taxation) "in the shortest time consistent with the general interests of the country," and, by an amendment to the Federal Constitution, authorize and require the Federal Government to levy "a duty, payable in lawful money, of one per centum per annum" on the income of all interest-bearing indebtedness issued by the United States and payable in lawful money; and "a duty, payable in specie, of seven tenths of one per centum on the principal of all indebtedness of the United States, which shall belong to any person or corporation, and the interest on which may be payable in specie." He was also of the opinion that such taxes on the income or principal of the indebtedness of the United States, should be "in addition to any ordinary duty or tax equally imposed upon all incomes, or directly upon all personal and real property within the United States subject to taxation."

A subsequent report to this effect was not received with any marked disfavor by the general public, and had the indorsement of not a few leading American bankers and capitalists. As the average annual rate of interest accruing on the market price of the gold bonds issued by the United States from January, 1862, to January, 1866, was 8·82 per cent, and on investments in the debt of the United States payable in lawful money, from 1863 to 1866, was 10·68 per cent, the proposition to levy a tax of one per cent on the

* The imperative necessity of a speedy abatement of the internal revenue taxes after the termination of the war finds striking illustration in the following examples of actual experience. Thus the tax of six per cent, levied and collected during the fiscal year 1864–'65, on the value of the products of the woolen industry in Massachusetts alone ($48,430,-671) was equivalent to nearly twenty per cent on the whole capital ($14,735,671) invested in this business; while the tax on the value of boots and shoes manufactured in the same State during the same year ($52,915,243) was equal to thirty per cent on the whole capital employed ($10,067,474).

income or principal of the same did not appear unreasonable, especially in the case where *no* exemption from taxation was stipulated in the contract for these issues. But neither the author of the report nor its indorsers could have anticipated that within little more than five years after it was submitted to Congress, the Federal Government could have borrowed $185,000,000 at four and a half per cent interest; and that twenty-five years afterward would be able to renew a debt of $25,364,500 at two per cent per annum, or at a rate fifty per cent less than loans on the best corporate or private securities would have at the same time commanded.

The method of prosecuting the work contemplated by Congress of the Commission was at the outset a matter of no little embarrassment. There was practically no material or basis to work on, except the bare statutes authorizing war taxes, and no official collection of these was published by the Government until two years after the commencement of the war. There was no bureau of statistics in the Treasury, and in this department of the Government the officials to whom was assigned the duty of collecting and publishing reliable data relative to the trade and commerce of the country were untrained. No full and reliable statistics concerning any branch of trade or industry in the United States, with possibly a very few exceptions, were then, or ever had been, available. The Treasury received returns of the aggregate of revenue collected and the sources whence it was derived; but these returns were rarely, if ever, accompanied by any suggestions, derived from administrative experience, of any value. The commercial returns from the customs were hardly worth the paper on which they were written. Thus, for example, when the duty on the importation of coffee came up for consideration as a source of revenue, the value of the coffee imported during the fiscal year 1864–'65 was officially returned at ten and a half cents per pound, while its average invoice price, according to the trade of New York for the same period, was not less than thirteen cents. Again, according to the Treasury statement, the aggregate imports of coffee for the same year, were 104,316,581 pounds. Of this amount 82,353,000 pounds, which were retained for domestic consumption, had a returned value of only six and four tenths cents per pound, while the value of 21,962,000 pounds of the same imports which were exported during the same year, had the extraordinary value of nearly twenty-five cents per pound. For the year 1863 the Treasury reported an aggregate import of spirits distilled from grain of 1,064,576 gallons, but of this quantity only 45,393 gallons were entered at the ports of Boston, New York, Philadelphia, Baltimore, and San Francisco, leaving an inferential import of 1,019,183 gallons at other ports of the loyal States that practically had no foreign commerce.

In the Bureau of Internal Revenue a better system prevailed; but this department of the Treasury being always overburdened with work, and its service largely rendered by assessors and collectors who were destitute of business training, contributed but little in the way of deductions from experience. It had, moreover, at one time as its head an official who subsequently in a higher position refused to allow data to be collected in respect to certain taxes, on the ground that the less the people knew about such matters the better it was for the Treasury.

Another great source of difficulty experienced by the Commission in conducting investigations with a view of arriving at any correct estimates of the prospective revenue of the country was the abnormal condition of every branch of trade and industry after 1861, due primarily to the war disturbances, and next to the frequent alterations in the rates of taxation. Every advance made in tariff, or internal revenue taxes, was anticipated to such an extent by importers, manufacturers, dealers, and speculators that the Government could not fairly test the capacity of any one of its great and legitimate sources of revenue. Thus, for example, the almost incredible profits made by reason of anticipation of the large and repeated advances in the taxes on distilled spirits have already been pointed out. Of cigars, in like manner, it was estimated that above eighty millions had been made and stored at one time in the city of New York alone, in anticipation of a higher tax; and in the case of the comparatively insignificant article of matches, on which the tax was only one cent per bunch, the stock accumulated in anticipation of an advance of tax was so large that it was not entirely exhausted for a subsequent period of three years.

In the absence of any specific instructions, either from Congress or the Secretary of the Treasury, it was difficult for the commission to form an opinion as to the best method of entering upon the comprehension and reform of a scheme of taxation which embraced almost every form of tax that the ingenuity of man could devise, and with an incidence on almost every form of property, business, profession, or occupation that was capable of yielding to the state a revenue. The conclusion arrived at, after no little consideration, involved a complete abandonment of any idea of endeavoring to enter upon and comprehend the whole field of inquiry at the outset; and in its place, and in accordance with the maxim attributed to Emerson, that the eye sees only what it brings to itself to see, it was determined to take up and study specifically the sources of public revenue in the order of their importance; and give no attention to any other subject, or attempt to theorize, until everything that domestic experience or the experience of other countries could teach concerning them had been made familiar. In practically carrying out this idea, the chairman of the commission put himself in direct and frequent communication with revenue officials and representative business men from every section of the country; and availing himself of the power to take testimony, under oath, he often came into the possession of important facts which in daily life had been screened from the eye of the public. The result was that the commission presented to Congress, in January, 1866, a report which gave for the first time a full, clear, and exact statement of the curious and complex scheme of internal and customs revenue that had been evolved, as it were, out of the financial necessities contingent on the prosecution of a gigantic war: which involved the raising by taxation during the war period (and exclusive of loans) of an aggregate of over $2,000,000,000, and a not infrequent daily disbursement (expenditure) of over two millions of dollars; and in addition to this feature the report contained special and elaborate exhibits on distilled spirits, fermented liquors, petroleum, cotton, tea, coffee, sugar, spices, proprietary articles, and patent medicines as sources of Government income, with estimates of the amount of revenue which the Treasury might annually expect if taxation at various rates on the same was to be continued; the whole being really the first practical attempt in the United States to gather and use national statistics for great national purposes.

On the termination by statute of the Revenue Commission, in January, 1866, its chairman was appointed to an office specially created by Congress, for a period of four years, with the title of "Special Commissioner of the Revenue" of the United States; and the duties of which were thus defined by statute:

"*He shall from time to time report through the Secretary of the Treasury to Congress, either in the form of bill or otherwise, such modifications of the rates of taxation, or of the methods of collecting the revenues, and such other facts pertaining to the trade, industry, commerce, or taxation of the country as he may find by actual observation of the law to be conducive to public interest.*"

In this office, and invested with large powers, its incumbent entered upon the work of co-operating with the appropriate committees of Congress—"Ways and Means" of the House and "Finance" of the Senate—in reconstructing the then existing and extraordinary system of the United States internal revenue; and under his initiation and supervision were originated almost all the reforms in this department of the Government that were considered or enacted by Congress between the close of the war and the year 1870; namely, the redrafting of nearly the whole body of complicated and often conflicting statutes; the reduction and final abolition of the taxes on crude products—especially cotton, salt, lumber, petroleum, and the metals—and most of the taxes on manufactures;

the creation of supervisory districts and the appointment of supervisors; the origination of the use of stamps for the collection of taxes on distilled spirits, fermented liquors, tobacco, and the sales of stockbrokers (the last in place of a general tax of one twentieth of one per cent on sales); and the creation and organization of the Bureau of Statistics as a branch of the national Treasury. These modifications brought the internal revenue duties within a reasonable compass, introduced systems where the want of it was working mischief, and by their ready application in administration reconciled the people to a maintenance of important sources of revenue and a continuance of taxes, which have by their stability and steady increase enabled the Government to meet financial exigencies otherwise awkward and dangerous. The service thus rendered met with recognition at the time both in and out of Congress, and was strongly indorsed by those most interested—the head of the Treasury and the industries taxed.*

The work of taking down the vast and complicated structure of internal taxation, which had been built up during the war, having been once seriously entered upon by Congress (in 1866), it was prosecuted so vigorously that in the comparatively short space of three years the aggregate annual receipts from such taxes were reduced from $310,906,000 in 1866 to $160,039,000 in 1869—a reduction of $150,865,000—and to $102,644,000 in 1872, a further reduction of $57,395,000; while the sources of revenue, the annual receipts from each one of which were specifically reported, were reduced from about two hundred and seventy-five in 1866 to nominally sixty-six in 1872; but practically to three—distilled spirits, fermented liquors, and tobacco—the receipts from which alone in 1893 were $150,865,000 as compared with $91,464,000 in 1872. It should, however, be noted that this remarkable increase of revenue, coincident with a large reduction in the number of taxed articles, was due mainly to an increase of consumption consequent upon an increase of population during the period under consideration (26,230,000) rather than to any

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* "I do not believe that any man appointed by the Government in the civil war has done for his country more work, and more valuable work, than David A. Wells. Into the financial chaos resulting from the war he threw the whole weight of a strong, clear mind, guided by an honest heart, and he has done more, in my judgment, to bring order out of chaos than any one man in the United States."—(*Speech of General James A. Garfield, Member of Congress, United States House of Representatives, July 13, 1868.*)

"There are few of my official acts that I look upon with more satisfaction than the appointment of David A. Wells to be Revenue Commissioner. All the reports that were made by him exhibited the most careful, painstaking, and intelligent investigation. In clearness and accuracy of statement, and in logical force, they have not been surpassed on either side of the Atlantic. Their ability was admitted, even by those who disagreed with the *writer in his conclusions.*"—(*Men and Measures of Half a Century, by Hugh McCulloch, Secretary of the Treasury during the Administrations of Presidents Lincoln, Johnson, and Arthur.*)

increase in the rate of taxes imposed upon the remaining sources after 1872.

Of many other curious and instructive economic experiences, consequent upon the rapid and radical changes in the fiscal policy of the United States during the period under consideration, the following seem especially worthy of notice: The first abatement or repeal of internal taxation on various articles after the war—to the extent of about fifty millions in 1866—was not attended with any general and immediate reduction in the prices of the articles relieved, corresponding to the reduction of taxation, but with rather an increase of prices. The explanation of this circumstance was, that the continuance of the heavy war taxation, for a period after the extensive war demands of the Government for various commodities had ceased, had diminished their production to a point below what would have been the normal consumption of the country; and that, therefore, prices increased concurrently with the abatement of taxes and a renewal of demand. Such a result was, however, but temporary, and the condition of affairs was soon reversed. The supply of manufactured products quickly became equal to or exceeded demand. The price of products fell faster than the price of either labor or capital, and taxation, which formerly had been paid wholly from profit, now fell mainly upon capital. The general result was a year (1867) of great industrial and commercial depression.

The enlarged use of stamps as machinery for the collection of taxes, and their novel application to fermented liquors and distilled spirits, were attended with very striking results. In the case of fermented liquors (beer), it was established almost beyond doubt by the Revenue Commission that previous to 1866 the Government was defrauded of its legitimate revenue to an extent of forty per cent, involving an absolute annual loss of about $6,400,000. The adoption, with no little hesitation by Congress in 1866, of the principle, that the payment of the tax on this commodity should be effected by the purchase and affixing a stamp to each barrel sold and removed from the place of manufacture, with the additional requirement that the stamp should be canceled by the retailer or consumer at once, increased the revenue from $3,657,000 in 1865 to $5,115,000 in 1866—the year of first application—and to $5,819,000 in 1867; and ever since has proved most effective and satisfactory.

A recommendation to make use of stamps for the collection of taxes on tobacco was acceded to by Congress in respect to smoking tobacco and snuff, but was refused in respect to chewing tobacco, cigarettes, and cigars; in the latter case on the assumption that it was impracticable to affix an adhesive paper stamp on the body of a cigar, while the "trade," not long afterward, and at its own volition, demonstrated its entire feasibility. Had the recommendation in this particular found favor, it would have resulted in an accretion of many millions to the national Treasury, a relief from espionage and other frictions to the trade, and a larger diminution of administrative expenditures both to the trade and the Government.

The experience of the Federal Government in its taxation of distilled spirits is extraordinary, and so replete with instruction to economists, moralists, and social reformers as to merit a more extended notice.

The product of distilled spirits in the United States for the year 1860, as returned by the census, was about 90,000,000 gallons. It would be an error to assume that all of this immense production of spirits was used for intoxicating purposes, or in the way of stimulants, inasmuch as the extreme cheapness of spirits or alcohol in the United States during the period under consideration occasioned their employment in large quantities for various industrial purposes; which uses were subsequently in a great degree discontinued when the price of spirits was enhanced from one hundred to one thousand per cent and upward by Federal taxation. For 1860–'61, the year preceding the war, the average price of proof spirits in Cincinnati was 14·40 cents per gallon.

From 1822 to 1862 distilled spirits, in common with all other domestic industrial products, were exempt from Federal taxation. In the latter year, under the necessity for revenue occasioned by the war, Congress imposed a tax of twenty cents per proof gallon on all distilled spirits of domestic production. This tax went into effect on the 1st of September, 1862, and continued in force until March, 1864. The total revenue derived from this source, including the receipts from licenses for rectifying, vending, and the like, for the fiscal year 1863, was $5,176,530. The receipts from the direct tax on the spirit itself was $3,229,990, indicating a domestic production of only 16,149,954 gallons as compared with a production of 90,000,000 gallons returned under the census of 1860, three years previous. The explanation of this result is to be found in the fact that a large amount of whisky was manufactured in anticipation of this low tax, and that there were doubtless some evasions of the tax after it was enacted—conditions that were repeated, as will be presently shown, in a greater degree on every occasion when an advance in the tax was enacted.

The tax of twenty cents continued in force until March 7, 1864, when the rate was advanced to sixty cents per gallon. The revenue accruing under these two rates for the year ending June 30, 1864, was $28,431,797, and the number of gallons returned as having been assessed was 85,295,393. The striking discrepancy between the number of gallons taxed in 1864 at twenty and sixty cents and the number taxed the previous year (1863) at twenty cents again finds explanation in the fact that when it became evident to the distillers that the fiscal necessities of the Government would soon compel an advance in the tax upon their product, and that such increase would not be made applicable to stocks on hand on which the lower rates had been assessed and paid, they pushed their production to the uttermost in order that they might take advantage of the great increase in the market price of all spirits after the advanced rates had taken effect; all which anticipations were fully realized. Thus, of the 85,295,393 gallons on which the Internal Revenue Bureau assessed and collected the spirit tax for 1864—69,000,000 in excess of the product of the preceding year—at least 70,000,000 gallons were manufactured prior to the 7th of March and were released from Government control by the payment of the twenty-cent tax only; and as after the 7th of March, 1864, the market price of the greater part of this increased product, which had not been allowed to pass into consumption, was advanced in accordance with the advance in the tax—i. e., forty cents per gallon—it is clear that $28,000,000 at least were thus at once legislated into the pockets of the distillers and speculators concerned.

Again, immediately after the imposition of the sixty-cent rate in March, 1864, nearly all the distilleries once more suspended operation; the country was acknowledged to be overstocked with tax-paid whisky, and the Government almost ceased to collect taxes upon its manufacture. In May, however, the project for a further increase in the rates began to be again agitated in Congress, and as soon as its realization became probable, all the distilleries speedily resumed operations. How great at that time was the capacity of the loyal States for production may be inferred from the circumstance that the number of distilleries in the country, which according to the census of 1860 was 1,138, had increased in 1864 to 2,415.

On the 1st of July, 1864, the tax was again advanced from sixty cents to a dollar and a half per gallon; and during that month the entire product of the country of which the revenue officials could take cognizance was only 697,099 gallons. How great a "stock on hand," the result of manufacturing under the twenty and sixty cent rates of tax, was carried over the 1st of July and experienced the advance of ninety cents per gallon in market price in consequence of the advance in the tax from sixty cents to a dollar and a half, can not be accurately known; but 60,000,000 gallons would certainly be a low estimate; and on this amount the profit that accrued to private interests was at least $50,000,000.

On the 1st of January, 1865 (the succeeding year), the tax was further advanced to two dollars per proof gallon, when all the operations above described were repeated, with all the benefits to private or speculative interests derived from former experiences, and a consequent very large extension of the sphere of participants in the resulting profits.

In short, all the available evidence indicates that the profits realized by distillers, dealers, and speculators, through Congressional legislation having reference to the taxation of distilled spirits from July 1, 1862, to January 1, 1865—a period of two and a half years—and exclusive of any gains accruing from evasions of taxes, and with every allowance for overestimates, must have approximated $100,000,000.

After the establishment of the two-dollar rate on the 1st of January, 1865, there was again a period of inactivity on the part of those interested in the manufacture of distilled spirits. The stocks on hand, manufactured in anticipation of the advances in rates, were very large, and, the markets being over-supplied, there was little legitimate inducement for activity on the part of distillers. The profits realized or made prospectively certain had been, moreover, enormous, and no further advance in the rate of tax could be anticipated. Under such circumstances there was an apparent disposition on the part of manufacturers and speculators to wait and see what developments in legislation and business would follow the termination of the war in favor of the Union, which was then everywhere recognized as approximately certain. These developments were not long in manifesting themselves.

The tax of two dollars per proof gallon (amounting to more than 1,500 per cent on the average cost of production) and the enormous profits contingent upon the evasion of the law, coupled with the abundant opportunity which the law through its imperfections, and the vast territorial area of the country, offered for evasion, created a temptation which it was impossible for human nature as ordinarily constituted to resist. This view was taken by the Revenue Commission in a report to Congress through the Secretary of the Treasury in February, 1866; and the chairman of the commission, after a thorough investigation of the subject and the collection and presentation of a large amount of evidence, expressed the opinion that the attempt to collect a two-dollar tax was utterly impracticable, and that the longer it was retained the less would be the revenue and the greater the corruption. He also coupled this opinion with a recommendation that a tax of fifty cents per proof gallon, with a judicious license system for rectifiers and dealers, be substituted as likely to be most productive of revenue and most efficient for the prevention of illicit distilling and other revenue evasions.

This report, although attracting much attention by reason of the singular revenue experiences of the preceding four years which it detailed (and which the public, with its thought concentrated on the results of the war, had in a great degree overlooked), found little favor in respect to its recommendation of tax abatement; and the general sentiment both in and out of Congress was expressed by a leading member of the House of Representatives, who publicly declared that "he was not ready to admit that the nation which had put down such a great rebellion at the cost of so much blood and treasure could not collect a tax of two dollars a gallon on whisky." * The two-dollar tax therefore was allowed to remain in force, and the tax experiences of the United States from 1865 to 1869 inclusive, in respect to spirits, viewed from the standpoint of finance, economics, and morals, constitute one of the most interesting, instructive, and disgraceful chapters in its history. Under the strong temptations of large and almost certain gains, men rushed into schemes for defrauding the revenue with the zeal of enthusiasts for new gold fields; and the ingenuity of the American people has never had more striking illustrations than was offered in their devices for evading the tax and providing for security against detection and punishment in so doing. The parties concerned in these transactions also showed throughout more ability than Congress and more shrewdness than the revenue department of the national Treasury; and at a later period a Secretary of the Treasury was obliged to resort to the use of a cipher for his telegraphic and written correspondence, in order to prevent the frustration of his plans for the enforcement of the laws by Treasury officials who were specially charged with their administration. The evidence in part confirmatory of these statements is as follows:

The revenue directly collected during the fiscal year 1866 (the first full year under the two-dollar tax) from spirits distilled from other materials than fruits † was $29,198,000, and in 1867 $28,296,000, indicating an annual product respectively of 14,599,000 and 14,148,000 gallons. But during the succeeding year, 1868, with no apparent reason for any diminution in the national production and consumption of spirits, and with no increase, but rather a diminution, in the volume of imported spirits, the total direct revenue from the same source was but $13,419,092, indicating a production of only 6,709,546 gallons.

As the consumption of distilled spirits in this latter year was probably not less than 50,000,000 gallons, and as out of this the Government collected a tax upon less than 7,000,000, the sale of the difference at the current market rates of the year, less the

* Of the then leading members of Congress, only two—the late President Garfield and Hon. W. B. Allison, both members of the House of Representatives—indorsed the recommendation of the commissioner at the outset.

† The revenue derived from the taxation of spirits distilled from fruits has always been comparatively small: $283,499 in 1866; $868,145 in 1867.

average cost of production (even if estimated as high as thirty cents in currency), must have returned to the credit of corruption a sum approximating $80,000,000.

Another curious feature developed was, that the number of distilleries in the country increased just in proportion as the tax on spirits was augmented; the inducement of the great profit to be obtained from a high rate of tax—the two-dollar rate especially—undoubtedly tempting many to engage in illicit manufacturing who would be unwilling to do so with a certainty of realizing a much smaller rate of profit. Of many curious examples of evidence to this effect, the following reference is particularly interesting: In the eighth collection district of the State of New York there was, before the internal revenue law went into operation in 1862, but one distillery. When the first tax of twenty cents per gallon was imposed, six additional distilleries were started. Under the sixty-cent rate about one dozen were in operation. But this number, under the two-dollar tax, increased to about forty. Furthermore, the tax collected at one distillery in the same district in one month in 1864, under the sixty-cent tax, was one third more than was paid in the aggregate by thirty distilleries in the district in the eight months succeeding November, 1865, when the tax was two dollars; or, to state it differently, one distillery in one month, in 1864, paid $58,819, at sixty cents per gallon, while thirty distilleries in eight months in 1866 paid, at two dollars per gallon, only $33,664. For the entire country the number of licensed distilleries, which in 1864 was 2,415, was returned in 1868 at 4,721—an increase of double in the short space of four years.

Thus confronted with positive evidence of astounding frauds which the Government that put down a great rebellion virtually confessed that it could not prevent, and a steadily diminishing revenue from what ought to have been a steadily increasing source, Congress finally became thoroughly alarmed, and, acceding to the recommendation of the Special Commissioner of the Revenue, reduced (in July, 1868) the direct tax on distilled spirits from two dollars to fifty cents per proof gallon.*

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* The statement that the tax on distilled spirits was reduced from two dollars to fifty cents per gallon in 1868 has been criticised (see letter of United States Commissioner of Internal Revenue, embraced in report of the Secretary of the Treasury for 1893) as not in accordance with the statement that the tax imposed in the above-mentioned year was not fifty but seventy cents per gallon. The only warrant for such criticism to be found in the circumstance that the statute of 1868, which fixed the direct tax on spirits at fifty cents per gallon, and none other, also contained separate and independent provisions imposing licenses, taxes on capacity of stills, and on the sales of dealers, with some modification of the fees of gaugers and storekeepers; and that these additional assessments brought up the tax from fifty to seventy cents per gallon. But this reasoning overlooked two essential features of the act, namely, that the direct tax on every proof gallon must be paid by the distiller, owner, or other person having possession thereof, before removal from the distil-

The results of such legislation were immediate and most remarkable. Illicit distillation practically ceased the very hour the new law came into operation. Industry and the arts experienced a large measure of benefit from the reduction in the cost of spirits; while the Government collected during the second year of the continuance of the new rate and system, with comparatively little friction, *three* dollars for every one that was obtained during the last year of the two-dollar tax. Assuming, as is warranted, that with a continuance of the two-dollar tax there would have been no increase in the revenue from distilled spirits beyond what accrued in 1868—the last year of its existence—the gain in revenue to the Government in the succeeding two years from the adoption of the fifty-cent rate was at least sixty millions of dollars. Furthermore, but for the injudicious but popular speech (to which reference has been made) at an opportune moment in committee by a statesman who had bestowed but little attention to the subject, the reduction of the tax from two dollars to fifty cents per proof gallon would undoubtedly have been anticipated by a year, and attended with like gainful results. The cost of this speech, therefore, to the national Treasury may be rightfully estimated as at least ten millions of dollars. The record of this chapter of the tax experience of the United States also forcibly illustrates the impolicy and disaster of embodying any fiscal policy in statute enactments without a previous study and full comprehension of all the elements involved.

For the first but incomplete fiscal year (1869) under the fifty-cent tax the revenue increased to the extent of nearly $20,000,000, or from $14,290,000 in 1868 to $33,735,000 in 1869; or, including all taxes on the manufacture and sale of distilled spirits, licenses, etc., from $18,655,000 in 1868 to $45,071,000 in 1869. During the next fiscal year (1870) there was a further increase in the total revenue of $10,534,864, or from $45,071,000 in 1869 to $55,606,094 in 1870.

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lery or warehouse; and next, that none of the indirect and supplementary taxes could be assessed or collected until after the direct tax (of fifty cents) had been paid; the license taxes, for example, varying according to the product of the distillery, and payable in block, at different specified times. A great and novel object here sought for, namely, of diminishing the inducements to fraud, by directing the collection of the direct and supplementary taxes on spirits as respects persons, places, and times, was fully achieved; for, although the aggregate of the direct and indirect tax on spirits undoubtedly increased their cost to their final consumers, the largest possible gain to the distiller from the evasion of the separate and comparatively small indirect taxes which contributed to this increase, even apart from the risks of punishment involved, were too small to be worthy of his attention. The effort, therefore, to attempt to minimize by sophistical reasoning the remarkable effect of the reduction in 1868 of the tax on distilled spirits to fifty cents has no rightful claim for consideration, and unquestionably was prompted by a very general but unwise public sentiment, that it is desirable always to subject the manufacture and sale of spirituous and fermented liquors to exceptionally high rates of taxation.

The specific tax on distilled spirits of fifty cents per proof gallon remained in force from July, 1868, to August, 1872, a period of a little more than four years. During this period the tax was assessed and collected on an average production of 67,175,822 proof gallons per annum, yielding an average annual revenue of about $34,000,000, and indicating an average annual consumption for all purposes of the country of about 1·65 proof gallons *per capita.* For the period of four years immediately preceding the fiscal year 1869, under a tax of two dollars per proof gallon for three years, and a dollar and a half and two dollars for one year (1865), the tax was assessed and collected on an average annual production of only about 13,300,000 proof gallons per annum, yielding an average annual revenue of about $21,727,000, and indicating an average annual consumption of only about 0·38 proof gallon *per capita.*

But, notwithstanding these satisfactory results, the law authorizing the reduction of the tax from two dollars to fifty cents per proof gallon had hardly become operative when agitation commenced for its repeal or modification. Speculators had the idea that the old scheme of increasing the tax after a little lapse of time, without making the increase applicable to stocks on hand, was, with its gainful prospects, again within the range of possibilities; while very many extreme advocates of temperance, untaught by and caring nothing for the record of recent experience, were inclined to regard the new and comparatively low tax as impolitic and in the light of the removal of a barrier against the spread of intemperance. These and other arguments proved sufficiently potent, and in June, 1872, Congress, by an act which took effect in the following August, increased the gallon tax to seventy cents, and subsequently, in March, 1875, raised the rate to ninety cents per gallon, and in August, 1894, further increased it to a dollar and ten cents, the present rate.

It is not necessary to recall that the experiences which were attendant upon every advance of the tax on spirits from its first imposition in 1862 to 1868 were repeated subsequently in 1872 and in 1875, when the increased rates of seventy and ninety cents were respectively enacted; those of the latter date being remarkable from the circumstance that the frauds upon the revenue, which were enormous, were more directly brought home to high officials of the Government than at any former period, and constitute a chapter in the history of government by the people which the people may well wish forgotten.

The above review of the experiences of the United States prior to 1869, in attempting to enforce the collection of an excessively high tax on the production and consumption of distilled spirits, is mainly valuable in this connection from the economic and moral lessons deducible from it, which may in brief be summarized as follows:

Whenever a government imposes a tax on any product of industry so high as to sufficiently indemnify and reward an illicit or illegal production of the same, then such product will be illicitly or illegally manufactured; and when that point is reached, the losses and penalties consequent upon detection and conviction—no matter how great may be the one or how severe the other—will be counted in by the offenders as a part of the necessary expenses of their business; and the business, if forcibly suppressed in one locality, will inevitably be renewed and continued in some other. It is therefore matter of the first importance for every government in framing laws for the assessment and collection of taxes to endeavor to determine, not only for fiscal but also for moral purposes, when the maximum revenue point in the case of each tax is reached, and to recognize that in going beyond that point the government "overreaches" or cheats itself.

Obviously those who in the past have shaped the policy of the United States in respect to the taxation of distilled spirits for the purpose of revenue have, for the most part, never studied this aspect of the case or cared to encourage any one to do so; but, on the contrary, as has been somewhat humorously expressed, "they have held out to the citizen, on the one hand, a temptation to violate the law too great for human nature as ordinarily constituted to resist, and in the other writs for personal arrest and seizure of property, and, thus equipped, have announced themselves ready for business."

The data officially collected and reported by the Internal Revenue Department of the United States Treasury furnish the only reliable basis for obtaining approximately correct answers to the following questions: 1. To what extent, through a well-considered system of taxation, can the manufacture and sale of distilled spirits be made available as sources of national revenue? 2. What has been and is the probable *per capita* and aggregate annual consumption of this class of spirituous liquors by the people of the United States? The first of these questions is eminently pertinent to the legislator; the second, to the student and advocate of social reform.

The experience derived from the taxation of distilled spirits previous to 1869 by the Federal authorities was so unnatural and, as it were, spasmodic as to debar its use for the determination of any general or average conclusions, and limits inquiry to the results which followed in subsequent years (1870–1894), under lower and more rational rates of taxation, and a more efficient and intelligent fiscal administration. And for the purpose of making a clear exhibit of these, attention is asked to the following table (prepared from official data), showing (1) the population of the country for each successive fiscal year from 1870 to 1894, inclusive; (2) the quantity of gallons of spirits annually taxed; (3) the average *per capita* consumption for each successive year; (4) the amount of revenue annually collected; (5) the average annual revenue, or tax *per capita*; (6) the annual tax per gallon; (7) the average tax per gallon.

YEAR ENDING JUNE 30.	Population.*	Quantity taxed.	Quantity per capita.	Revenue.	Rev'nue per capita.	Tax per gallon.	Average tax per gallon.
		Gallons.	Gallons.	Dollars.	Dollars.	Cents.	Cents.
1870..........	38,558,371	78,490,198	2·03	39,245,099	1.02	.50	50
1871..........	39,555,000	62,314,628	1·58	31,157,314	.79	.50	50
1872..........	40,596,000	66,235,578	1·63	33,117,788	.82	.50	50
1873..........	41,677,000	65,911,141	1·58	43,131,064	1.03	.50 .70	65·14
1874..........	42,796,000	62,581,562	1·46	43,807,093	1.02	.70	70
1875..........	43,951,000	64,425,911	1·47	46,877,938	1.07	.70 .90	72·76
1876..........	45,137,000	58,512,693	1·30	51,390,490	1.14	.70 .90	88·58
1877..........	46,353,000	58,043,389	1·25	52,671,291	1.14	.70 .90	89·97
1878..........	47,598,000	50,704,189	1·07	45,626,533	.96	.70 .90	89·99
1879..........	48,866,000	53,025,175	1·09	47,709,464	.08	.50 .70 .90	89·98
1880..........	50,155,783	62,132,415	1·23	55,919,119	1.11	.70 .90	90
1881..........	51,316,000	69,127,206	1·34	62,214,127	1.24	.70 .90	90
1882..........	52,495,000	71,976,398	1·37	64,778,756	1.23	.70 .90	90
1883..........	53,693,000	76,762,063	1·43	69,085,856	1.22	.90	90
1884..........	54,911,000	79,616,901	1·45	71,655,211	1.30	.90	90
1885..........	56,148,000	69,158,025	1·23	62,242,221	1.23	.70 .90	90
1886..........	57,404,000	70,851,355	1·23	63,766,219	1.11	.90	90
1887..........	58,680,000	67,380,391	1·15	60,642,351	1.03	.90	90
1888..........	59,974,000	71,565,486	1·19	64,408,937	1.07	.90	90
1889..........	61,289,000	77,163,529	1·25	69,447,175	1.13	.90	90
1890..........	62,622,250	85,043,336	1·35	76,539,002	1.22	.90	90
1891..........	63,975,000	88,473,437	1·38	79,626,093	1.24	.90	90
1892..........	65,520,000	95,045,787	1·45	85,541,209	1.31	.90	90
1893..........	66,826,000	99,145,889	1·48	89,231,300	1.34	.90	90
1894..........	68,000,000	88,777,387	1·33	79,862,647	1.74	.90 1.10	

The first point of interest which an examination of the above table reveals is, that the average *per capita* consumption of tax-paid distilled spirits by the people of the United States during the years 1870, 1871, 1872, and 1873, under the tax of fifty cents per gallon, was greater than it has been at any subsequent period

* Population for 1870, 1880, and 1890 from census; other years calculated by the actuary of the Treasury Department.

under a seventy and ninety cent rate. Such a result is undoubtedly referable in the main to the economic law that a reduction in the price of a commodity encourages its consumption (in this instance for industrial as well as stimulant purposes), and in a degree to the fact that a fifty-cent tax, with its accompaniment of stringent penalties, greatly diminished the incentive for illicit production. A wonderfully striking illustration of the strength of temptation for the evasion of the revenue created by the previous high taxation, which had little other reason than mere sentiment for its imposition, is also afforded by the fact that while the Government in 1872, under a tax of fifty cents per proof gallon, took cognizance of an average annual tax-paid consumption on the part of the people of the United States of 1·63 gallons per capita, it was only able to recognize in 1868, under a two-dollar tax, a similar average annual consumption of about 0·38 proof gallon *per capita.*

The second point of interest in connection with the foregoing tabular exhibit is the demonstration it affords of the very curious variations which occurred in the successive years from 1870 to 1894, inclusive, in the quantity of spirits that annually paid taxes to the Government, and which may be regarded as constituting an approximately accurate measure of the average annual *per capita* consumption of this commodity by the entire population of the country. The explanation of such changes is not difficult. They are in general unquestionably referable to immediately antecedent or contemporary changes in the business condition of the country, which in turn are determinative in a high degree of the popular ability to consume an article—like distilled spirits—of comparatively high cost and largely a luxury, popular tastes and habits and restrictive moral influences remaining constant. Thus, passing by the year 1870, in which there was a great increase (from altogether abnormal causes) in the number of gallons produced and made subject to taxation, the increase in the tax-paid product and in the average *per capita* consumption during the succeeding fiscal years 1872 and 1873, when the business of the country was fairly prosperous, was regular and not inconsiderable. The commencement of the next fiscal year (1874) was signalized by one of the most memorable financial panics in American history and a general prostration of business, from which last there was no decided recovery until 1879.

During all this period the domestic production of distilled spirits of which the Government took cognizance continued to decline, and the average *per capita* of consumption touched the exceedingly low proportions of 1·07 and 1·09 gallons in the fiscal years of 1878 and 1879 respectively. With a renewal of active and profitable business throughout the country in 1880, the annual taxed production of spirits went up from 50,704,189 gallons in 1878 to 79,616,901 gallons in 1884, and the *per capita* consumption from 1·07 gallons to 1·45 gallons in the corresponding years. During the period from 1871 to 1880 there was a decrease both in the quantity of spirits on which the Government was able to collect a tax and in the apparent *per capita* consumption of the people, and this, too, notwithstanding an increase during this same period of thirty per cent in the population of the country; 1871 showing a tax on sixty-two and one third millions (1·58 gallons *per capita*), while in 1879 the tax was collected on only fifty-three million gallons (1·09 gallons *per capita*).

The decade from 1870 to 1879 was further characterized by two periods of disturbance—which ought to be instructive in view of future legislation—occasioned by an advance in 1873 of the gallon tax from fifty to seventy cents, and again in 1875 from seventy to ninety cents. In both cases these advances in rates were followed by large annual reductions in the quantity of the spirits taxed and in an apparent *per capita* consumption, which in turn indicated extensive revivals of illicit practices which the reduction of the tax to fifty cents in 1868 had nearly extinguished, and which indications were also made certainties by abundant direct evidence.

The decade of 1880 to 1889 showed, on the other hand, an increase in the aggregate amount paying taxes from sixty-two and one eighth million gallons in 1880 (1·23 gallons *per capita*) to seventy-seven and one eighth million gallons in 1889 (1·25 gallons *per capita*), an aggregate increase approximating a concurrent increase of twenty-two per cent in the population of the country.

During the fiscal years from 1888 to 1893, inclusive, under a uniform and prospectively stable rate of tax, an apparently good and efficient administration of the law, and a fairly prosperous condition of the country, the results in this department of our national revenues were very exceptional and interesting. The continuous increase in production, in *per capita* consumption, and in revenue was remarkable, the average increase in spirits paying taxes having been nearly 4,600,000 gallons per annum, or in a ratio greater than any concurrent increase in the population of the country; in average *per capita* consumption, nearly one third of a gallon; in average increase in revenue of nearly $5,000,000 ($4,910,000) per annum, the whole culminating for the fiscal year (1893) in a product of 99,000,000 gallons, an annual revenue of $89,000,000, and a *per capita* consumption of 1·48 gallons. During the same period the *per capita* consumption of all spirits, domestic and foreign, in Great Britain was about 1·063 gallons.

The financial troubles and business depressions in Europe and other countries during the years 1892 and 1893 do not appear to have exerted the slightest influence on the production and consumption of distilled spirits in the United States. But the advent in 1894 of a similar state of affairs in the latter country speedily manifested itself, reducing the current *per capita* consumption from 1·48 gallons in 1893 to 1·33 gallons; the direct revenue from $89,231,000 in 1893 to $79,899,000; the current *per capita* consumption from 1·48 to 1·33 gallons, and the total annual revenue to the extent of $9,461,008.

The normal consumption of distilled spirits in the United States in 1894, as indicated by withdrawals from distilleries and warehouses, was about 8,000,000 gallons a month. The extent to which the increase in the direct tax on spirits by the act of August 28, 1894, from ninety cents to one dollar and ten cents per gallon, was anticipated by speculators is strikingly illustrated by the fact that an average monthly revenue from the lesser tax of about $8,000,000 per month during the first six months of 1894 increased during the month of July and the first twenty-seven days of August to $19,064,000 and $21,470,000 respectively, and declined in the succeeding month of September to $510,696.

Any review of the comparatively recent tax experiences of the United States would be incomplete that failed to notice its taxation (concurrent with that on distilled spirits) of domestic fermented liquors (beer, etc.). The internal revenue tax on this commodity has been practically uniform since its first authorization in 1863, namely, one dollar per barrel, holding theoretically thirty-one gallons. The tax was originally assessed and collected on the returns of the brewers, and was largely evaded. After July, 1866, it was successfully enforced through the employment of stamps, one of which, "denoting the amount of the tax," is required to be affixed upon the spigot hole or tap (of which there shall be but one) in such a way that the stamp shall be destroyed upon the withdrawal of the liquor from the barrel or other receptacle. The following table exhibits in detail the experience which has characterized each fiscal year since the inception of this source of revenue in 1863 down to and including 1894:

Years.	Population.	Beer.				
		Quantity taxed.	Quantity per capita.	Revenue collected from barrel tax.	Revenue per capita.	Tax per barrel of 31 gallons.
		Gallons.	Gallons.	Dollars.	Dollars.	Dollars.
1863.........	33,365,000	62,205,375	1·86	1,558,083	.05	1.00 .60
1864.........	34,046,000	97,382,811	2·86	2,223,719	.07	.60 1.00
1865.........	34,748,000	113,372,611	3·26	3,657,181	.11	1.00
1866.........	35,469,000	158,569,340	4·47	5,115,140	.14	1.00
1867.........	36,211,000	192,429,462	5·31	5,819,345	.16	1.00
1868.........	36,973,000	190,546,553	5·15	5,685,663	.15	1.00

Years.	Population.	BEER.				
		Quantity taxed.	Quantity per capita.	Revenue collected from barrel tax.	Revenue per capita.	Tax per barrel of 31 gallons.
		Gallons.	Gallons.	Dollars.	Dollars.	Dollars.
1869.........	37,756,000	196,603,705	5·21	5,866,400	.16	1.00
1870.........	38,558,371	203,813,127	5·29	6,081,520	.16	1.00
1871.........	39,555,000	239,948,060	6·06	7,159,740	.18	1.00
1872.........	40,596,000	268,442,237	6·61	8,009,969	.20	1.00
1873.........	41,677,000	298,633,013	7·16	8,910,823	.21	1.00
1874.........	42,796,000	297,627,807	6·95	8,880,829	.21	1.00
1875.........	43,951,000	293,033,607	6·66	8,743,744	.20	1.00
1876.........	45,137,000	306,972,912	6·80	9,159,675	.23	1.00
1877.........	46,353,000	304,111,860	6·56	9,074,355	.20	1.00
1878.........	47,598,000	317,485,601	6·67	9,473,360	.20	1.00
1879.........	48,866,000	344,195,604	7·04	10,270,352	.21	1.00
1880.........	50,155,783	413,760,441	8·25	12,346,077	.25	1.00
1881.........	51,316,000	443.641,868	8 65	13,237,700	.26	1.00
1882.........	52,495,000	525,514,635	10·01	15,680.678	.30	1.00
1883.........	53,693,000	550,494,652	10·25	16,426,050	.31	1.00
1884.........	54,911,000	588,957,189	10·73	17,573.722	.32	1.00
1885.........	56,148,000	594,764,543	10·59	17,747,006	.32	1.00
1886.........	57,404,000	642,038,923	11·18	19,157,612	.33	1.00
1887.........	58,680,000	716,767,306	12·21	21,387,411	.36	1.00
1888.........	59,974,000	765,086,789	12·77	22,829,202	.38	1.00
1889.........	61,289,000	778,715,443	12·71	23,235,863	.38	1.00
1890.........	62,622,250	854,420,264	13·64	25,494,798	.41	1.00
1891.........	63,975,000	944,823.952	14·77	28,192,327	.44	1.00
1892.........	65,520,000	986,352,916	15·05	29,431,498	.45	1.00
1893.........	66,826,000	1,071,183,827	16·03	31,962,743	.48	1.00
1894........	68,000,000	933.373,944	14·90	30,843,764	.44	1.00

The points of interest made apparent in the foregoing tabular exhibit, and to which attention is especially asked, are as follows:

(1) The regular and great increase in the quantity of fermented liquors annually made subject to internal revenue taxation—i. e., from 62,205,375 gallons in 1863 to 1,071,183,827 gallons in 1893, and an increase in *per capita* consumption very far in excess of the rate of increase in population—i. e., from 1·86 gallons in 1863 to over sixteen gallons in 1893.

(2) The concurrent regular increase in revenue from this source—i. e., from $1,558,000 in 1863 to nearly $32,000,000 in 1893.

(3) The variations in the product of fermented liquors which the Government has been able annually to subject to taxation since 1863 have been inconsiderable and in remarkable contrast to those occurring in the case of distilled spirits. Business depression from 1874 to 1879 and for the year 1884 appears to have been influential in checking *per capita* consumption, though in a small degree, and to have exerted little or no influence in the subsequent years, that are subject to analysis, down to 1894, when financial and industrial depression was again operative in the country, results indicating that similar larger and contemporaneous decrements in consumption and revenue in the case of distilled spirits

were due to fraudulent practices, rather than to an impairment of ability to consume on the part of the masses.

(4) The average annual increase in the receipt of internal revenue from fermented liquors for the ten years from 1883 to 1892 was $1,306,057, and for the four years ending with the fiscal year 1893 about $1,617,000. That this latter ratio of annual increase under the present rate of tax is likely to indefinitely continue is almost demonstrated by the fact that the popularity of fermented or malt liquors as beverage among the American people is unquestionably increasing; and also that large, seemingly, as is their present average *per capita* consumption—namely, sixteen gallons—the present *per capita* consumption of the people of several other nationalities is much greater; that of the United Kingdom being estimated at thirty gallons; of England and Wales, thirty-six; of Belgium, forty; and of Germany, forty-five. An important fact pertinent to the prospective consumption of beer and its permanent value as a source of national revenue is, that the cost of the materials used in its manufacture has decreased in comparatively recent years, in the United States, Great Britain, and probably other countries characterized by its large consumption, to the extent of at least forty per cent; and the advantage from this change which has accrued to British brewers was stated by the British Chancellor of Exchequer, in May, 1895, to have been upward of £2,000,000 ($10,000,000) per annum. Another point of interest in this connection which is especially worthy of attention is, that if moral influences have ever materially affected the general consumption of distilled spirits or fermented liquors in the United States, the tabulated tax experiences of its Government, which constitute the only reliable basis for forming an opinion, do not afford any indication of it.

Having reformed and radically reduced the war taxes in the Department of Internal Revenue, it was next in order for Congress to consider the readjustment of the customs system of taxation, which had also been evolved, as it were, out of the war's fiscal exigencies; and it accordingly in 1867 instructed the Secretary of the Treasury to present at its next session the draft of a tariff embodying reductions of war rates. The responsibility of preparing such a draft having been next intrusted by the Secretary to the Special Commissioner of the Revenue, the latter, with a view of qualifying himself for the trust, visited Europe under a Government commission, and investigated under almost unprecedented advantages nearly every form of industry then competitive with the United States in Great Britain and on the Continent. The results of this visit and investigation effected an enlightenment on his part in respect to two salient and fundamental points:

First, that no country, with the exception of the United States, which had adopted in a greater or less degree the policy of protection through duties or restrictions on imports, had ever regarded the taxation of the imports of "raw,"* or crude, or partly manufactured materials, to be subsequently used for larger manufacturing, as an element of protection in its largest sense to its domestic industry, but rather as antagonistic to, and destructive of, such industry; and that, while such taxation in the United States had undoubtedly built up some industries and enriched their owners, it had been a great restraint on the development of a much larger and higher class of industries, employing a greater number of workmen, and paying much higher average wages. *Second,* that the countries of Europe in which the average rates of wages were lowest were the most clamorous for protective duties on imports; and that high wages in any country, conjoined with the extensive and skillful use of machinery, instead of being evidence of industrial weakness, were evidence of great industrial strength; inasmuch as no employer can continuously pay high wages unless his product is large, his labor most effective, and his cost of product, measured on the terms of labor, comparatively low.

The announcement of these views, and especially their publication in a report in 1869, created much antagonism among the advocates of the policy of extreme protection in the country; and Horace Greeley and others publicly charged that the commissioner had been induced to change his views through the corrupting agency of British gold. Notwithstanding this, a draft for a complete revision of the tariff of the United States, prepared under his almost sole supervision, and accompanied with a report on the existing revenue resources and industrial and financial condition of the country, was submitted to the Forty-first Congress by Secretary McCulloch, with his indorsement, in December, 1887. This draft, subsequently embodied in the form of a bill, with slight modifications by the Finance Committee of the Senate, came very near enactment into law, the Senate passing it by a vote of twenty-seven to ten. In the House of Representatives it failed in the closing hours of the second session by a very few votes, and not by a direct vote, but on a motion to sus-

* The definition, or rather determination, of what constituted a "crude" or "raw" material for manufacturing purposes has always been a matter of embarrassment to legislators and economic writers, inasmuch as a confessedly manufactured and often elaborate product may be relatively a raw or crude material for successively higher grades or processes of manufacture. A proposition recently proposed by Mr. Lindley Vinton, of New York, to restrict the application of the above terms in law, commerce, and economics, to the state or condition in which any product *first* enters into trade or commerce, would seem to be so free from any ambiguity of meaning as to be worthy of consideration.

pend the rules, take the bill from the Committee of the Whole, and put it upon its passage. This motion, which required a two-thirds vote, was defeated—one hundred and six in the affirmative to sixty-four in the negative. It was thus made evident that, could the bill as it came from the Senate have been brought directly before the House, it would have passed by a large majority, and probably have quieted for years all difficult and disturbing legislation on this subject.

When the office of Special Commissioner expired by limitation in 1870, the appointment as chairman of a State commission, specially created for investigating the subject and laws relating to local taxation, was tendered to its late incumbent by the Governor (Hon. John T. Hoffman) of the State of New York, and accepted. This new position afforded an almost unprecedented opportunity and facilities for becoming acquainted with a practically new department of taxation; the taxes levied by the Federal Government being mainly of an indirect character, and subject to constitutional limitations; while those of the States are mainly direct, and practically subject to no limitations as to object, except as respects imports, exports, and the property and instrumentalities of the United States. The results of this new field of exploration were laid before the Legislature of the State of New York in the form of two reports (in 1871 and 1872), with an accompanying draft of a code of laws. The facts developed on this line of investigation, and which will be restated with much additional evidence in the following chapters, are generally regarded as antagonistic to the theory of taxation as accepted and taught by most economists, and incorporated into statutes by lawmakers. The Legislature to which these reports were submitted paid no further attention to them than to order their printing. They were, however, contrary to almost all precedent, reprinted in the United States and in Europe.

NOTE.—The writer would take this occasion to acknowledge his great indebtedness to the late Isaac Sherman, of New York, whose innate modesty and desire to avoid publicity alone prevented a general recognition by his countrymen of his great intellectual ability; and that this characterization is not unwarranted is proved by the fact that it was fully admitted by such men of his time as Samuel J. Tilden, Charles O'Conor, and Rev. Dr. Bellows; and also by the circumstance that he was the one man of all others that President Lincoln selected as his adviser in the most critical periods of the war, and to whom he repeatedly tendered the highest civil offices in his gift. Mr. Sherman took a deep interest in the work of the New York State Tax Commission; participated in its investigations; contributed to its councils a very thorough knowledge of the views of English, French, and German writers on taxation, and of the cognate opinions and decisions of American and European courts and jurists; and is entitled to equal credit for whatever of merit may pertain to its conclusions. If these conclusions, arrived at and expressed in the following chapters, do not meet the full concurrence of economists, the writer has the satisfaction of knowing that they received, in the main, the full indorsement of one so pre-eminently qualified to pass judgment upon them.

A STUDENT'S RECOLLECTIONS OF HUXLEY.

By Prof. ANGELO HEILPRIN.

IT was my pleasant fortune, a few years back, to have my name enrolled with a limited few in the registry book of the Royal School of Mines in London, destined for work at one of the ten or twelve tables which covered the greater part of the ground space of Prof. Huxley's laboratory. The building was a comparatively new one, having been erected as an adjunct to the new South Kensington Museum on Exhibition Road, and from the top floor looked out the various rooms in which we were to receive our tutorage from the great naturalist. A climbing flight of stone steps, with landings, wound round to this summit, to which at times of irregular journey also conducted a box "lift." On one of my daily upward saunterings I chanced to stumble upon my master. who, always a rapid walker, overtook me on the grand "round," and cordially greeted me as a fellow-traveler. Possibly I allowed myself a little to be overtaken, for, though I had already been in the workshop and lecture theater a number of days, and had answered questions on *Torula, Paramœcium,* and other low grades of organisms, and had even swallowed a good-natured rebuke for attempting to use a compound binocular in place of the simple, and confessedly clumsy, microscopes which were furnished gratuitously to the students, the opportunity to meet the man as man and not as teacher had not yet presented itself. Prof. Huxley's private rooms almost adjoined the laboratory, and frequently on passing the door the temptation grew strong upon me to knock and allow myself the honor of an interview, but each time a certain Tootsian timidity overcame me, and directed my course either to the right or to the left. The meeting on the landing was thus a deliverance, and Huxley allowed me to make the most of it by himself opening the conversation. It began with a reference to the deficiencies in modern building construction, particularly applied to the South Kensington annex, and evoked by the absence of proper mounting appliances. "Our lifts are not like the grand elevators in your country," remarked the professor—a thought in which it was not difficult to concur.

This first bit of extra-class conversation impressed itself forcibly upon my mind, both for the pleasure that it gave me and the surprise it occasioned in the knowledge that I was from American soil. No reference to foreign studentship had heretofore been made, and I was a little puzzled to know what kind of information had led to the betrayal of my personality. Considerably later I learned that a close friend of my father's, the late Prof. Youmans—himself a friend equally to science and to the scientific student—had addressed a personal note to Prof. Huxley, advising him of my presence and commending me in the usual way to a kind consideration and to an equally considerate esteem. It was characteristic of the justness and fairness of the master that this letter, while it may have paved the way to a more informal acquaintance outside of the class room, in no way influenced favoritism within, or saved me from sound criticism of my work when it merited it. This was not exactly at long intervals, and particularly do I recall the painful awaiting of judgment on a mangled dissection of the nerves of the frog. "Your blue papers are where the red should be, and the sympathetic is gone"—a piece of information, the basis of a portion of which had already only too keenly been realized.

At no time was criticism given in a way to hurt, and more commonly encouragement and commendation took the place of criticism. But a thing had to be really well done to call out praise, and an exuberance of it rarely broke an echo from the laboratory walls. On one occasion I was startled by the inquiry if my drawing—a drawing of the division lines in the cells of a certain water plant—was made from the object or from imagination, an inquiry which threw doubt in my mind as to whether I was receiving praise or condemnation. The representation was considered unusually true to Nature, but I was forced to admit that it was a combined product of the visual and mental eye, and not a mere transcript of Nature. This explanation was in no way a satisfaction to Prof. Huxley, who took the opportunity to admonish the class that drawings, however true they may appear to Nature, are only true when they strictly copy the objects which they are intended to portray.

Huxley himself was an excellent draughtsman, and it was frequently remarked of him, as it was also of our own Dr. Leidy, that had he devoted himself to painting, instead of to science, he would have forced himself to a position not less prominent as an artist than that which he occupied as a naturalist. He was always precise in his drawings on the blackboard, and if he could not, perhaps, like Prof. Weisbach, of Freiberg, jump to a circle and punch its middle point with a stub of chalk, he could, apparently without any hesitancy, draw the most complex anatomical constructions, and in such a way as to make every point clearly intelligible to the student. It was probably from the father's side that Mrs. Thomas Collier, *née* Huxley, who had well earned her several premiums from the fine-art institutions of London, inherited her tendencies and capabilities in the direction of painting. Inspired in a measure, probably, through his love for art, and with an inborn feeling for mechanical constructions, Prof. Huxley always held a kindly sympathy for all that pertained to the science of engineering; and he frequently expressed the thought, which will doubtless seem strange to many, that he had missed his vocation, and that the true field of his activities should have been the field of an engineer. Yet it is singular that with this proclivity for a branch of study which requires for its successful accomplishment a generous supply of mathematical stimulus, the fact that he was in no way a mathematician did not terrify Huxley. He frequently admitted that he had neither a liking nor an aptitude for figures, and it was a timely forethought in lecturing, when a condition required a mathematical calculation for its elucidation, to have the answer written in advance at one corner of the board. This, as was naïvely explained by the lecturer, was to avoid the easy possibility of an error creeping into an offhand calculation or problem in sums.

In lecturing to his classes Huxley adhered strictly to business, and it was rarely that a matter of levity was introduced to give merriment to his listeners. I recall, in a course of some seventy lectures, only a single instance of this kind, when, for some reason (no longer in my memory), a reference was made to Chamisso's Peter Schlemiel—a book which Prof. Huxley frankly admitted gave him more genuine pleasure than any other in nonscientific literature. Whether it was the refreshing frankness of this admission, or the fact in itself that was quoted, which on this occasion brought forth an unbounded merriment from his students, was perhaps not fully decided for all of us, but there was no questioning the spontaneousness of the applause which followed the utterance. And this, as I now recall it, was the only instance of applause greeting the lecturer in the middle of the lecture during the entire course of my studentship. Huxley, like Tyndall, was always careful to have his lectures fully prepared. A few notes jotted down on a fly-sheet of paper or in small note-books were the only guide for the full hour, which to most of the students passed very rapidly. There was no display of eloquence, no attempt to clothe description or explanation in floral verse, but everything was stated in terse and succinct language, although with due emphasis on important points, and this it was that made it easy to follow. These class lectures were naturally very different from public addresses, in which Huxley always maintained that wonderful dignity of expression and choice rhetoric which have been the despair of his combatants, scientific no less than clerical, and have for all time rendered classical that which he has chosen to put in print.

Contrary to what is generally supposed, Huxley was not a ready speaker, or perhaps it would be more true to say that his deliverances were not unaccompanied by stage fright, or a nervous uneasiness which frequently required for its subjugation a strong mental effort. It was this that told heavily on his health, and more than once the quiet resolve had been made to forever abandon the public platform. I was present on one occasion at a rather extensive gathering where, following a few after-dinner remarks by Sir Joseph Hooker, Prof. Tyndall, and Sir Wyville Thomson, Huxley, contrary to previous agreement, was also called upon for a few words, and with the pleasing introduction (as nearly as I can now recall the passage), "There is one among us who, by reason of his witty tongue and ever-readiness, it is a pleasure to call upon."

Following the applause which greeted his name—the mention of which was unmistakably a disagreeable surprise to the one more particularly concerned, Huxley took occasion to explain in emphatic language that were it only generally known how much of an effort it cost him to speak, his friends would willingly allow him more peace, and save the lingering wreck of his bodily frame. This admission—which was followed by a short but most happy *ex-tempore* utterance—appeared to me so strange that I was determined on the first proper occasion to obtain at first hand its true meaning. The opportunity presented itself a few days later, immediately after the conclusion of a stirring public address (read from manuscript) on "Sunday Opening," if by this name we may designate the liberty of displaying and using on the Sabbath-day collections of books and paintings, museum and other treasures, and of listening to scientific discourses. Dean Stanley and one or two other speakers had preceded him, but manifestly the audience was waiting for the speaker of the occasion. A more brilliant and incisive arraignment of those who by legal process attempted to forever remove from the workingman his one day of self-improvement could hardly have been formulated, and the speaker was greeted with vociferous applause. Meeting him on the way homeward from the lecture hall, I asked for a significance of the explanation made a few evenings before at the dinner table, for it did not seem possible to me that one gifted with such fluent powers of speech, and backed by an almost unfathomable fund of knowledge, could feel any fear or hesitancy in speaking, no matter what the occasion. In his answer, Prof. Huxley repeated in substance what he had before said, only more clearly emphasizing the nervous fear with which he mounted the platform. He then assured me that he might have saved himself an African journey, undertaken for health recuperation, had he abstained from public deliverances.

It has been frequently assumed that Huxley cared for little beyond science, and especially for that side of it which was combative either with the Church or with the State, but nothing could be further from the truth than the belief that this was in fact the case. It is perfectly true that Huxley used all the vigor of speech of which he was capable to emphasize what he considered to be the proper position of science in any education, and perhaps he even considered the acquisition of scientific knowledge to be of more importance than any other form of learning, but he was always careful to emphasize that education was only such when it was broad and comprehensive, when it comprised not only science, but in addition a goodly share of the world's history and literature. His own resource in the fields of literature (English, French, German, and Italian) and history was prodigious, and he rarely was at a loss to instantly take advantage of a citation from some early scholar to demolish at first or second hand an adversary at arms. When I was in London he was reading, with the assistance of a friend, Russian, and mainly for the purpose of fully familiarizing himself with the work of the great anatomist, A. Kovalewski, whose writings he was seemingly the first to bring to the critical notice of English-speaking naturalists. It was this thorough familiarity with what one is almost tempted to call universal knowledge that made Prof. Huxley such a dreaded foe to his enemies, and it has well been remarked, "Woe be to him who attempts to measure arms with such an antagonist!"

Huxley was a firm believer in thorough knowledge, and he took no stock in brain-stuffing; to have known a thing once, and to be able to put your hand upon it when you again want it, was his maxim. The opening address delivered by him before the Johns Hopkins University, in 1876, gives the keynote to his position in the matter of special training. "Know a thing directly," he often remarked, "and do not assume that you know more of it by knowing *around* it." He had no patience with those who spoke with a pseudo-authority begotten of chance, and was bitter in his denunciation of officialism as affording a pretext for either defending or attacking scientific dogma. An interesting anecdote, which Prof. Huxley himself related to me, shows the occasional happy frame of mind in which our *savant* found himself when he, in turn, was receiving blows. A prominent bishop of the English Church, whose name it is not here necessary to mention, had been for some time endeavoring to smash the Darwinian hypothesis through some actual researches in zoölogy which he claimed to have undertaken. Toward the accomplishment of this laudable effort he used many pages of the current magazines and equally many columns of the daily press, in each of which the "undernurse of Darwinism" came in for an uncommonly large share of ridicule. Finding that none of these papers brought forth any comment from Prof. Huxley, their author in a personal letter called his attention to them, at the same time asking to be advised as to what particular course of reading would most readily enable him to grapple with the various scientific questions which at that time agitated the world. Prof. Huxley's full and laconic answer was, "Take a cockroach and dissect it." No further inquiry came from that source.

I once found Prof. Huxley much depressed over a small paragraph which also touched, and in a very depreciatory manner, the evolutionary hypothesis, which had been contributed to the daily press by his friend Carlyle. He greatly deplored the recklessness of the utterances contained in the squib, and especially painful to him was a markedly undignified reference to the one man for whom Huxley had a greater reverence than for any other—Charles Darwin. To my interrogatory as to whether he considered it necessary to reply to the paragraph, he promptly and emphatically answered, "No!"

Remorseless as Huxley occasionally was in the cold exposition of the blunders of his colaborers in science, he was usually very lenient to those who pointed out his own mistakes. I remember one occasion when a post-graduate student of the Royal School of Mines, Patrick (now Professor) Geddes, intimated to the professor that his interpretation of the mechanism of the radula in the common garden snail, as was set forth in the Anatomy of Invertebrated Animals, was not supported by the newer laboratory dissections. Prof. Huxley's response was a request of Mr. Geddes to try a new dissection; it was done, and it was found that the pupil was right and the master wrong. Only once do I recall when a correction was received with a regret almost akin to displeasure—the case of the *Bathybius*, the all-pervading protoplasm of the oceanic deep. When Sir Wyville Thomson separated this substance as a mineral precipitate, it smashed a thought that had already become pregnant with English and German naturalists, and which threatened to become of genuine usefulness in explaining the origin and development of the organic life forms of the earth.

Among his many eminent scientific contemporaries there were few for whom Huxley had greater admiration than the German morphologist, Gegenbaur, and Karl Vogt; the latter he regarded as a tower of strength and in a certain sense a genius. When, nearly two years after leaving London, I returned to my alma mater and informed my past master that I had in the meantime been enrolled as a student, although in the class of paleontology instead of zoölogy, under Vogt, he appeared to be really pleased, and expressed himself freely on the advantage of being guided by so eminent an authority and so liberal a thinker as was the self-imposed exile of the University of Geneva. And in truth it must be admitted that there was much in Vogt that reminded me of Huxley. Like the latter, he was fearlessly outspoken in his utterances. Witness his tirade against the late Emperor William of Germany, delivered as a protest against the expenditure of the state's money on bronze and iron cannon when it could have been more humanely and profitably used in the purchase of the then recently discovered second specimen of *Aarchæopteryx*—that strange fossil hybrid connecting bird and reptile which has since found its way to the Berlin Museum. Like his English prototype, Vogt was also an admirable lecturer, fluent in diction and facile with the crayon, but it can hardly be claimed that either the quality or the tone of his lectures was fully representative of the scholarship of their author.

Vogt never allowed the opportunity of a pun to escape him, and his *bons mots* were at times hardly more elegant than they were appropriate; but, for all that, he was very popular, and equally so with the few women students of his class as with the men. He spoke in French with a decided German intonation, frequently relieving himself of a sigh brought about by an uncomfortably asthmatic condition. His powerful bodily frame, disproportionably shortened through a generous development of tissue about the equatorial region, was in marked contrast to the tall and nearly upright carriage of Prof. Huxley, whose slightly stooping head and shoulders reduced somewhat what might otherwise have been considered a more than average height. Huxley never entered the class lecture room except in a dress in which he was immediately prepared to go to the street; Vogt rarely appeared without a coat which did not in one or more places show visible signs of underlying shirt sleeves. The presence of women in no way affected his *Wohlgefühl,* and in truth it must be said that this class of students was to him in a measure a blank, as he invariably addressed the class only as "*Messieurs.*"

Among the many warm friends and admirers that Huxley numbered within the ranks of the scientific fraternity there was none who was more enthusiastic in his admiration of the great man than the distinguished comparative anatomist of the Royal College of Surgeons, the late Prof. Kitchen Parker. An afternoon and evening spent at the home of this most genial and all-overflowing host serves my memory as the record of one of the pleasantest incidents of my student life in London. Huxley and Parker had not many years before announced their new classification of birds—worked out conjointly on characters founded principally on the position and construction of the bones of the palate and beak—and the stir which that radical departure in classification brought out had not yet subsided. Prof. Parker was still largely engaged in proving his case, and was naturally, to use an expression that is less elegant than determining, full of it. The overjoyful manner in which he pointed out a confirmatory character here and there, or an exception to the rule elsewhere, kindled a glowing enthusiasm within the listener to follow in the line of the master, and a desire to make immediate friends with basi-sphenoid and pterygoid bones. Drawer after drawer of neatly prepared bird skulls, colored in correspondence so that identical or homologous parts could be immediately detected, were pulled out and hastily scanned over; but the explanations that were given, whatever they might have been, were liberally sprinkled with admiration for the genius of Huxley—who first broke into the method which Parker so successfully elaborated—a second to whom was not to be found in all Britain. I shall not easily forget the ocular gleam of pleasure, perhaps even delight, with which Prof. Parker announced dissent on certain anatomical points from the opinions of his friend and colaborer. The following very graceful tribute to the clearness of Prof. Huxley's expositions appears in this author's article on Birds, contributed to the ninth edition of the Encyclopædia Britannica (page 717): "The writer will often use the very words of Prof. Huxley, despairing as he does of coming near that excellent writer either in condensation or order."

Huxley, as is well known, was a master hand in the construction of the English language. For elegance and force of diction he had no superior—perhaps not even an equal—among the writers of his day, and there are few purely literary men whose productions maintain so uniformly a high quality of excellence. In borrowing from the decorative side of language, he never allowed the embellishment of phrases to interfere with the clear statement of what he had to convey either by word of mouth or of pen, or to in any way cloud his meaning. Friends and foes thus knew his position precisely, and he was always taken on his own recognizance. A strict adherence to the sequence of truth, fact, and a logical deduction from facts, was his maxim, and it was this that assured his ground for battle, and carried him triumphantly through nearly all his combats. As has before been remarked, Huxley took little stock in brain-stuffing, yet it can in no way be complained of that his own brain was "of the empty kind." The range of topics that his conversation touched was almost bewildering, yet so discreetly was his knowledge dispensed that oftentimes one assumed that he was making an inquiry, when, in fact, he was giving the answer to it. Well do I recall a meeting on Brompton

Road when the conversation almost immediately turned upon American racing and race horses, a topic on which I was obliged to confess myself an absolute ignoramus by the side of my interlocutor.

A few parting words. In 1893 I had the pleasure of being constituted one of a committee of five on the award of the Hayden Memorial Medal of the Academy of Natural Sciences of Philadelphia—a medal (and accompanying fund) awarded for meritorious work in the domain of geology and paleontology. The award was made unanimously, and almost without discussion, to Prof. Huxley, and his name thus appears in association with the names of James Hall, Cope, Suess (of Vienna), and Daubrée (of Paris), other recipients and masters in a field with which the labors of Prof. Huxley are not very generally associated. The following characteristic reply, acknowledging the receipt of the award, was addressed to the Academy.

HODESLEA, STAVELY ROAD, EASTBOURNE, *January 4, 1894.*

GENTLEMEN: The Hayden Memorial Medal, with your draft (which will incorporate itself into an ornament for my wife's drawing room), reached me the first of the month, a New-Year's gift of a value quite unexampled in my experience. I am very sensible of the great honor which the Academy of Natural Sciences of Philadelphia has conferred upon me—a retired veteran who has much reason to suspect that he has already received quite as much promotion as he has deserved.

But increasing years, if they bring a diminution of variety (I am not sure they do), leave the desire for the esteem of those who have a right to judge us intact, perhaps intensify it; and I beg leave to assure you and your colleagues—fellow-workers of Hayden and of Leidy—that the kindly and sympathetic terms of your award have given me very great pleasure.

With all respect, I have the honor to be, gentlemen,

Your obedient servant and colleague,

THOMAS HENRY HUXLEY.

It is not for the student to sum up either the quality or the quantity of the labors of his teacher and master, but for those who still doubt—and there are some such—the justice of the position which has by almost common consent been given to Huxley in the realm of science, it may be recommended as a healthy exercise to carefully read the titles of the hundreds of papers with which this indefatigable writer, for the better part of half a century, has crowded the pages of scientific journals and popular magazines; and after that, with equal care, the inquirer into fame will take an advantageous turn in mastering the papers to which these titles relate. Huxley was great not because he correctly deciphered the history of a fossil bone, not because he probed deep into the anatomical or physiological mysteries of the living world, nor yet for the reason that he was well-nigh the first—one might say, indeed, the first—to pound the truths and consequences of evolution into the material world, but because in addition to these accomplishments, and much more, he molded the tendencies of modern thought, and to a greater extent than any scientist of his generation with the exception of Charles Darwin. Well could this great philosopher observe that, had it not been for Huxley, the acceptance of the evolutionary hypothesis would have been removed from us by probably at least a generation.

THE BOTANICAL GARDEN OF BUITENZORG, JAVA.

By M. ALBERT TISSANDIER.

THE importance of establishing botanical gardens—the utility of which is incontestable—in suitable spots, and particularly in its colonies, has been perceived by nearly every nation. The English, as early as 1786, planted a very fine garden at Calcutta, under the direction of Colonel Robert Hyde; and in 1821 they created the Garden of Peradeniya, near Kandy, in Ceylon. The French Government has laid out interesting botanical gardens at Saigon, in Cochin China, and on the island of Réunion.

The Dutch established in 1817 the Garden of Buitenzorg, on the island of Java, and have made it the finest in the world. It is situated on one of the long ridges that descend on the north from the Salak Mountain to two hundred and eighty metres above the level of the sea. In 1857 the garden was arranged by M. Hasskari, botanist at the time, and at the suggestion of M. Diard, director of a French Natural History Society, into sections, in which the plants of the same family were grouped together. As a result of this scientific organization, which then existed only incompletely in other gardens, the establishment took the first rank. It possesses other considerable advantages growing out of the exceptional importance of its collections of all tropical species, and the generous hospitality with which it receives all foreign naturalists who resort to it for study. The present director, Dr. Treub, an accomplished botanist, has labored constantly for the improvement of the plantations. The garden has been much enlarged within recent years.

The Dutch Government has comprehended from the very foundation of this establishment that a single botanical garden would not be enough, and has supplemented it with annexes. The gardens supported by the state are divided into three parts: the botanical garden of Buitenzorg, the most celebrated, the surface of which covers one hundred and forty-eight acres and a quarter, situated in the city next to the residence of the governor; the agricultural garden of Tjikeumenh, of one hundred and seventy-

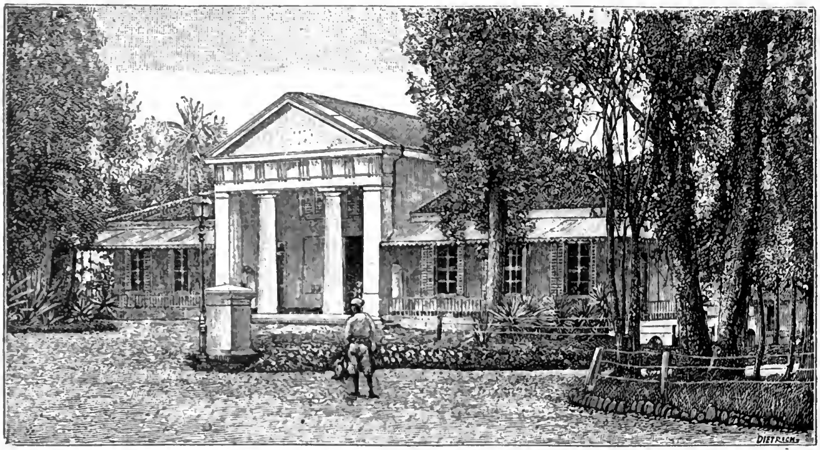

Fig. 1.—Entrance to the Museum of Herbaria, Botanical Garden of Buitenzorg, Java. (From a photograph.)

three acres; and the garden of forestry, with a reserve in the virgin forest, which together occupy seven hundred and forty-one acres.

The climate of Buitenzorg and its vicinity is especially favorable to the development of plants. It is at the same time very warm, the mean temperature being 82° or 83° F., while during the dry monsoon the thermometer may rise to nearly 90° F. The constant moisture, afforded by a rainfall that amounts to more than twelve feet of water a year, gives the culmination of these conditions. In Holland, where it rains a great deal, the annual mean is only about twenty-six inches.

A number of the trees in the garden have grown extraordinarily. Some palm trees of the genus *Oreodaxa*, planted when very young along the borders of an alley, grew in five years to a height of more than thirty-two feet; while plants of *Albizzia Moluccanna* grew in the same time to about sixty-five feet. The section of palms, the ferns, climbing plants, and gigantic lianas surpasses in interest all that can be found in any other botanical gardens.

As a result of the perfect scientific arrangement of the garden, the stranger, with a plan in his hand, which is furnished gratuitously to all who wish to work there, can find his way at once to whatever section he is most interested in. Numbers, referred to the catalogue, are marked on each species of the several families. When foreign students arrive, they are received immediately by the director, and assigned a place in the grand laboratory where they can study as they will, free of charge. A small library of the books most in demand and all the materials needed for experiments are kept conveniently at hand in the great room. A photographic laboratory is very near; next is the great laboratory containing the old botanical books and a complete collection of modern periodical publications of all countries. These journals represent all subjects related to botany, agricultural chemistry, and pharmacy. This library is situated in the pavilion containing the collection of herbaria, and behind this is the laboratory where poisonous plants are studied. In buildings by the side of these are collections representing all the forest plants of the country.

The agricultural garden of Tjikeumenh is twenty minutes' carriage ride away. The road is a charming one, bordered by villas with luxuriant flower gardens and fine trees. Strangers can also work in this garden, as at Buitenzorg, and are given separate laboratories, arranged somewhat like those in the museum at Paris. To the garden of forestry is a ride of five hours. The

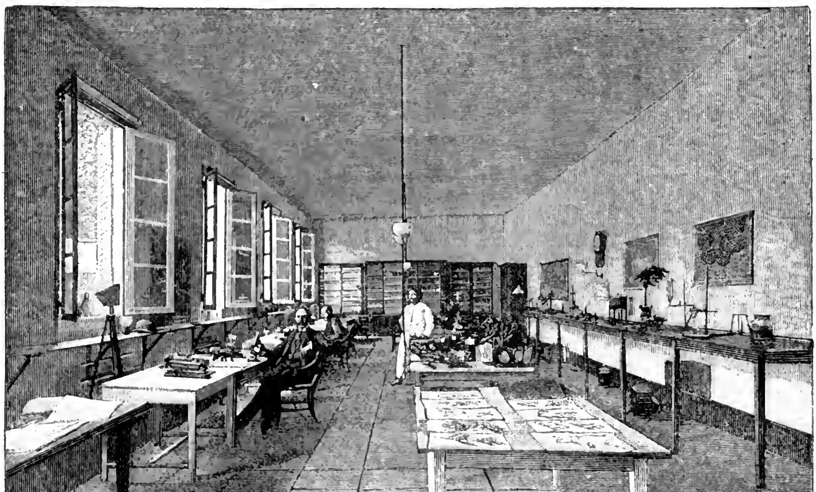

FIG. 2.—LABORATORY OF THE BOTANICAL GARDEN AT BUITENZORG. (From a photograph.)

excursion is one for which supplies have to be taken, but the country is a very fine and picturesque one, and the time passes without our thinking that we have been long on the road. The pavilion of Tjibodas, where visitors are received, is situated at an altitude of about fifteen hundred metres, and contains every desirable comfort. Foreign students have the privilege of a saloon furnished with a library and a large room for work. A dining room and a few bedrooms are provided, for there is no hotel. The garden of forestry, situated about halfway up the old volcano of Gedé, is planted chiefly with Australian and Japanese trees and shrubs. Of these, perhaps the most remarkable are the curious specimens of the Australian *Xantoroa actinis* in front of the mountain pavilion. The forest of Tjibodas, in which the garden is placed, is a remarkable one. Paths have been traced which lead by numerous windings to interesting spots, up to the height of about two thousand metres. Outside of these paths one could not go three steps on account of the impenetrable thickness of the woods. The ground is carpeted with a world of mosses and finely

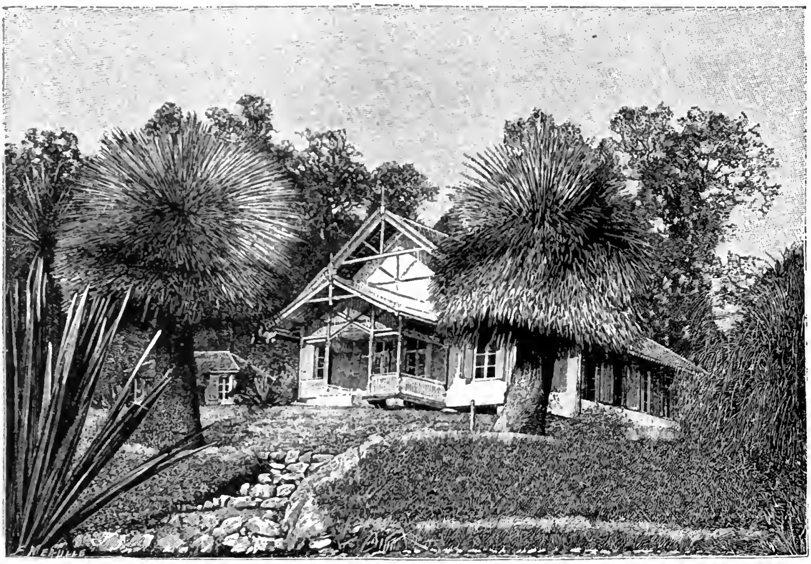

Fig. 3.—Reception Pavilion for Foreign Students in the Forest Garden of Tjibodas. Java. (From a photograph.)

cut ferns, of the most surprising and various forms. In the trees of from one hundred to one hundred and twenty feet high are masses of orchids, ferns, and lianas to make one dream, away up to the topmost branches. The lianas in some places form complete stalagmites of verdure, so thickly covered are their supple stems with mosses and broad-leaved parasites. They form an inextricable but transparent network, through which the rays of the sun pass to lighten up the minutest details of these rare beauty spots.

The vegetation varies constantly as we ascend the slope of the Gedé, and seems to grow more and more interesting.—*Translated for the Popular Science Monthly from La Nature.*

HELIUM, ITS IDENTIFICATION AND PROPERTIES.

BY PROF. C. A. YOUNG.

THE famous "D_3," so called because it is very near the D lines of sodium, is a bright yellow line in the spectrum of the solar chromosphere, in which it is more conspicuous than anything except the C and F lines of hydrogen. Unlike them, however, it has no corresponding dark line in the ordinary solar spectrum, a rather perplexing fact which has caused much discussion, and has not even yet found an explanation in which all authorities agree.

It was discovered in 1868, when the spectroscope was for the first time directed upon a solar eclipse. Most of the observers supposed it to be the sodium line, but Janssen noted its non-coincidence; and very soon, when Lockyer and Frankland took up the study of the chromosphere spectrum, they found that the line could not be ascribed to hydrogen or to any other known terrestrial element. As a matter of convenient reference Frankland proposed for the unknown substance the provisional name of "helium" (from the Greek "helios," the sun), and this ultimately, though rather slowly, gained universal acceptance.

Within a year, two other lines (λ 7,065 and λ 4,472) were discovered in the chromosphere spectrum by Rayet and Respighi respectively, which like D_3 are always present in the prominences, but have no corresponding dark lines. It was of course early suggested, but without proof, that these lines might also be due to helium. Since then some eight or ten other lines have been found, frequently, but not always, presenting themselves in the chromosphere spectrum, and, like the first three, also without dark analogues. Moreover, still more recently, D_3 and its congeners have been detected in the stellar spectra—*dark* in the spectra of the "Orion stars," *bright* in the spectra of certain variables and of the so-called Wolf-Rayet stars; and *both bright and dark* in β Lyræ and the "new star" of Auriga which appeared in 1892.

Naturally there has been much earnest searching after the hypothetical element, but until very recently wholly without success; though it should be mentioned that in 1881, Palmieri, the director of the earthquake observatory upon Vesuvius, announced that he had found D_3 in the spectrum of one of the lava minerals with which he was dealing. But he did not follow up the announcement with any evidence, nor has it ever received any confirmation, and from what we now know as to the conditions necessary to bring out the helium spectrum, there is every reason to suppose that he was mistaken.

The matter remained a mystery until April, 1895, when Dr. Ramsay, who was Lord Rayleigh's chemical collaborator in the discovery of argon, in examining the gas liberated by heating a specimen of Norwegian clèveite, found in its spectrum the D_3 line, conspicuous and indubitable. The mineral was obtained from Dr. Hillebrand, one of our American chemists, who had previously studied it, and ascertained that it could be made to give off a gas which he identified with *nitrogen*. It really was nitrogen in part, but Ramsay suspected that he should also find *argon*, as he did—and helium besides, which was unexpected.

Clèveite is a species of uraninite or pitchblende, and it soon appeared that helium could be obtained from nearly all the uranium minerals, and from many others; from many, mingled with argon; from others, nearly pure. In fact, it turns out to be very widely distributed, though only in extremely small quantities, and generally "occluded," or else in combination—seldom, if ever, free. It has been detected in meteoric iron, in the waters of certain mineral springs in the Black Forest and Pyrenees, and Kayser even reports traces of it in the atmosphere at Bonn.

It is generally obtained by heating the substance that contains it in a close vessel connected with an air pump of some kind by which the liberated gases are drawn off and collected. They are then laboriously treated to remove as far as possible all the foreign elements (nitrogen, etc.), since the presence of no more than five or ten per cent of other gases prevents the new elements from giving any spectroscopic evidence of their presence; they are too shy and modest to obtrude themselves. In many cases, as has been said, argon and helium come off together, and certain lines in their spectrum are nearly coincident, so that for a time there was supposed to be some close bond of connection between them. The latest observations, however, make it certain that this is not so: as Mr. Lockyer puts it, "argon is of the earth, earthy, but helium is distinctly celestial."

Its spectrum has been thoroughly studied by Crookes, Lockyer, and Runge, who agree as to all its leading characteristics.

Runge, whose work is the most complete and authoritative, finds that its lines have a remarkably regular arrangement, falling into two distinct "sets," each set consisting of a principal series and two subordinate ones, the lines in each series corresponding very accurately to a formula quite similar to that discovered by Balmer as governing the hydrogen spectrum.

In the whole spectrum he finds (by photography mainly, though two of the most important were detected by the bolometer) sixty-seven lines, twenty of which only are in the visible part of the spectrum. Of the sixty-seven, twenty-nine belong to the first "set" and thirty-eight to the second. Of the twenty "visual" lines, thirteen have been observed in the spectrum of the chromosphere; the missing lines all belong to the second subordinate series of the first "set," and are so faint in the artificial spectrum of the gas that their failure to be found in the chromosphere needs no explanation.

The fact that the lines thus divide into two mathematically independent "sets" has led Runge to believe that the helium obtained from the minerals is really a mixture of two distinct gases, and he has found it possible to partially separate the two by a process of diffusion. The true helium, the element that gives D_3 and the other lines that are *always* present in the chromosphere spectrum, he considers to be the *denser* of the two; the spectrum of the other contains most of the lines that appear only occasionally in prominences. The lighter component has as yet received no name. Lockyer calls it simply X.

The lines of the series to which D_3 belongs are all *double*, having a very faint companion on the lower (i. e., red-ward) side, extremely close to the principal line. When Runge announced this discovery early in June it at first produced something like consternation among spectroscopists, for at that time there still remained more or less doubt as to the validity of Ramsay's identification, and the solar D_3 had never been observed to have such a companion. Very soon, however, Hale, Huggins, Lockyer, Reed of Princeton, and other observers who had sufficiently powerful instruments, detected the little attendant of D_3 in the spectrum of prominences, so that the momentary distrust was replaced by absolute confidence.

As to the physical and chemical properties of the new gas, our knowledge is still limited and our conclusions are embarrassed by the uncertainty whether we are dealing with a single element or a mixture—whether Dr. Ramsay has introduced to the world one infant or a pair of twins.

The gas liberated from clèveite, and purified as far as possible, shows a density just a little more than double that of hydrogen, and is therefore much lighter than any other known gas except hydrogen itself. If it is a mixture, the lighter gas must have a density less than two, and may even prove to be lighter than hydrogen; while the true D_3 helium may have a density anywhere between two and four, depending on the proportions of the mixture and the density of the lighter compound. In any case both the true helium and X are lighter than anything else but hydrogen.

It would be very fine, we may remark in passing, if the lighter component could have been identified with "coronium," but this seems impossible since the characteristic 1,474 line (λ 5,316) does not appear at all in the spectrum of terrestrial "helium" derived from any source whatever.

Ramsay's acoustic experiments tend to show that helium, like argon, is monatomic, but can hardly be considered conclusive. If he is right, the atomic weight of helium regarded as a single element would be not far from four; but thus far all attempts to make it enter into chemical combination have failed, though it seems rather probable that in the uraninite minerals it is held by stronger bonds than those of mere occlusion.

Olszewski has tried his best to liquefy the gas, but thus far unsuccessfully; the methods that have conquered every other gas, hydrogen itself included, have failed with helium—a circumstance very remarkable, since generally a denser gas liquefies more easily than a lighter one, and hitherto hydrogen has stood pre-eminent in its refractoriness. The fact that the gas is probably a mixture may explain his failure: air is more difficult to liquefy than either oxygen or nitrogen.

Probably the question has suggested itself to every reader how it happens that helium, so conspicuous in the atmosphere of the sun and many stars, should be so nearly absent from our own atmosphere and so scantily present in any form upon the earth. The answer seems to depend upon two facts—the chemical inertness of the substance and its low density.

According to Johnstone Stoney's deductions from the accepted theory of gases, no *free* gas of low density can remain permanently upon a heavenly body of small mass and habitable temperature, but the molecules will fly off into space. A particle leaving the earth with a velocity of about seven miles a second would never return to it, this "limiting velocity" depending upon the mass of the earth and its diameter. Now, according to the dynamic theory of gases, the molecules of our atmosphere are flying swiftly about with velocities (at ordinary temperatures) of from fifteen hundred to fifteen thousand feet per second; the heavier molecules, like those of oxygen and nitrogen, move comparatively slowly, but if any lighter gas, like free hydrogen or helium, is present, its molecules take up velocities several times more swift, and any that may happen to be near the upper limits of the atmosphere would be likely to be thrown off into space. In the case of the moon even the oxygen and the nitrogen would go, since she is so small that a velocity not much exceeding a mile a second would carry them off. If this is correct, it is easy to see why we now have no appreciable quantity of *free* hydrogen or other light gas in our atmosphere.

But while we have no atmospheric hydrogen to speak of, hydrogen *in combination* is extremely abundant; one eighth part by weight of all the water in the sea is hydrogen; and hydrogen combines freely with many other elements besides oxygen, so that we continually liberate it in all sorts of chemical decompositions. Helium, on the other hand, enters into combination most sparingly, is therefore scarce, and even when present is, as we have said before, not easy to detect.

SCIENTIFIC TEMPERANCE.

By DAVID STARR JORDAN.

AMONG the exhibits at the Columbian Exposition of 1893 was a map illustrating the progress of "scientific temperance" in the United States. On this map those States of the Union in which scientific temperance was a compulsory study in the schools were shown in white. Those States which had not yet reached this condition were shaded in black. The Northern States generally were white in color, while dark shades covered much of the region south of the Ohio and Potomac. From this dark area, however, one long black tongue stretched itself to the northward from the Ohio River to Lake Michigan, separating the whiteness of Ohio and the Northeast from that of Illinois and the Northwest. Indiana alone in the North was a stumbling-block in the triumphal march of the cause, the only district in which "science" and "temperance" were not hand in hand.

This map leads one to consider for a moment the educational history of Indiana, and especially the conditions under which instruction in human physiology becomes changed into "scientific temperance."

With a view to lessening the cost of school books, the Legislature of Indiana in 1889 passed an act directing the State Board of Education to contract with competing publishers for a uniform series of text-books for the State. By the terms of this law the standards were made high and the prices low, the low prices to be made possible by the large sales of the books chosen. In putting this law into action, the State Board of Education, of which the present writer was a member, made a good deal of interesting history, most of which need not be discussed here.

In the subject of human physiology the series of text-books chosen as the best was one written for this competition at the instance of a local publishing house. The author of this series is a teacher of biology, familiar with methods and results of scientific research, and who has also a large interest in the teaching of children. In the judgment of the Board of Education, one of the points of superiority in this Indiana series over other works offered in competition was the scientific way in which the difficult question of temperance was treated. In other words, the reasons for temperate living were stated as truths of science in the proper relation to other truths. But, as events have proved, this statement did not contain the essence of "scientific temperance." It is as sign of condemnation of the series adopted by us that the State of Indiana appears in black on the white charts of the "National Woman's Christian Temperance Union."

Let us, therefore, examine the teachings which are thus placed under ban. On pages 289, 290, and 291 (Advanced Lessons in Human Physiology: Indiana State Series), we read:

"Alcoholic Drinks.—The most serious and widespread derangement of the natural tastes is that caused by alcoholic drinks. Alcohol has been demonstrated to be a poison. Its continued use, even in what are called moderate quantities, will pave the way for many diseases, some of which are sure to overtake those who have the habit of using drinks with alcohol in them.

"Examples of the effects of the excessive use of alcoholic drinks are numerous and revolting enough in most communities to make the strongest of appeals against their use.

"When it is seen that by the means of alcohol an intelligent man may act without reason; that a kind-hearted man may become brutal to his most loved friends; that it may cause an honorable man to become a dishonorable one; that it may make a noble nature become one with the most depraved of tastes; when its use has over and over again been the cause of bitter disappointments, of intense suffering, and of crime, it would seem that vastly stronger reasons existed against its use than that of the mere fact that some slight changes in the tissues occur which might possibly be demonstrated. It is to avoid these most serious results that the use of alcohol is to be shunned, and not simply to avoid a differently shaped liver.

"The physiological effects of poison are generally much greater than the visible changes which they produce in the tissues would lead us to expect. Indeed, such effects can seldom be detected by the changes seen in the tissue cells.

"Strychnine produces powerful spasms, which end in death. It acts, it is said, on the spinal cord, but it would be hard to show any changes that it produces in the cells. And a knowledge of the changes it produces in the cells could not make us fear the poison any more than we do who know that it results in suffering and death.

"The Moderate Use of Alcoholic Drinks.—The most serious results so well known are, of course, from the effects of excessive use. But in the moderate use of these drinks there is constant danger, as has been demonstrated a countless number of times, that the 'moderate' may grow into the immoderate use.

"Even the continued moderate use of alcoholic drinks is, as has been said, almost certain to lead to some of the many forms of disease which are ready to invade some portion of the body that has had its processes of nutrition for a long time thus disturbed. If we now add to this the constant imminent danger of the growth of an already abnormal appetite for such drinks until it leads to excess in their use, which is so revolting in its every aspect, is there not enough to deter one from even a moderate cultivation of this dangerous appetite?

"NARCOTICS.—There are a number of other poisons whose use the body at first endures, though with considerable protest, but which finally have the effect to cultivate a demand for the poison that generally ends seriously or fatally.

"Among the most dangerous of these is morphia, which appears in many forms of medicine. The morphine habit is fully as dangerous as the alcohol habit.

"The tobacco habit, while it does not compare with those just discussed in the seriousness of its results, is of no benefit, is of great and useless expense, and is often the direct cause of a derangement of the healthy actions of the body. Its use has been demonstrated to be very dangerous to the young. It is a habit easily avoided, and one that no one who has formed it would advise you to form."

As soon as this book with its associate (Primary Lessons in Human Physiology) came into use, agitation was begun against it, not because of any defect in its science, not because its stand was not strongly against the use of stimulants and narcotics, not because of any lack of fitness in its methods, but because it was not a book of "scientific temperance."

At last, after some four years of agitation, an act was passed in Indiana by which "scientific temperance" must be forced into those books, or the books themselves taken out of the schools.

I have not the text of the Indiana law at hand, but I understand that it is based on a law lately enacted under like influences in the State of New York. The full text of the New York law is as follows:

"To amend the consolidated school law providing for the study of the nature and effects of alcoholic drinks and other narcotics in connection with physiology and hygiene in the public schools.

"The people of the State of New York, represented in Senate and Assembly, do enact as follows:

"SECTION 1. Sections 19 and 20 of Article XV of the consolidated law are amended to read as follows:

"19. The nature of alcoholic drinks and other narcotics and their effects on the human system shall be taught in connection with the various divisions of physiology and hygiene as thoroughly as are other branches for not less than four lessons a week for ten or more weeks in each year in all grades below the second year of the high school in all schools under the State control or supported wholly or in part by public money, and also in all schools connected with reformatory institutions. All pupils must continue such study till they have passed satisfactorily the required primary, intermediate, or high school test in the same, according to their respective grades. All regents' examinations in physiology and hygiene shall include a due proportion of questions on the nature of alcoholic drinks, tobacco, and other narcotics, and their effects on the human system. The local school authorities shall provide facilities and definite time and place for this branch of the regular course of study. All pupils who can read shall study this subject from suitable text-books, but pupils unable to read shall be instructed in it orally by teachers using text-books adapted for such instruction as a guide and standard, and these text-books shall be graded to the capacities of primary, intermediate, and high school pupils. For students below high-school grade they shall give at least one fifth their space, and for students of high-school grade shall give not less than twenty pages to the nature and effects of alcoholic drinks and other narcotics, but pages on this subject in a separate chapter at the end of the book shall not be counted in meeting the minimum. No text-book on physiology not conforming to this act shall be used in the public schools except so long as may be necessary to fulfill the conditions of any contract existing on the passage of this act.

"20. In all normal schools, teachers' training classes, and teachers' institutes adequate time and attention shall be given to instruction in the best methods of teaching this branch, and no teacher shall be licensed who has not passed a satisfactory examination in the subject and the best methods of teaching it. No State school money shall be paid for the benefit of any district, city, normal, or other school herein mentioned until the officer or board having jurisdiction and supervision of such school has filed with the officer whose duty it is in each case to disburse the State school money for such school an affidavit made by such officer, or by the president or secretary of such board, that he has made thorough investigation as to the facts, and that to the best of his knowledge, information, and belief all the provisions of this act have been faithfully complied with during the preceding year.

"SEC. 2. This act shall take effect August first, eighteen hundred and ninety-five."

Thus it comes to pass that Indiana is at last in line with her sister States, and her children shall no longer be ignorant of "scientific temperance," if text-books can give them knowledge. And it seems that text-books must do so, for nowhere else in the world can this kind of knowledge be obtained.

What is "scientific temperance"? What it is not we know from the above quotation from the ill-fated Indiana physiology. A strong statement of the reasons for abstinence from the use of stimulants and narcotics evidently does not suffice. Whatever of science or temperance may be in the Indiana series, it is clearly not "scientific temperance," else these years of agitation have been in vain.

To decide what "scientific temperance" is we must do as the children do. We must turn the leaves of our text-books till we find the answer; for "scientific temperance," like "Christian science" or "manly art," is not an expression which defines itself. To find a definition we must go to the source of information. Let us, then, select a series of physiologies approved by the leaders in the movement for "scientific temperance"—books in undisturbed use in States more fortunate than Indiana.

Our Bodies and How we Live is one of the best written books of the class in question. We learn from its preface that "the author and publishers are under deep obligations to Mrs. Mary H. Hunt, the Superintendent of the Department of Scientific Instruction of the National Woman's Christian Temperance Union, who has carefully revised the book." There is therefore no question that we have the right book for comparison with the Indiana series.

That which first impresses us is the strange new censorship which is imposed on scientific teaching. We find, to quote from the unpublished letter of a friend, that—

"A small group of people who have no scientific education or training in general, and not the slightest training in the specific science of physiology, one of the most complex and difficult of sciences, manages to become the dictators of both the matter and methods of teaching of this science in almost all the States of the Union. They do not profess to control this teaching for the sake of advancing the science of physiology or of the intellectual advancement of the student, but for the promulgation of a specific reform. This reform is no more naturally connected with physiology than it is with history. The effects of alcoholic drinks on the history of the country could be traced with more clearness and more reason than its effects on the bones. How is it that history has escaped?"

In this case physiology is used as the name under which attacks on the use of alcohol are brought into the schools. There is a science of physiology, a science which treats of the life action of cells and organs, but this science has scarcely found its way into our system of education. It has been obscured by the ignorance of text-book makers who have never heard of its laws and principles. It is obscured by the popular demand for its association with hygiene. The knowledge of rules of health is most valuable, but it is not physiology. The real bases on which such practical generalizations rest are never simple, and in most cases they are beyond the reach of elementary text-books. The rules of health ordinarily given are not deduced from physiological laws. They are rather the expression of the experience of the race. Their introduction into books on physiology is perhaps justified by their utility. But their presence interferes with the development of the science. In an ideal educational arrangement hygiene will have a place to itself, and will not crowd out physiology any more than it will chemistry or physics. The anti-alcoholic material demanded in "scientific temperance," in all its various grades, takes all form of scientific impartiality away from the discussion of hygiene, while physiology being mere science is crowded out altogether. In the book in hand all proportion of parts is lost sight of, while the effort to teach physiology as science is virtually abandoned.

If physiology is not wanted in the schools, let us give it up. But if hygiene is to be substituted, let us have it from pure sources. The rules of health should come from those who have made them a life study, using the methods and tests of science. If temperance is the sole important part of hygiene, let us again demand the words of the highest authorities. Let us incite to sobriety by the words of soberness, not by the battle-cries of the Crusaders.

By casting aside the orderly development of the science of physiology we may find place anywhere in our text-books for discussions of alcohol and its effects. In Our Bodies and How we Live we find sixty-seven pages devoted to it out of a total of four hundred and twelve. The corresponding book of the Indiana Series has but two pages in three hundred and one. And in the former work this matter is not gathered together in one place, where it might be disposed of in one lesson, or even omitted by the evil-minded teacher, but it is diffused throughout the book, so that no topic or discussion is free from allusions to it. In no part of the volume can we escape from the contemplation of the ravages of alcohol.

For example, we have in the description of the bony framework (page 40) a discussion of "the effect of alcohol and tobacco on the bones," as follows:

"Since the bones constitute the framework of the body, a person's form depends upon the size and shape of his bones. The bones grow during childhood and youth; whatever growth one loses during that time can not be afterward made up. It is the testimony of sagacious physicians that alcoholic drinks and tobacco tend to check the growth of the bones.

"The smoking of cigarettes is especially hurtful to growing boys, because such a habit tends, besides other harmful things, to dwarf the growth of the bones. A well-developed form is something to be prized. No wise boy or girl will risk attaining it by indulging in filthy or injurious habits while young."

Under Physical Exercise (page 68) we have:

"THE EFFECT OF ALCOHOLIC LIQUORS AND TOBACCO ON PHYSICAL EXERCISE.—The main object of physical exercise is to get our bodies into such a condition, and to keep them in that condition, whereby the average amount of working power can be utilized at any time without harm to the bodily health. To keep up this amount of physical power and endurance we must be obedient to certain great laws of health.

"One of these laws, which never can be violated with impunity, is that which forbids the use of alcoholic liquors and tobacco. Strong drink and tobacco will put to naught the most elaborate system of physical training.

"Those who train athletes, baseball and football players, oarsmen, and all others who take part in severe physical contests understand this, and rigidly forbid their men to touch a drop of alcoholic drink, or even to smoke or chew tobacco. Experience has proved beyond all doubt that strong drink is a positive injury, either when men are in training for or undergoing contests demanding long-continued physical endurance.

"The same law holds good in the ordinary physical exercises of everyday life. Alcohol and tobacco act as poison to the nerve force which controls the muscles, and thus lessen the amount of muscular power and endurance.

"The demands of modern life call for a sound body rather than a strong body. Neither is possible to those who indulge in alcoholic drinks or tobacco."

In like manner, at the end of every chapter, the effect of alcohol and tobacco, like the refrain of a song, comes in to recall the real motive of the whole. There is a long and essentially accurate account of the origin and formation of alcohol. Another chapter gives experiments to be performed with this fluid. At the end of the book, in an appendix, are twenty pages of notes, collected from all sorts of authorities—some good, some doubtful, some worthless—"concerning the nature and effects of alcoholic drinks and other narcotics." A strong case is there made against these evil agencies, and no testimony in mitigation is allowed or even hinted at. For easy reference the following table of the chapters on alcohol is given (pages 329, 330), which shows the thorough saturation of the work with the alcohol idea:

1. The Bones (chap. ii, p. 13).	Effect of alcohol and tobacco on the bones (35).
2. The Muscles (chap. iii, p. 42).	1. Effect of alcohol on the muscles (44). 2. Effect of alcohol on strength (45). 3. Effect of tobacco on the muscles (46).
3. Physical Exercise (chap. iv, p. 56).	Effect of alcohol and tobacco on physical exercise (58).
4. Food and Drink (chap. v, p. 70).	Effect of drinking tea and coffee (72).
5. Origin and Nature of Fermented Drinks (chap. vi, p. 81).	1. Change produced by fermentation (74). 2. Ferments and what they do (75). 3. Alcohol a poison (76). 4. Narcotic poisons (76). 5. The alcoholic appetite (77). 6. The evils of overdrinking (78). 7. Wine, and why it should be avoided (79). 8. Beer: Its origin. Relation to drunkenness (80). 9. Distilled liquors (81). 10. The cost of the alcoholic vice (note, p. 89).
6. Digestion (chap. vii, p. 92).	1. Effect of alcohol on the stomach digestion (99). 2. Effect of alcohol on the liver (100). 3. Effect of tobacco on digestion (101).
7. The Blood and its Circulation (chap. viii, p. 122).	1. How alcohol gets into the blood (117). 2. Effect of alcohol on the circulation (116). 3. Effect of alcohol on the heart (119). 4. Effect of tobacco on the heart (120).
8. Breathing (chap. ix, p. 142).	1. Effect of alcohol and tobacco upon the lungs (132). 2. Alcohol and the bodily heat (133). 3. Alcohol in hardship (note, p. 160).
9. How the Body is Covered (chap. x, p. 161).	Effect of alcohol and tobacco upon the skin (145).
10. The Nervous System (chap. xi, p. 177).	1. Narcotics (162). 2. General effect of alcohol on the nervous system (163). 3. Effect of alcohol on the brain tissue (164). 4. Final result of alcoholic poisoning (165). 5. Inherited craving for alcohol (166). 6. Tobacco and its use (167). 7. Evil effect of tobacco (note, p. 203). 8. Effect of tobacco upon young people (168). 9. Tobacco from a moral point of view (169). 10. Opium (170). 11. Practical hints about opium (171). 12. Chloral and other poisons (172).
11. The Special Senses (chap. xii, p. 210).	Effect of alcohol and tobacco on the special senses (196).
12. Excretion (chap. xiii, p. 235).	Effect of alcohol on the kidneys (202).
13. Throat and Voice (chap. xiv, p. 243).	Effect of alcohol and tobacco on the throat and voice (207).
14. Simple Matters of Every-day Health (chap. xv, p. 249).	Pernicious use of alcoholic liquors in accidents and emergencies (225).

This, then, is "scientific temperance"—a work on human physiology transformed into a pamphlet or argument on the evils of stimulants and narcotics, with such incidental science as will strengthen this argument or secure for it a place in the schools. It is not enough that the case against these agencies be put briefly and strongly, it must be reiterated until it becomes the central object for physiological study. This makes a necessity for space-writing such as that above quoted. In the two pages of the Indiana Series I find twenty-one distinct ideas as to the evils of alcohol and tobacco. These it is the work of the teacher to illustrate or to dwell upon as he sees fit. No additional strength comes from dilution or repetition. Still less do the gigantic reasons why men should lead sober lives gain from association with arguments based on doubtful observations or spurious interpretations. In the sixty-seven pages of the other book I find about sixty different ideas, many of these not relevant to the subject in hand, the space being filled by repetition, quotation, and padding. Apparently this was not the author's original plan. It was forced upon him by the demands of the trade. A single collective paragraph, for example, would have covered the known effects of alcohol on most of the tissues; for alcohol does not affect the bones in one way, the muscles in another, and the stomach in a third. It confuses the nerves and poisons the blood, and these influences show themselves variously. The effects that concern us most are not the changes of tissue, but the changes of life.

Such a treatise as the New York law contemplates can not be written by a scientific man. The inclusion of "scientific temperance" in the course of study means the disappearance of scientific physiology. "It is insisted," says the writer from whom I have already quoted, "that in it shall be taught certain effects of alcohol on certain tissues and organs, when it is not known that such effects occur, and when some of them are known not to thus occur. Extravagant statements are demanded when only the most moderate ones can be made. If alcohol and its effects are mentioned at all, the true scientific spirit would demand that the whole truth and that only be told. This can not be done to meet the approval of the committee of censorship. These people demand this most monstrous thing, that there shall be a law compelling a scientific author in treating his subject to devote a certain prescribed amount of his space in such and such a way. They demand a large introduction of matter into the treatment of a subject that is wholly irrelevant to it. Indeed, they have the effrontery to demand of a scientific author in treating a certain scientific subject in the school courses that he shall introduce only so much of the subject as shall bear on a certain reform that they are advocating. Can even earnestness of purpose or the importance of the reform be a shadow of an excuse for such a course?"

The primary purpose of science teaching is to give not virtue but strength. The strong mind forms its own precepts of right action. The weak mind fails, whatever its memorized precepts. The methods favored by the advocates of scientific temperance must always fail of their purpose. No impulse to virtue is less effective than memorized statements of the evils of vice. Information learned by heart is never vital, least of all that which is given on doubtful authority, by methods not sanctioned by pedagogic experience. If such educational methods really led to temperance we might overlook their less desirable results. But the youth can not be made virtuous by sentimental gush nor by scientific bug-a-boos. Just in proportion to his ignorance of the subject will be the teacher's willingness to undertake the teaching proposed by the New York law. Hence arise the penalties laid on teachers and trustees, a thing unheard of in relation to any study that justifies itself.

As already stated, it is evident that the value of the study of physiology is weakened or destroyed by neglecting its scientific aspects and by throwing its conclusions out of perspective. We might as well ask that our histories of the United States should devote a fifth of each chapter to the effect of the spoils system on the events described. The spoils system is to our politics what alcohol is to our bodies, and a wonderful field would be open to reformers if their doctrines could be forced into all historical text-books. And if one class of reformers is admitted, there would be room for many others. It will not be long before we hear from the Baking Powder people, while the manufacturers of oleomargarine will claim the ear of the schools for their product, which is free from the microbes of tuberculosis that infest the dairies. In so far as science yields the basis for any class of reforms, let the facts be known. But these demands should stand in clear relation to the facts on which they depend. Injunctions to temperance may be derived from scientific knowledge; but science should not be distorted for purposes of argument. Confusion and verbiage add nothing, and the teaching of positive untruths works constant injury to the cause of education.

The success of "scientific temperance" legislation, in spite of the combined protest of all intelligent teachers, is really not surprising. It is pressed mainly by committees of women, and by women who are very much in earnest. Politicians are always glad to humor women when a sop like this will serve to do so. So long as nothing substantial is asked for they are wonderfully complaisant. The mercantile interests have no objection to laws of this sort, which can in no way harm the liquor traffic either present or future. If the temperance movement spent itself in such ways only, it could count on the help of its enemies. The opposition to "scientific temperance" comes mainly from theorists who regard meddling of this kind as outside the province of good government, and from teachers who know by experience that text-book virtue enforced by penalties works only mischief in the schools. The more stringent the penalties on teachers and school officers, the more certainly do such influences fail as agents for good.

The whole matter has been thus strongly stated by Dr. J. G. Schurman, President of Cornell University, referring to the New

York law: "We find that all who are in any way engaged with the practical work of education have a protest constantly against the multitude of subjects which would-be 'reformers,' 'cranks,' and 'faddists' would require our boys and girls to study in the schools. If they get their way, the mental energy of our children would be dissipated and education become a sheer impossibility. The most fundamental of all reforms at the present time is the limitation of the number of subjects taught to any one student, with distinction between what is fundamental and what is subsidiary, in order that the short time which the young people of the country can devote to study can be put upon the most important and fruitful subjects. You hear people say every day, 'Is it not a shame that children should grow up in ignorance of this, that, and the other subject!' whereas the truth of the matter is, that it is in most cases an advantage that pupils have heard nothing of the matter.

"When I pass from the general principle of this law to scrutinize its details, it shows itself absurd on the very face of it. If there is any one thing which scientific teachers require at the present time, it is that students of science shall not be taught from text-books. In the programme of many of our best schools (I do not mean colleges or universities) the use of the text-book in science is absolutely forbidden. The 'reformers' who desire the legislation under consideration prescribe a text-book; and not only so, they tell the teachers how many pages are to be studied in order that students may understand 'the nature and effects of alcoholic drinks and other narcotics.' It would be a great reflection on the educational wisdom of those who are responsible for making our laws if a conception of scientific teaching so wooden, so utterly mechanical, were ever to find a place in our statute books. The scientific teachers of the country, whether in the public schools or in the colleges and universities, would justly hold us up to ridicule."

In the same vein Dr. William R. Huntington, rector of Grace Church, says: "As a member of the Committee of Sixty, charged with the investigation, from a scientific and impartial standpoint, of the whole question of the relation of alcoholic stimulants to the animal economy, I have been in the way of hearing the educational phase of the subject very fully discussed, and I am convinced that the attempt to indoctrinate the minds of the youth of the country in the premises, though well meant, has been overdone. Let the children be taught the perils of drinking and the horrors of drunkenness as emphatically as you please, but let us not palm off on their innocent minds pseudo-chemistry and inaccurate physiology as necessary truth."

Every institution tends to magnify itself, and the need of a reason for existence leads it to try to show results. Hence the unwillingness of the advocates of "scientific temperance" to let well enough alone. From two pages out of three hundred they have come to insist upon sixty pages out of four hundred. But this will not satisfy. Sooner or later the whole must be conquered. With every additional page taken from science for temperance, they have the basis for a show of results.

"The natural result of the dictatorship of unscientific people over a scientific subject is that they require all sorts of the most absurd things. Their success with legislatures has made them arrogant and oppressive in the extreme. These women certainly must be in earnest to be willing to assume to control for the whole country the teaching in the schools of a subject in which they do not profess to be trained; to assume to dictate to those who have made a certain science their life work what they shall and shall not say on this subject; to be willing to see, indeed to put in motion the machinery which brings about, a form of legislation which further developed would turn the public schools into an instrument which the smartest politicians who could capture them might use to further on any true or false reform or visionary scheme."

The only remedy for such meddling lies in allowing that science shall be free to teach its own lessons, and that the public schools shall not be used by advocates of any kind of social or political reform, no matter how meritorious the cause may be in itself.

The whole "scientific temperance" movement is opposed to the movement for good schools through the choice of good teachers. It has been judged thus far mainly by its motives, which are good. It will come to be judged by its results, and these are bad.

In his estimate of the age of Niagara Falls, Mr. J. W. Spencer assumes that the authors of the later computations have failed to take sufficient account of the factors that have caused the rate of recession of the cataract to vary, and of the consequent variation. He has newly examined the channels of the river and the geological evidences they offer, and has incorporated the results in his estimate. He finds that at the nativity of the Niagara River there was no fall. Then the waters sank to the level of Iroquois Beach, and the falls were very much like the modern American cataract in height and volume. This afterward increased in volume and went through a number of changes that are detailed in the author's paper. His computations result in the conclusion that the falls are thirty-one thousand years old, and the river is of thirty-two thousand years' duration. It is further roughly estimated that the lake epoch began fifty or sixty thousand years ago. If the rate of terrestrial deformation continues as it appears to have done, then in about five thousand years, Mr. Spencer thinks, the life of Niagara Falls will cease by the turning of the waters into the Mississippi.

THE GEOLOGICAL WORK OF THE AIR.

By M. STANISLAS MEUNIER.

SOME specimens recently received at the geological laboratory of the National History Museum in Paris suggest a study of the action of the wind in geology and of the importance, long overlooked, of wind deposits. The specimens are lavas from the volcano Mauna Loa, which the wind, lashing them before hardening, has reduced to fibers of extraordinary fineness. They might be called bunches of oakum. The mechanism of the formation of these—or Pélé's hairs, or bald men's locks, as they are poetically called—is similar to that by which similar formations are produced in furnaces when the blast is directed against the melted slags. It has been proposed to employ the product thus prepared as a textile material; but it is not well adapted to such use, be-

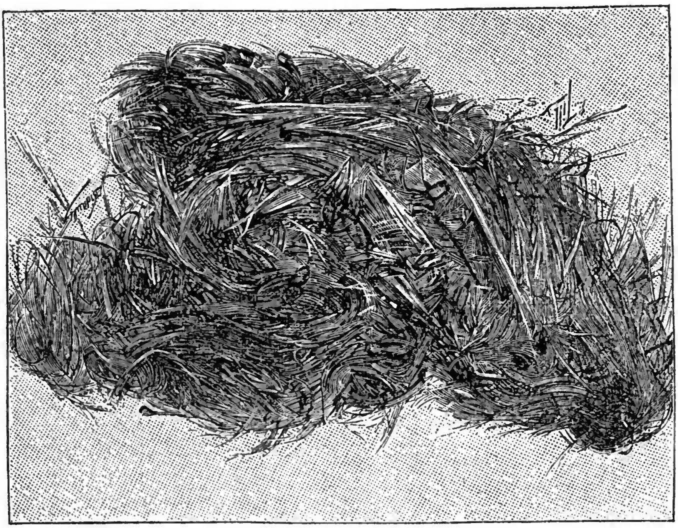

Fig. 1.—Pélé's Hairs: Volcanic Lavas spun by the Wind and resembling Tow; from the Volcano Mauna Loa, Sandwich Islands. Natural size.

cause of frequent abrupt changes in the diameter of the vitreous threads. This peculiarity is shown in Fig. 1, where the little black tears mixed in with the brownish fibrous material are really the knots by which the filaments may at any time be interrupted. If we examine these bald men's locks with a microscope, we shall find the evidences of their wind origin more abundant. Fig. 2 represents them magnified fifteen diameters, and Fig. 3 one hundred diameters. We see in the former of these figures that, notwithstanding their coarse appearance, the filaments are anything but homogeneous in all their parts. The axial region of each of them is usually marked by a sort of thread, either continuous or discontinuous, which sometimes suggests a cylindrical cavity, but is more usually in the condition of scattered granulations. The nature of these included bodies can often be determined with precision; and to select one of the clearest cases, they may not infrequently be perceived acting energetically upon polarized light as if they were true crystals, while they show geometrical forms on larger or smaller parts of their contour. On closer examination it is possible to refer them to grains of pyroxene. In some of the filaments the axial inclusions are of a different character; their perceptibly spherical form and other features identify them with the gaseous bubbles frequently observed in rocks. The

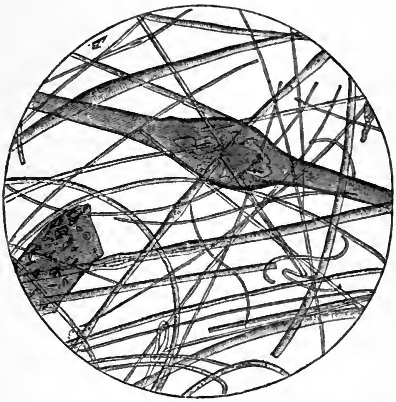

Fig. 2.—Pélé's Hairs seen through the Microscope. Magnified fifteen diameters.

Fig. 3.—Pélé's Hairs seen through the Microscope. Magnified one hundred diameters.

matter which fills the cylindrical cavity, often as long as the filaments themselves, is also gaseous; and so likewise are the bubbles that may sometimes be seen by thousands in the vitreous scales, such as are abundantly represented in an angular plate near the edge of Fig. 2. Another point to be noticed is the way the filaments terminate that we are sure have not been broken after consolidation. They are very rarely drawn out to a fine point without bending, but usually they suffer a more or less abrupt curve or are done up into a knot or a loop, of which Fig. 3 indicates some common forms.

If we lightly shake these locks above a sheet of white paper, a fine dust will fall upon it in which the microscope detects among the finest filaments myriads of brownish, translucent, and sometimes transparent, vitreous pellets. Most frequently they are perfectly homogeneous, but they also often contain inclusions similar to those in the filaments. The perfection of their spherical form is not strictly in proportion to their diameter, as might be supposed; but some of the larger ones are very regular, and some of the smaller ones are more or less pyriform. Many of these are traversed by fine perlitic cracks. Together with the pellets are numbers of the vitreous scales which we have just mentioned. Some are perfectly smooth and uniformly transparent; while others contain bubbles and blisters, and have a rough surface. Sometimes innumerable little vitreous pellets are massed upon them, similar to those which form bunches like bunches of grapes on some of the finer hairs.

I do not think that the mixture of pellets with the slag threads spun accidentally near the nozzles of blowers in factories has been insisted upon. These little balls result from a special action of a gaseous medium; and it is important to remark that we can by their presence recognize the wind origin of the deposits that contain them. They have a bearing upon some observations of M. Gaston Tissandier, who has found similar globules in atmospheric sediments in very different localities.* These spherules have evidently originated from the action of the air upon the fluid matter developed upon the surface of meteorites during their passage through the atmosphere. They should be formed in considerable numbers at every fall of meteors, and their small volume is favorable to their remaining suspended in the air for a long time, and to their being carried by the wind to considerable distances. This explains the quantities of them found in the ocean bottoms. All marine sediments that have been carefully examined yield globules of this kind; and, as is shown by the common researches of M. Tissandier and myself, they were equally abundant in the ancient geological seas. Thus, to cite an example that has struck us very forcibly, the green sand extracted from the artesian well of Passy, at five hundred and sixty-nine metres below the surface, and which is of the Albian (lower Cretaceous, Potomac group), is full of spherules as perfect as those which are extracted from the dust that has accumulated in the towers of the Cathedral of Paris.

The mechanism of the production of these globules is rendered very evident by their abundance in certain industrial residues, especially in the iron oxide produced by hammering, and in the product of the combustion of iron in oxygen. Evidently the melted oxide spread into laminas by mechanical projection goes through the same capillary action as gives their form to soap-bubbles. We can study all the details of the phenomenon with greater facility if we have recourse to substances much easier to melt than oxide of iron. I have had occasion to do this with the experimental products which M. Daubrée has asked me to

* Les Poussières de l'Air. By Gaston Tissandier. Paris, 1877.

examine, and which have been formed in his investigations of the perforation of rocks by gaseous explosions. In these experiments, channels were opened through the granite by the gases of nitroglycerin, showing on their vitrified surfaces all the stages, from the drawing out of a thin pellicle of melted glass to the formation of a perfect spherule. Grains of two different categories may be distinguished with the microscope in the dusts produced in the trituration of rocks by the violent passage of gaseous explosions. Some can not be distinguished from those produced by simple mechanical pulverization. But, besides these materials—angular grains of quartz, feldspar, and mica—we find abundance of perfect, or nearly perfect, spheres, opaque and black or slightly translucent and brownish, with shining surface and often the characteristic little neck. Identical elements are found in the dust derived from different rocks that have been submitted to experiment, but with features that vary in each of them.

Dust obtained from the lava of Vesuvius exhibits the globuliform character in the highest degree. Nearly all the matter is in the condition of black globules of various dimensions, but always very light, and sometimes having a tubulure. The abundance of these globules is manifestly associated with the relatively easy fusibility of the rock, which is also represented in the constitution of the general glaze with which all the parts that have been in contact with the incandescent gases are covered. The identity of these globules with those that exist so abundantly in the atmospheric dusts and marine sediments can not be contested. Till now, says M. Daubrée,* the general opinion, and the only one possible, has been to connect the origin of these globules with the arrival of cosmic masses in the atmosphere; and we may add now to the arguments already presented in support of this thesis, the results afforded by the gaseous trituration of meteoric rocks. The dust furnished by a stone cylinder that fell from the sky in 1888, at Pultusk, was marked by innumerable globules, associated with fragments of peridote and entastite, and with metallic granules which had preserved their ramified form and their adherence to lithoid minerals. What we have said shows also that terrestrial rocks, as well as meteorites, may engender these globules. Hence the arrival of meteorites into the atmosphere incontestably contributes greatly to the production of the brilliant globules so abundant in aërian and aqueous sediments. It seems also to be established that the openings of diatremes † have an active part in

* Les Régions invisibles du Globe et des Espaces celestes (The Invisible Regions of the Globe and of Celestial Space). Paris, 1892.

† Cylindroid vertical apertures traversing the crust of the earth, of which the diamond-bearing *pans* of the Cape and volcanic chimneys furnish well-known types.

the matter. The spherules concomitant with the gaseous erosion of granites and other rocks, thrown up into the atmosphere to the great height reached by fine volcanic ejections, may be sustained in the air for a very long time, and fall to the earth at great distances. In support of this opinion it will be recollected that in the basins of seas, the corpuscles of which we are speaking, to which MM. Rénard and Murray do not hesitate to ascribe an extra-terrestrial origin, are generally associated with clearly volcanic products.

In order to elucidate completely the origin of the globuliform matters, I have placed melted wax in a pipette with a capillary end, and blown the jet into a vessel of cold water. The product had all the characteristics of the globules of which we are trying to explain the origin, some hollow and having little necks like the meteoric spherules, others full and joined together like the associated spherules in the bald men's locks in the crater of Mauna Loa.

The geological importance of atmospheric sediments is marked in these days in many ways. The facts with which we have been occupied will contribute to illustrate it still more.—*Translated for the Popular Science Monthly from La Nature.*

NEW OUTLOOKS IN THE SCIENCE AND ART OF MEDICINE.*

BY T. MITCHELL PRUDDEN, M.D.

I WANDERED last summer over that marvelous land of sunshine in our great Southwest where still fast dwindling groups of the real Americans cherish quaint customs, and linger among the superstitions of vanished centuries. And Fortune made me for a time a guest in a small tribe of these Indians, as yet almost untouched by the blighting finger of what to us is civilization.

I was drawn to them in this way: There came to our camp upon the plains, one evening, a woebegone dark fellow of this tribe, who with his squaw had wandered away from his comrades, seeking a quiet place to die. He was wan and feeble. A demon, he told us, had long since gained entrance to his body and had tortured him with pain and cold and fire. All the art of his tribal medicine men had failed to free him from the intruder, and a little while before, some spirit had begun to whisper to him in his sleep, he said, that he must go into the dark. All this was gathered from lip and gesture and pantomime as he lingered with

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us, loath to relinquish at the last the scant comfort of human companionship.

In the light of the lore which had been imparted to me many years ago by my medical teachers here at Yale, I reckoned him the victim of malaria; and shortly, in fact, quinine had cured him. The demon was exorcised, the spirit ceased to whisper, the sun was again his friend, and the winds began anew to breathe to him their wonted biddings to the chase. The grateful soul, now eager to be away, was urgent that I should visit his people, for he was fain to celebrate the facility of the white medicine man who could banish evil spirits without rattle, dance, or chant. And so I went. Eighty miles across the desert from any settlement, down at the bottom of a rock-walled chasm which leads into the Grand Cañon of the Colorado, and whose sides tower sheer half a mile, these brown-painted folks have lived alone and almost forgotten since long before the Spanish pioneers came hither for God and gold some centuries ago.

At the time of my visit several persons in the tribe were ill, and a celebrated medicine man had been summoned from afar in council over the stricken ones. After long and repeated conferences, my dark medical brothers consented to lay aside cherished forms of professional etiquette, and permitted me to take a place in the grave circle which at midnight crouched about a small fire built in the open, near which lay, half naked, the group of patients. One of these was clearly the prey of consumption; one was shivering with malarial poisoning; one was a croupy child; one I judged to have partaken unwisely and too much of spoiled jerked meat; and one was the victim of old age. I have not time to picture for you, as I should like to do, the weird scene which was enacted there from midnight until dawn, night after night. A low rhythmic chant rising and falling to the time of a rattled gourd; slow passes of the hands over the prostrate bodies, which now and again were blown upon from the pursed lips of the painted Æsculapius, who now crouched crooning beside his charges, now danced furiously about them, while at frequent intervals wild yells from the attending circle woke hideous echoes from the cliffs. I will not dwell upon the sequels of this adventure, but remind you only that the conceptions of disease which these people foster, and the practices which they adopt to free the body from what is to them a definite possession by some evil thing, are essentially those which were prevalent ages ago, and whose significance we glean so toilsomely to-day out of the misty and broken records of the past.

I have lingered in story on the threshold of this address, because I wish to emphasize the fact that in this country and to-day —in all countries of the world, for that matter—a large proportion of mankind, consciously or unconsciously, personify disease or think of it as something foreign to the body, some definite or mysterious thing intrusive. From the painted red man of the plains, who associated his bodily ailments with demons, spirits of the dead, witchcraft, magic, evil possession, and angry gods, and hopes to banish these with shrieks and songs, it is indeed a far cry to the clean, clad, business or professional white man of the town, who more or less sheepishly confesses that he carries a horse-chestnut or a potato in his pocket to ward off rheumatism. But between the charm of the horse-chestnut and the chant of the savage lies a great body of ignorance and superstition, upon which quacks flourish mightily, and which can not be altogether ignored in any wide outlook to-day over the field of medical science and medical art.

In fact, the superstitious red man is much more reasonable and logical in his procedures for the cure of disease, considering the scope and character of his conceptions of its nature and the phase of civilization which he represents, than are large numbers of considerably evolved white folks who, in the midst of highly civilized and cultured communities, bow still at the altars of sanitary savagery, cherish a devotion to drugs almost pathetic, and utterly fail to grasp the significance of the new conceptions of disease which at last have made of medicine an exact science.

That which has especially contributed to the establishment of medicine on a firm and rational basis is the gradual centering of our thought and experiment upon definite and tangible structural features of the body, and the conviction that the physical nature of man is closely interlinked with that of lower forms of life.

In its primitive phases, medicine brought gods and men into close relationship and led constantly to religious conceptions. It was, in fact, not a science, but a religion. The early priests were physicians, the primal gods were gods of healing, and their temples were hospitals. As time passed, absorbing speculations, fantastic often, frequently grotesque, about the structure of the body and the nature of disease, won general belief and disappeared. Theories, systems, and schools came and went. Now mysticism and magic, now humors and philosophy, held sway. Quackeries and frauds flourished for their little hour, and vanished, as they always must. Finally, the body itself became the object of direct study, and the mysteries began to clear.

But it was a long time after it became reputable and legal to study the anatomy of the human body before the old physicians acquired a definite conception of it as an admirably grouped assemblage of tissues and organs. It took much longer for the development of accurate notions as to the functions and uses of the separate parts of the human frame. And it was not until the early decades of the present century that science was able to declare the ultimate element out of which all these varied parts are built to be a tiny particle of living matter which was called a cell.

Somebody has said of Turner that he was a man who thought in paint. The modern devotee to medicine, if he seriously thinks at all, must think in cells. Physicians used to think in symptoms, and it took them a great many years to learn that they must think also in cells and organs—that is, with clear morphological conceptions—if they would crystallize for use the knowledge which experience brought them.

Through the long processes of evolution, these cells have acquired peculiar forms, and adapted themselves to the performance of special functions. The great cell groups—we call them liver, lung, brain, muscle, bone—each doing its particular work, all act in harmony for the maintenance of the life and performance of the body as an independent being.

We do not yet understand, nor shall we soon, what that marvelous vivifying influence is which sets this self-built cellular mechanism at work, and keeps it going, as a rule, under favorable conditions until the shadows of threescore years and ten begin to deepen about the worn machine. Nor has all our gathered life lore led us far among the mysteries which cluster about the vague region in which the spiritual and the material meet and interfuse. But this we know, that all the things the body does, from its high borderland achievements in thought and memory down through the homely processes of nutrition and repair, are accomplished by these small life units in accordance with physical laws as definite and unvarying as are those which we trace in plant and earth and star.

Under a variety of adverse conditions the human body can still hold its own and secure for a time a certain degree of health, thanks to the adaptability to circumstances of its component cells. Thus, by the nice control of its ceaseless chemical processes, the body can maintain a nearly uniform degree of heat, no matter what the latitude or season. Starve the body, and its cells can feed for a while upon the stores which they have in times of plenty laid aside. They struggle long and faithfully against the manifold excesses which may be forced upon them. They fight with fashion, in one sex at least, for space within this none too roomy tabernacle, with business and with pleasure for a time to rest, with drugs and blighting drinks and unwholesome foods for release from poisons which it is not usually thought criminal to administer to one's self. They work as best they can without the wholesome air so frequently denied them. They resist with what force they can muster inherited weaknesses or taints.

But after a time, when the conditions under which the cells live and work are definitely unfavorable, they may fail to maintain the standard. Their performances become faulty or feeble, or, with their structure, may largely change. If carried beyond a certain limit, these weakened or perverted functions and their attendant physical changes constitute the condition called disease.

In fact, science does not now permit us to forget that "the living body is a mechanism, the proper working of which we term health; its disturbance, disease; its stoppage, death." The happy condition known as health does not commonly draw attention to itself, and so has escaped personification; while the other conditions—disease and death, strictly its analogues—from the earliest times have been invested with such mysteries as among all people have led to misconception and to figurative speech.

I wish especially to emphasize the simplicity of the modern scientific conception of disease as a disturbed condition of a complex cellular mechanism, because it is largely due to a failure to comprehend this that the shadows of the middle ages actually still lie dark over certain of the popular conceptions of medicine, and seriously retard the speedy fruition of many of its new discoveries.

The practical ends which have been of necessity held in view by the devotees to medicine, the bald empiricism through which most of the therapeutic resources of our art were won, and the stubborn persistence of old and misty conceptions of disease have greatly hindered the realization of the fact that medicine is, after all, only one phase of the great science of life which we call biology, and that its varied themes must be pursued by the same methods and under the same strict safeguards against error in observation and in inference as are current among those who study science in its simpler aspects. It may make some practical difference that the particular animal to which the medical man devotes his time is highly complex, fosters a soul, has a future, and pays in cash (sometimes) the expert who can relieve it from discomfort or pain and prolong for a little now and then the cellular confederation. But if we do not constantly draw light from the common sources, we shall wander hopelessly in empiricism and fail at last. In truth, to strive for wide comprehension of the human frame without the constant aid of sister sciences and frequent reference to simpler forms and functions is but to build upon the surfaces.

Permit me now in a somewhat desultory fashion to glance with you at two or three phases of recent development in medicine. I have not wished to frame an exhaustive inventory of our gains, but rather to note such features as can be led to wider beneficence through forces which we may ourselves administer as we go about our usual tasks.

When we group diseases according to causation, we find that many are due to excesses—excesses in food, in drink, in drugs, in exercise, in indolence, in work, in rest, in play. Sometimes the body labors under adverse influences which we do not understand. Sometimes the organism is handicapped from the start by inherited defects. Sometimes subtle poisons which the body itself forms are not properly disposed of, and the organism suffers.

In spite of the vast stores of experience with the human body in disease, clear down to the early part of the last decade, the nature and cause of some of the most common and fatal human maladies were practically unknown. I speak of the diseases which we call infectious. These were so widespread and so mysterious as to foster superstition, and lead to the perpetuation of the earlier notions about angry gods, offended Providence, judgments, warnings, witchcraft, and so forth, long after the legitimate presence of such developmental phases in human thought had passed away. Man had gone on making up inventories of his visible life neighbors in the world, had traced their pedigrees and relationships, had found how closely their evolution was bound to his own, and had got the systems pretty well completed, when his surprised attention was called to an inconceivably populous world of beings lying far beyond the reach of the unaided vision and closely woven into the chain of life. And shortly the so-called "germ theory" of disease had ripened into a well-grounded body of positive knowledge, so far-reaching and significant that more than anything else it has seemed to dominate medical science for more than a decade, and has led to most beneficent practical results in the prevention and the cure of disease.

For a good while after attention had been called to the existence of microbes, most people thought of them—many still do—almost exclusively as inciters of disease. But this is a most narrow conception. The amount of material on the earth available for the temporary uses of living things is limited, and it is largely through the intervention of these lowly but active organisms that when once the material, which for a little while has come under the sway of the life forces, has fallen into death, it is rescued and worked over into available life stuff again. And so, chained over to the material, the cycle of life on the earth is maintained only through these swarming hordes which serve all animate things in serving their own necessities.

We can to-day trace their presence through geologic ages, sharing in the life of earlier times. We are but just beginning to realize their vast economic importance in agriculture, in the vine-yard, the dairy, and the kitchen, in certain of the arts, in the normal processes of digestion, and in the maintenance in many ways of the salubrity of the earth and air and water.

The sooner we realize that the exercise of their disease-producing powers by the microbes as a class is only an incident in their largely beneficent careers, the sooner shall we arrive at a just comprehension of our newly discovered earth neighbors, upon whose ministrations we are dependent for the creation and the maintenance of conditions which make possible our being here at all.

The variety and complexity of the chemical transformations which microbes effect in the soil and in the water are but just becoming evident. But we already know that through the vast reaches of time which their life history covers the delicate work which they have to do has been intricately apportioned among them, and a most elaborate physiological division of labor adjusted. The struggle for existence among these lowly forms of life is so keen that they are almost always confined to their legitimate haunts and to their beneficent offices.

I need not refer in detail to the story of the discovery, one after another, of the bacteria which have been shown to cause fatal maladies. Tuberculosis, cholera, pneumonia, diphtheria, tetanus, anthrax, and more of the sinister brood have now yielded the secret of their causation.

At first the relationship of bacteria to the diseases which they were found to cause seemed quite simple. But as research went on it became clear that we were still only scanning the surface. It was shown that these intruding germs do not act chiefly by their mere presence as foreign bodies, but more usually or more fatefully by the elaboration of subtle poisons which permeate the body and destroy the cells or disturb their nice adjustment.

So the study of the products formed and set free in the life processes of these germs opened a new line of intricate and delicate chemical procedure. Think of the complexity of the processes which are induced in the body by the presence and action of these living organisms! We have, on the one hand, the body cells, each one, small as it is, a chemical factory, setting free unnumbered complex substances, some of which are to be used by the body as a whole, some to be resolved into other forms, some to be eliminated, since they are powerful poisons. To these multiform cell units of the body enter the germs, cells too, mostly plants, equally complex in their processes, also poison factories sometimes of most appalling energy and grown hardy through ages of strenuous battle for existence.

Great progress has been made in research upon the agencies which the body can bring into play to protect itself against these sinister intruders, and did time permit I should like to call your attention somewhat in detail to the mimic warfare which is maintained, often in extreme hazard, under conditions which belong especially to modern life.

There are still several tissues and organs about whose uses we are, in the main, ignorant; but there is much reason for the belief that several of these unknown mechanisms are largely useful in disposing of or rendering harmless numerous poisonous substances which in their complex metabolisms the varied body cells set free; and the recent revelations in the relationship which microbes bear to disease have made it seem probable that the agencies which the body has developed for its own protection against itself are the same agencies which it employs to protect itself against these small invaders.

We have learned of late that not infrequently more than one germ species may be at work in producing the cell disturbance which we call disease, and that an individual whose inherent protective mechanism promises a favorable outcome to the fight when one enemy alone is within the citadel, may speedily succumb upon the entrance of its allies.

It has been shown that the same germ, under varying conditions, can induce maladies hitherto thought to be different; so that the number of our unseen enemies in this silent realm may, as our outlook becomes more commanding, prove to be smaller than we have been led to think.

Several of the most fateful germs are constantly with us, especially in towns, but doing no harm, unless through some breach in the complex and curious line of the body's defenses they enter the sanctuary. Even then they are often harmless, as we have seen, except in an organism whose defensive mechanism is already weakened by excesses or disease.

The extreme rapidity with which these organisms multiply has made it possible to study experimentally, in the countless generations which come and pass within the range of a single experiment, the effect of environment upon their morphological and biological characters, and the existence of races and varieties within the limits of what we are pleased to call bacterial species has been well established.

It has been possible by changes of environment to so alter the metabolism of disease-producing germs that, though apparently growing as vigorously as ever, the poisons by which their evil effects on man are caused have lost their power. In fact, we now know several germs quite similar to those which are of most sinister import to man which, apparently, under what we call natural influences, have lost their power to harm. These are some of the lines of study with which bacteriology to-day is busy.

But the greatest immediate practical benefit derived from the new knowledge of micro-organisms is the certainty with which some large groups of infectious disease can be controlled by private and public measures of sanitation.

Of course, in sanitation, as in other phases of morals, it is not as easy to do as to know what 'twere well to do. But it is safe to say that if we were ready in this country to follow such dictates of science in sanitary measures as are of known efficiency, we could secure their birthright of long life and health to a large proportion of that forty per cent of all the people who, as statistics show, are now destined to perish from preventable infectious maladies.

The means by which individuals and health boards may realize the possibilities for human weal so clearly indicated in the newly won lore of preventive medicine I need not here recount. They are easily enough learned as soon as the conviction of their importance has grown to a fixed purpose of action.

The scope of this address does not permit me to dwell upon the really wonderful degree of accuracy with which the educated and experienced physician of to-day can detect abnormal conditions in the varied cellular structures of the living body, nor upon the clear conception which he may acquire of morbid states and processes in situations physically inaccessible. He can recognize what groups of hidden cells are faltering in their work, are struggling under burdens, or in what way the co-ordinating mechanisms are failing in their tasks; and now in one way, now in another, and not most often with drugs, as so many think, can he tide the halting mechanism over its hour of stress. The cause of the disturbance may be removed, rest secured, pain assuaged, perverted function set right, and even for a time the aged, worn-out mechanism encouraged to prolong its task. And if the physician can not so frequently as we would wish guide to the happiest issue the healing forces over which the human frame has gained control, it is certain that, other things being equal, his success is assured just in proportion to his accurate practical knowledge of the delicate mechanism which he is seeking to repair, and his comprehension of the nature of the life forces which he must in the right way and at the right moment aid, and with which he must as certainly not unwisely interfere.

In these hurried glimpses of only a limited phase of medicine, it is most significant that there is no talk of humors and auras and vital spirits, nor of illusive and intangible fancies such as for centuries held sway in fields once ruled by demons and angry gods, but of definite things which we can see and handle and measure. Herein, to my thinking, lies the heart of our achievement and the brightest promise for the future.

But while our science and our art are now steadily growing in precision and usefulness, our practical accomplishments are greatly limited, because general enlightenment regarding the things of the body has not kept pace wlth the acquisitions of science.

Our new outlooks in preventive medicine have made it plain, as I have said, that a very wide curtailment of suffering and a large saving of human life are possible if only the people can have an elementary knowledge of the human body and of such simple principles of hygiene and sanitation that under the increasingly complex conditions of modern life they may be able to guard against common forms of infection and against unwholesome modes of life, which not only invite infection, but many other forms of ill.

It seems to me that here the schools and the colleges have high responsibilities, and of these I wish briefly to speak.

The conviction has for some time been current that the children should be taught something about the structure and working of the human frame, and in this way already much has been achieved. Of the importance of this sort of knowledge no special demonstration is needed to-day. But in many of the public schools in this land the instruction in physiology and hygiene has been of late largely subordinated, if not actually falsified, to the interests of what some are pleased to call temperance; meaning thereby the avoidance of alcohol and tobacco, lest horrible and frequently impossible things should happen to the liver or the brain.

But I think that the distortion of truth is not liable to lead at last, no matter how worthy the motive, to the ends for which the anti-alcoholic and anti-nicotinal physiologies and hygienes of our schools have been devised. It seems to me certain that a great deal of the future physical and mental well-being of our people depends upon the acquirement early in life of absolutely accurate, though it be rudimentary, knowledge of this complex and sensitive bodily mechanism; and that the self-control and self-respect which such knowledge fosters will in the long run do more than vague fear of bodily ill to promote a temperance much more comprehensive and beneficent than that which centers itself in the avoidance of alcohol and tobacco, bad as the misuse of these may be. It is to be hoped that mistaken zeal in this direction may not long prevail to the physical and moral detriment of the children.

Many of our institutions for higher education now recognize the value of a knowledge of the body, and of the physical conditions under which man can best secure the highest usefulness and enjoyment. But I do not think that as yet this subject has received attention at all commensurate with its vital bearing upon the well-being—spiritual as well as physical—of those whom the universities equip. So long as a knowledge of the human frame was looked at from the standpoint of the dispenser of mysterious drugs to a mysterious organism for the purpose of expelling mysterious foes; so long as the body was regarded chiefly as a more or less disreputable tabernacle for the temporary uses of the soul; so long as its harmonious and significant relationship to other forms of being lay largely beyond our ken; so long, I say, as all these conditions prevailed, accurate knowledge of the body and the factors necessary to its physical well-being did not command attention in the higher educational outlooks.

The equipment which I urge is in no sense medical, nor is it such as encourages the fancy to linger upon trivial ailments or inspires the dread of disease. For it should be remembered that the fundamental facts of anatomy, physiology, hygiene, and sanitation do not belong particularly to medicine, as is too often hastily assumed. This knowledge is indeed especially useful to the physician, and upon it he builds up into the domain of medicine. But it is a part of the common stock of world lore. And I do not think that there are any forms of provisional knowledge among those which candidates for admission to the colleges are required to possess more important than this.

Nor can I regard any schedule for the higher education, no matter what the calling to which it is initiatory, as adequately comprehensive which does not embrace definite and well-balanced instruction in the more advanced knowledge of the human body, its relationship to other forms of being, and the means through which it best can serve those larger purposes of life which the university inspires. One often marvels at the pitiful ignorance of the body and of the simplest principles of healthy living common among learned and cultured men and women to-day. Ashamed not to know the origin of a word, or to fail in the comprehension of a literary allusion, masters in theology, wise in the law, keen in business, versatile and brilliant in society, they are prone to court disaster in senseless modes of life, and fall easy victims to charlatans and unscrupulous drug venders—an association which they share with the illiterate and uncultured in a fashion highly democratic, and which suggests the survival of traits less incongruous and much more picturesque in the North American Indian.

Our new outlooks in medicine have not been won without toil and sacrifice on the part of its devotees, and these will still be necessary. But it is evident that in the medical colleges there must now be fuller endowment of research and more adequate provision for instruction, not only in the traditional themes of undergraduate study, so largely expanded, but also in recently developed disciplines.

The clear appreciation of the close relationship of medicine to other phases of biology; the newly recognized importance of practical familiarity with things themselves, rather than with the impressions which another has gathered and more or less lucidly imparts; the patient training of the hand and eye and ear to catch minutest variations in surface and color and shape and sound—all these requirements of modern medical instruction involve pecuniary support far beyond that which was formerly sufficient.

As was to be expected, the necessity for improvement in the medical curriculum and the urgency of the requirements of research have been recognized at this university in the revision and expansion of its medical course. And it is to be hoped that the appeal for endowment of the medical school here at Yale, made in the President's last report, may not go unheeded by those who are now for a little while the custodians of wealth, and in whose power it is to bring into play facilities for instruction and capacities for research so full in the promise of immediate practical utility.

What, now, is the attitude of the physician, in the light of the broader and more exact science which is to-day at his disposal? It may be at once conceded that his physical presence has mainly lost its old-time picturesqueness.

It is inevitable that as soon as he laid aside the mysteries and fictions and superstitions with which erstwhile he was wont to invest his calling, was obliged to abandon charms and auguries and secret remedies, and could no longer safely summon to his aid the occult forces with which outgrown fantasies invested plant and mineral and pregnant aspects of the stars, and was forced to confess that in dealing with his charges he was even, as other devotees to other sciences are, simply a student of common things with the simple resources of actual knowledge and common sense —it was under these conditions, I say, inevitable that his claims to confidence must more definitely rest upon his sound learning, his obvious skill, his actual experience.

A large part of the late surviving professional mannerism and dictatorial assumption has also passed away, and the doctor of to-day is a man of the world, the friend as well as the expert.

It is a very wide-eyed generation which is coming on the scene, and not prone to invest with unnecessary ceremonial or mystery the dealings of its professional advisers with its ailments. Many laymen know as well as we do that the administration of drugs in their hour of stress is but an adjunct to the often more needful and more potent guidance in diet, in regimen, and in the varied general measure by which the stricken organism may be nursed back to health.

And if we mumble and shift as we face legitimate inquiry as to the nature of disease and of remedial measures, and strive to foster the old conception of the body's hidden mechanisms as of a "strange internal kingdom of which we are the hapless and helpless monarchs," we surely can not justly protest if the baffled inquirer turn to the charlatan.

While in many cases the patient is so ignorant, so heedless, so indifferent, so little in control of his mental outfit, that the simple dictum of the doctor may convey all that is wise, it is still, I think, true that usually a clear and simple explanation of his condition and an enlistment of his intelligence, or that of his friends, in the nature of his malady and the measures proposed for its removal, not only often contribute to success, but also, on the part of the physician, are more dignified and more humane.

But, beyond this phase of helpfulness, the physician has the largest opportunity in his intimate dealings with his charges to so counsel and instruct that, especially in the routine of household life, the fundamental principles of healthy living may be understood and followed.

I am aware that to many physicians this is now the accustomed way; but it might, I think, wisely be the way more often trod.

Again, the practitioner of medicine has facilities for fruitful research to-day, however simple or obscure the field of his activity, such as no earlier time has realized—because our problems are more precise, our methods more exact, and opportunity for interchange of thought abundant.

There is, indeed, no better example of the scientific method of research than the performances, physical and mental, of the well-equipped physician as he stands in the presence of this delicate mechanism faltering in its tasks. He summons his facts—by story, by test, by observation; frames from them, in the light of all the lore which he can muster, a clear conception, or a theory if you will, of the cause and nature of the disturbance; and then, by all the varied agencies at his command, assumes the rôle of Nature's helper in the promotion of recovery.

There is nothing which the worker in the laboratory can do with his tubes and balances more strictly scientific than the work which engages the practitioner in his daily rounds. For it is the method, not the tools or place or subject of our tasks, which makes them scientific or unscientific. It is just as easy to be unscientific in the laboratory as at the bedside, and in either place it is easy to lose sight of science in the detail of mechanical routine.

But beyond all that which the physician can accomplish as the friend and expert adviser of the sick in whom, first of all, his allegiance centers, as the student of all things which promise help in his fight against disease, as the friendly teacher ever mindful that prevention is better than cure, and as one who toils for Science for her sake alone—beyond all these high offices there is yet another upon whose duties he must now more seriously enter, if he would hope to realize all that which our new outlooks promise. I speak of the duties of citizenship.

Municipal and State health organizations have accomplished much of late in the protection of the people against disease. But the humiliating confession must be made that in many measures of public sanitation in this country we are far behind the requirements of science. This is not, as a rule, because our health officers do not know what to do or how to do. It is not usually because they are indifferent or negligent. But in many cases the pitiful sacrifice of life and the inexpressible suffering and loss which preventable disease involves are due to legislative indifference or folly.

I am aware that there are many exceptions, but I think that I am not mistaken when I say that among the measures vital to the public welfare over which our legislators, State and Federal alike, wrangle and bicker and deal—when these are not treated with indifference and contempt, as not contributory to the profit or to the disgraceful notoriety of the hour—there are none which more often fail of intelligent consideration than those which concern the public health.

But laymen in public office can not be regarded alone at fault if they be not wisely directed; and physicians are not, I think, as keenly alive in this way as they should be to their responsibilities as citizens. They know what ought to be done in the larger public way to render the new knowledge in sanitation and the control of disease available, and yet do not individually or as a guild bring their expert knowledge strongly to bear as the intelligent citizen always can, if he be right and enough in earnest.

There is little doubt that almost any legislative measure which the medical profession unites and persists in urging as essential to the maintenance of the public health can be speedily secured.

I know that there is a general feeling among physicians of the better sort that conspicuous interest in public affairs may be misconstrued and looked upon as in some sort a means of professional advertisement. And one can not choose but appreciate and admire the sensitiveness and high sense of honor of which this sentiment is born. But, after all, there are greater misfortunes in life than being misunderstood, and I think that the fine feeling which leads the physician so often to waive the privileges of social and public life in the interest of what he conceives to be professional ethics is capable of a richer fruitage yet, in the defiance of misconstruction, when impelled to whatever performance of public duty he can justify to himself.

While the penalties of ignorance in things sanitary and hygienic are growing more severe as our communal life becomes more complex and crowded, there are, as we have seen, a good many ways in which the lessons of modern sanitation can be learned. Some of these lessons may wisely, as I think, be woven into the educational equipment of the young. They may be acquired in later life from books. Many may be assimilated under the kindly offices of the physician. Much is taught by such public measures as health boards may enforce. But, learned these lessons must be sooner or later, and learned they are too often now at the bedside and the grave.

Physicians know well enough that a stringent system of dairy inspection should be at once and widely enforced, and it is really for them more than for any other class of citizens to say how many more object lessons will be necessary like those recently enforced at Montclair, at Waterbury, and at Stamford, before all such caterers shall be compelled to conform to the rules of sanitary decency. The prevention of pollution of water supplies, the compelling of reasonable cleanliness in public vehicles for human transportation by land and by sea, the enforcement of precautions against the spread of disease in public hostelries and places of assembly, the organization of a national health bureau—these are all tasks which must speedily be undertaken, and they may be led to rich accomplishment if the physician will but hold more clearly in his consciousness his primal duty as a citizen.

In all that which I have urged about the more precise physical and, I might almost say, mechanical nature of the professional duties which in the new light the physician is called upon to assume, I have purposely left largely out of sight his more intimate personal relationships to those to whom he ministers. And yet, lest one should fear that in our eager search for light we overlook the man in the machine, I should like to assure the timid that all that which always has and ever will dignify and ennoble his calling, as one who is strong serving the weak, remains unchanged in the physician, and is potent or feeble, not in ratio to his scientific knowledge, but as he is more or less honest, keen of insight, high of purpose, sympathetic; and finds its highest fruition joined to good judgment and self-reliance, and to whatever confidence-winning and hope-inspiring qualities he can command.

It is not easy to estimate accurately the scope and value of contemporary achievement. But as I look over the field of medicine, with all its varying lights and shades, it seems to me that the things which are most deeply significant in these closing years of the century are not the newly gained skill in diagnosis, not the marvelous strides which surgery has made, beneficent as these may be, not the more exact and purposeful and moderate use of drugs, not the insight which has been gained regarding the complex nature of the nervous system, nor even in the high achievements, too numerous and varied to be even mentioned here, which the new science of bacteriology has made possible.

Beyond all these accomplishments, notable enough though they be for any age, the things which more than all else, it seems to me, will signalize this time, are that we have now definitely freed medicine, in all its borders, from the thralldom of mystery and superstition, have finally and clearly recognized that its problems are the problems of biology, and are to be solved only by such patient research and guarded inference as all science has learned to trust; that the doctor is in command of no mysterious forces, and that the only chance for the full and speedy fruition of our hope in the prevention of disease lies in general education, and in the enlistment of the interests of the people, of whom the medical profession should be the teacher and the guide.

Of course, the shadows here and there will linger on; of course, one and another for some time to come will still invest his calling with the puerile mysteries which were fostered in ignorance, and which should have been put aside with the scarlet cloak and the wig and the ponderous walking stick. Of course, so long as the people are largely ignorant of elementary facts regarding the human frame, quacks will flourish and more or less well-meaning advocates will be found of water, of electricity, of faith, of exorcism, of infinitesimal dosage, and of every sort of named and unnamed folly, as panaceas and as substitutes for science. But, after all, when medicine is once placed where it belongs, close to its sister disciplines, from which it gathers light and in its turn inspires, the shadows are certain soon to fade and the truth to prevail.

You will observe, ladies and gentlemen, that the current of my thought has led again and again to the outlooks which command the field of preventive medicine. This is not only because here the new light shines brightest, and gives clearest glimpses of definite achievement, but also because upon this field success is possible only if we can secure general and earnest co-operation in the spread of the new ideals of cleanliness.

In truth, the exactions of our modern sanitary codes, so far as they affect the performances of the individual and the routine of the household, are neither complex nor burdensome; and a very moderate amount of care, if happily joined to informed intelligence, will suffice, under almost all conditions, for the maintenance of a safe *régime.*

You will, I hope, forgive me for casting the shadow of disease over the festival spirit of this hour. But, after all, our lasting enjoyment is most frequently secured by such physical well-being as these new outlooks in medicine promise to cherish.

And so, gentlemen of the graduating class, at last, to the lifelong study of this science which looks out upon so many pathways toward the light, and to the practice of our art, whose aims are ever closely linked to the high realities of life, it is now my privilege, on behalf of our guild, and in the name of the Faculty of this ancient and honored college of medicine, to bid you a cordial welcome.

SUGGESTIBILITY, AUTOMATISM, AND KINDRED PHENOMENA.

By Prof. WILLIAM ROMAINE NEWBOLD.

II. THE PROPERTIES OF MENTAL STATES.—THE CONCEPTION OF THE SUBCONSCIOUS.

THERE is another deduction from the doctrine of parallelism which has been much disputed but which seems to me legitimate. I know that when I glance up from my paper, see a pen, reach out and take it, ether waves which fell upon the retina of my eye produced there chemical changes which irritated the optic nerve; the irritation was transmitted to the visual centers of the brain, thence propagated to the motor centers, and from the motor centers went an impulse which contracted the muscles of my arm. But I am not directly conscious of all this. It seems to me that the conscious state which I call the perception of the pen caused the thought of the movement and the movement itself at almost the same time. Now, if we believe that every conscious state which we know has its physical concomitant of which we know nothing save by inference, I see no reason why we may not, for the time at least, ascribe directly to the mental states the properties which we believe belong in all strictness to their physical bases only. Thus, I think it correct to say that the perception of the pen awakened the thought of taking it and that that in turn produced the movement. Yet in using this form of speech we must guard against certain erroneous inferences which are frequently drawn from it. The first is that the perception of the pen was the *only* cause of the thought of taking it, and so on. We now know that the whole sequence which I have described depends for its existence and development upon the constitution of the total system of processes. This we are apt to forget, when we deal with the mental only, for the law of attention prevents any but a small portion of those processes obtaining clear recognition in consciousness at any one time: the remainder affect the clearest portion more or less, but exist themselves only dimly in the marginal region to which I am not attending. Again, we must not suppose that in ascribing to the mental state active properties we mean to imply that the mental states could exist or manifest those properties apart from the physical processes which form their basis, or that they can act upon them in any way from outside, as the older psychology supposed. I do not think, as most psychologists do, that this notion is inconsistent with the doctrine of parallelism, but it certainly can not be derived from it, or from the facts upon which it rests. Guarding against these two errors, then, we may justly regard the mental state as an active, dynamic thing, subject to laws and possessed of properties into which it is the business of the psychologist to inquire.

We all know the difference between red as *seen* and red as we *think* it, although the difference is hard to describe. In most persons the sensation red is peculiarly intense and vivid, while the idea is lacking in some indescribable way in both these traits. Now, we have reason to believe that both mental states are of the same general kind, and that the idea is capable of passing into a state indistinguishable from the sensation. Such a transition is known as development. In some persons certain ideas are normally already developed, so to speak, to their maximum degree. A friend of mine tells me that, so far as vividness and intensity go, it makes little difference to him whether his eyes are open or shut—what he sees is about the same in either case. But more commonly the idea must be much heightened before it reaches sensational intensity. Another friend of mine by thinking intently of a friend's appearance can see that friend slowly taking shape, at first as a shadowy outline, then gaining in clearness and solidity until the shadowy outline has become the perfect form of a real person. Now, if we regard the dimmest idea as zero and the clear sensation as the maximum, we may say that any mental state may conceivably run through all the intervening grades, and we have reason to believe that every mental state tends to run through some grades. This I would express by saying that every mental state tends to develop within limits which we can not at present assign. The first property of the mental state, then, is that of development. It is of importance in explaining the phenomena of dreams and hallucinations.

The second group of properties which I shall mention depend upon the transmissibility of the physical impulse. I have already shown in my first paper how mental elements become agglutinated into systems in which any one tends to awaken the others. It is also true of the relation of any one system to another; they tend to awaken one another. This is what is commonly described as association of ideas. The reverse is also true, although not as well known; many states tend to prevent the appearance of other states. Agreeable states, for example, tend to force out the disagreeable, and *vice versa*. This, then, may be generalized in the statement of the second property of mental states: every mental state tends to produce, or prevent the production of, other states. We may suppose that these phenomena are due to the interplay of systems of activities within the cortex with one another.

But these activities within the cortex which underlie our ordinary life of sensation and thought tend also to discharge downward through the Rolandic region into the motor mechanism, producing contractions of the muscles. Thus the third property of the mental state is the ability to produce or prevent muscular contraction. Not all mental states have this property in the same degree. It is most evidently true of the *feeling* of movement. I once asked a class of sixteen girls to think intently what it would feel like to lift the right hand and touch the left shoulder. After a few minutes had elapsed nine of them confessed having felt a desire to do it. I then dropped the subject and spoke of something else: in a few moments six actually did it. Most persons when concentrating attention upon the thought of what a given movement would feel like, find themselves becoming possessed of a desire to do it, and this desire marks the tendency of the thought to produce the movement. But as we not only feel but also see our movements, we find that the thought of what a movement looks like has also motor value and tends to produce it. This is also true of touches and ideas of touch—indeed, all or nearly all mental states produce some motor changes in the body, but the motor effects of sensations and ideas of sound, taste, and smell are relatively slight.

Again, mental states tend to help or hinder the processes of secretion and nutrition. We all know that the secretions of the salivary glands, of the kidneys, of the mammary, and other glands are readily affected by many mental states, but their effect upon the processes of nutrition is more disputed. It is quite certain that in a general way the impulses sent out by the central nervous system are necessary to the proper nutrition of the body, but it is not as generally accepted that individual mental states can produce definite changes, as, for example, when it is reported that a hypnotized patient, by thinking of a burn, has actually produced the burn. Yet even for this there is good evidence.

One may justly ask how it is, if mental states really have definite consequences, that we fail to note in our mental life the orderly sequence of cause and effect with which we are familiar in the physical world? If there be any truth in the theory above outlined, this inability to observe it is precisely what one should expect. It is not possible to analyze the total content of consciousness into any definite number of "states." The total state of consciousness at any given moment depends upon the condition and character of a system of physical activities, and its few distinguishable elements are related to some rather than to other elements of that system. But no portion of the system could be what it is if the other portions were not just what they are, and in the succession of the clearer states of consciousness we see not merely the effect of the one clear state upon the next clear state, but the effect of one whole system upon the next whole system; and often the active factor in determining the character of the next clear state is not what was clearest in the preceding, but one of those which were dimly existent in the margin, or even one of those that were subconscious. To determine the true properties of any state it would be necessary to isolate it by breaking up this co-ordination, and that, as I shall show later, we can to some extent do.

Before taking up these more complex forms of disorganization, or, better, disordination, I must make plain the meaning of the word *subconscious*, which I have had occasion once or twice to use.

I am sitting in a chair and reading an interesting story; the clock strikes and I do not hear it. Why? There are only four possible theories. We must suppose that the air vibrations strike the ear drum and are propagated through the ear bones and lymph to the auditory nerve. Then either (1) the physical process is blocked at some point between the terminal filaments of the auditory nerve in the inner ear and its origin in the cortex; or (2) the irritation reaches the cortex, but fails to awaken any cortical process; or (3) it awakens a cortical process which is unaccompanied by any mental state; or (4) it awakens both a cortical process and a mental state. For the first of these alternatives there is no evidence. On the contrary, since I hear the clock strike if I am expecting it, and since all theories require us to regard expectation as dependent upon cortical processes, if any mental phenomena are, we must look to the cortex for the explanation and not to the peripheral machinery. The second alternative is conceivable, but there is no direct evidence for it and there is some against it. It is frequently possible, for example, to awaken by hypnotic suggestion a memory of the event which was not consciously experienced, and, as memory depends upon the traces left by earlier experiences in the cortex, it would seem to follow that there must have been a cortical disturbance. The third alternative is more probable. There is reason for believing that any cortical process must attain a certain degree of intensity before its mental concomitant comes into being at all, and perhaps the existence of other active processes prevents its attaining that degree of intensity. Again, if we revert to the old soul theory, now almost wholly abandoned by psychologists, but still, I think, worthy of consideration, we may suppose that the cortical process alone can not produce consciousness, but requires the co-operation of some other factor. The *pros* and *cons* in these last two suppositions are too intricate for present discussion, and, indeed, my purpose is, not to prove a theory, but to state the fourth supposition and to analyze some of its logical implications.

The parallel theory would raise the presumption that any cortical process is accompanied by mental phenomena of some kind. We would then assume, in the case under consideration, that the cortical process in the auditory center generated a sound. But how is this to be reconciled to the testimony of consciousness that I heard no sound ?

Well, it may be that I did hear it, but instantly forgot it, so that my present memory of that period contains no trace of it. That this frequently happens there can be no doubt, but there are many curious phenomena which require a further assumption, and that further assumption may be thus stated: The sound may have existed simply as a solitary sound, all alone, not in my consciousness or in the consciousness of any one, but as a bare mental event, related to my consciousness much as a sound in your consciousness is related to mine. It is not an easy conception to grasp, for our mental life always consists of many elements, and it would seem that this multiplicity is essentially involved in our notion of consciousness. Yet occasionally we have experiences which help us in forming the conception of a mental state existing outside a personal consciousness. I remember a trifling operation upon the eye which I once underwent. For a few seconds my consciousness seemed reduced to one element—a flood of frightful pain, which was not in my eye but seemed to pervade my whole being, to the almost complete exclusion of all else. Again, under nitrous oxide, my consciousness seemed reduced to something so rudimentary as to be wholly indescribable. I have heard of many similar experiences.

Without pronouncing upon the relative merits of the last two hypotheses I shall develop some of the logical implications of the latter. A state such as I have described, supposed to exist within my head, so to speak, but outside my consciousness, may be described as subconscious. There are, then, two conceivable ways in which a mental state may vanish from the upper consciousness. The cortical process upon which it depends may die away; it then perishes absolutely; or the cortical process may be dissociated from the system underlying the total consciousness and yet remain active, thus giving rise to a subconscious state. This supposition, that a cortical process may exist without coalescing at all with the general system, is a somewhat novel assumption, and it is in my opinion the weakest point of the theory. It would require the further assumption that a cortical system, once coordinated, tends to resist the introduction of a new element into it, and for this there is some introspective evidence.

For consistency's sake the dynamic conceptions which I would apply to mental states in consciousness must be applied also to these mental states existing subconsciously. Subconscious ideas and sensations must be capable of development in intensity and in perfection of finish, so to speak; must be able to awaken associated ideas, to produce bodily movements, to affect secretion and other metabolic processes. It would appear possible that the dissociated processes underlying them may suddenly effect union with the upper system, thus intruding the subconscious state into the upper consciousness. When it does not actually effect union it is conceivable that some of its results, such as its associated ideas or emotional consequents, may appear in the upper consciousness. It is also conceivable that its mere existence may disturb the normal tension of the cortical activities, what has been termed the psychostatic equilibrium of the cortex, and thus affect the upper consciousness. A mental state supposed to be thus growing and working subconsciously has been happily termed by Pierre Janet a mental parasite or neoplasm. For all these inferences, which I have stated as deductions from the hypothesis that there exist mental states dissociated from the normal consciousness, there is a great deal of direct evidence, and it is upon an inductive study of that evidence that the hypothesis is based; but the limitations of space prevent my giving concrete illustrations.

At a recent meeting of the English Folklore Society, a presentation was made to Mr. G. Laurence Gomme, late president of the society, after which Mr. Gomme spoke of his connection with the society—as honorary secretary, director, president, and now vice-president — since seventeen years ago, when he was one of four who started it in the dining room of the late Mr. Thoms, founder and editor of Notes and Queries. The society had taken its position now, he was sure, as representative of the psychological side of the history of man. With Mr. Brabrook, President of the Anthropological Society, and Prof. Haddon working with them, they hoped as soon as possible to obtain their proper position at the British Association, and, with their scientific standing officially recognized, proceed to accomplish some of the great work he believed they had before them. They were not a *dilettanti* society, playing with antiquities, but they were taking part in unraveling some of the great mysteries of man's nature.

STUDIES OF CHILDHOOD.

XIV.—THE CHILD AS ARTIST.

By JAMES SULLY, M. A., LL. D.,
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ONE of the most interesting, perhaps also one of the most instructive, phases of child-life is the beginnings of art activity. This has been recognized by one of the best-known workers in the field of child-psychology, M. Bernard Perez, who has treated the subject in an interesting monograph.* This department of our subject will, like that of language, be found to have interesting points of contact with the phenomena of primitive race culture.

The art impulse of children lends itself particularly well to observation. No doubt, as we shall see, there are difficulties for the observer here. It may sometimes be a fine point to determine whether a childish action properly falls under the head of genuine art production, though I do not think that this is a serious difficulty. On the other hand, the art impulse, where it exists, manifests itself directly and for the most part in so characteristic an objective form that we are able to study its features with special facility.

In its narrow sense as a specialized instinct prompting its possessor to follow a definite line of production, as drawing of the artistic sort, or simple musical composition, the art impulse is a particularly variable phenomenon of childhood. Some children who afterward take seriously to a branch of art culture, manifest an innate bent by a precocious devotion to this line of activity. Many others, I have reason to believe, have a passing fondness for a particular form of art activity. On the other hand, there are many children who display almost a complete lack, not only of the productive impulse, but of the æsthetic sense of the artist. So uncertain, so sporadic, are these appearances of a rudimentary art among children, that one might be easily led to think that art activity ought not to be reckoned among their common characteristics.

To judge so, however, would be to judge erroneously, by applying grown-up standards. It is commonly recognized that art and play are closely connected. It is probable that the first crude art of the race, or at least certain directions of it, sprang out of playlike activities, and, however this be, the likenesses of the two are indisputable. I shall hope to bring these out in the pres-

* L'Art et la Poésie chez l'Enfant, 1888.

ent study. This being so, we are, I conceive, justified in speaking of art impulses as a common characteristic of childhood.

Although we shall find many interesting points of analogy between crude child-art and primitive race-art, we must not, as pointed out above, expect a perfect parallelism. In some directions, as drawing, concerted dancing, the superior experience, strength, and skill of the adult will reveal themselves, placing child-art at a considerable disadvantage in the comparison. Contrariwise, the intervention of the educator's hand tends seriously to modify the course of development of the child's æsthetic aptitudes. His tastes get acted upon from the first and biased in the direction of adult tastes.

This modifying influence of education shows itself more especially in one particular. There is reason to think that in the development of the race the growth of a feeling for what is beautiful was a concomitant of the growth of the art impulse, the impulse to adorn the person, to collect feathers and other pretty things. Not so in the case of the child. Here we note a certain growth of the liking for pretty things before the spontaneous art impulse has had time to manifest itself. Most children who have a cultivated mother or other guardian acquire a rudimentary appreciation of what their elders think beautiful before they do much in the way of art production. We provide them with toys, pictures, we sing to them, and perhaps we even take them to the theater, and so do our best to inoculate them with our ideas as to what is pretty. Hence the difficulty—probably the chief difficulty—of finding out what the child-mind, left to itself, does prefer. At the same time the early date at which such æsthetic preferences begin to manifest themselves makes it desirable to study them before we go on to consider the active side of child-art. We will try as well as we can to extricate the first manifestations of genuine childish taste.

At the very beginning, before the educational influence has had time to work, we can catch some of the characteristics of this childish quasi-æsthetic feeling. The directions of a child's observation, and of the movements of his grasping arms, tell us pretty clearly what sort of things attract and please him.

In the home scene it is bright objects, such as the fire flame, the lamp, the play of the sunlight on a bit of glass or a gilded frame; out of doors, glistening water, a meadow whitened by daisies, the fresh snow mantle, later the moon and the stars, which seem to impart to the dawning consciousness the first hint of the world's beauty. Luminosity, brightness in its higher intensities, whether the bright rays reach the eye directly or are reflected from a lustrous surface, this makes the first gladness of the eye, as it remains a chief source of the gladness of life.

The feeling for color as such comes distinctly later. The first delight in colored objects is hardly distinguishable from the primordial delight in brightness. This applies pretty manifestly to the brightly illumined, rose-red curtain which Preyer's boy greeted with signs of satisfaction at the age of twenty-three days, and it applies to later manifestations. Thus Preyer found, on experimenting with his boy toward the end of the second year as to his color discrimination, that a decided preference was shown for the bright or luminous colors, red and yellow.* Much the same thing was observed by Miss Shinn in her interesting account of the early development of her niece's color sense.† Thus in the twenty-eighth month she showed a special fondness for the daffodils, the bright tints of which allured another and older maiden, and, alas! to the place whence all brightness was banished. About the same time the child conceived a fondness for a yellow gown of her aunt, strongly objecting to the substitution for it of a brown dress. Among the other colored objects which captivated the eye of this little girl were a patch of white cherry blossom and a red sunset sky. Such observations might easily be multiplied. Whiteness, it is to be noted, comes, as we might expect, with bright partial colors, among the first favorites.‡

At what age a child begins to appreciate the value of color as color, to like blue or red, for its own sake and apart from its brightness, it is hard to say. The experiments of Preyer, Binet, Baldwin, and others, as to the discrimination of color, are hardly conclusive as to special likings, though Baldwin's plan of getting the child to reach out for colors throws a certain light on this point. According to Baldwin, blue is one of the first colors to be singled out; but he does not tell us how the colors he used (which did not, unfortunately, include yellow—the child's favorite according to other observers) were related in point of luminosity.#

No doubt a child of three or four is apt to conceive a special liking for a particular color, which favorite he is wont to appropriate as "my color." A collection of such perfectly spontaneous preferences is a desideratum in the study of the first manifestations of a feeling for color. Care must be taken in observing these selections to eliminate the effects of association, and the unintentional influence of example and authority, as when a child takes to a particular color because it is "mamma's color"—that is, the one she appears to affect in her dress and otherwise.

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* *Op. cit.*, p. 7 and p. 11 f.

† Notes on the Development of a Child, p. 91 ff.

‡ Cf. Perez, L'Art et la Poésie chez l'Enfant, p. 41 ff.

\# See Baldwin's two articles on A New Method of Child Study, in Science, April, 1893, and his volume, Mental Development in the Child and the Race.

The values of the several colors probably disclose themselves in close connection with that of color contrast. Many of the likings of a child of three in the matter of flowers, birds, dresses, and so on, are clearly traceable to a growing pleasure in color contrast. Here again we must distinguish between a true chromatic and a merely luminous effect. The dark-blue sky showing itself in a break in the white clouds, one of the colored spectacles which delighted Miss Shinn's niece, may have owed much of its attractiveness to the contrast of light and dark. It would be interesting to experiment with children of three with a view to determine whether and how far chromatic contrast pleases when it stands alone, and is not supported by that of chiaroscuro.

I have reason to believe that children, like the less cultivated adults, prefer juxtapositions of colors which lie far from one another in the color circle, as blue and red or blue and yellow. It is sometimes said that the practice and the history of painting show blue and red to be a more pleasing combination than that of the complementary colors, blue and yellow. It would be well to test children's feeling on this matter. It would be necessary in this inquiry to see that the child did not select for combination a particular color as blue or yellow for its own sake, and independently of its relation to its companion—a point not very easy to determine. Care would have to be taken to eliminate further the influence of authority as operating, not only by instructing the child what combinations are best, but by setting models of combination, in the habitual arrangements of dress and so forth. This, too, would probably prove to be a condition not easy to satisfy.*

I have dwelt at some length on the first germs of color appreciation, because this is the one feature of the child's æsthetic sense which has so far lent itself to definite experimental investigation. It is very different when we turn to the first appreciation of form. That little children have their likings in the matter of form is, I think, indisputable, but they are not those of the cultivated adult. A quite small child will admire the arch of a rainbow and the roundness of a kitten's form, though in these instances the delight in form is far from pure. More clearly marked is the appreciation of pretty, graceful movements, as a kitten's boundings. Perhaps the first waking up to the graces of form takes place in connection with this delight in the forms of motion, a delight which at first is a mixed feeling, involving the interest in all motion as suggestive of life, to which reference has already been made. Do not all of us, indeed, tend to translate our impressions

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* The influence of such authority is especially evident in the selection of harmonious shades of color for dress, etc. *Cf.* Miss Shinn, *op. cit.*, p. 95.

of still forms back into these first impressions of the forms of motion?

One noticeable feature in the child's first response to the attractions of form is the preference given to "tiny" things. The liking for small natural forms, birds, insects, shells, and so forth, and the prominence of such epithets as "wee," "tiny" or "teeny," "dear little," in the child's vocabulary alike illustrate this early direction of taste. This feeling again is a mixed one; for the child's interest in very small fragile-looking things has in it an element of caressing tenderness which again contains a touch of fellow-feeling. This is but one illustration of the general rule of æsthetic development in the case of the individual and of the race alike that a pure contemplative delight in the aspect of things only gradually detaches itself from a mixed feeling.

If now we turn to the higher aspects of form, regularity of outline, symmetry, proportion, we encounter a difficulty. Many children acquire while quite young and before any formal education commences a certain feeling for regularity and symmetry. But is this the result of a mere observation of natural or other forms? Here the circumstances of the child become important. He lives among those who insist on these features in the daily activities of the home. In laying the cloth of the dinner table, for example, a child sees the regular division of space enforced as a law. Every time he is dressed, or sees his mother dress, he has an object lesson in symmetrical arrangement. And so these features take on a kind of ethical rightness before they are judged as elements of æsthetic value. As to a sense of proportion between the dimensions or parts of a form, the reflection that this involves a degree of intellectuality above the reach of many an adult might suggest that it is not to be expected from a small child; and this conjecture will be borne out when we come to examine children's first essays in drawing.

These elementary pleasures of light, color, and certain simple aspects of form may be said to be the basis of a crude perception of beauty in natural objects and in the products of human workmanship. A quite small child is capable of acquiring a real admiration for a beautiful lady, in the appreciation of which brightness, color, grace of movement, the splendor of dress, all have their part, while the charm for the eye is often re-enforced by a sweet and winsome quality of voice. Such an admiration is not perfectly æsthetic: awe, an inkling of the social dignity of dress,* perhaps a longing to be embraced by the charmer, may all enter into it; yet a genuine admiration of look for its own sake is the core of the feeling. In other childish admirations, as the girl's

* On the nature of the early feeling for dress, see Perez, L'Art et la Poésie chez l'Enfant.

enthusiastic worship of the newly arrived baby, we see a true æsthetic sentiment mingled with and struggling, so to speak, to extricate itself from such "interested" feelings as sense of personal enrichment by the new possession and of family pride. In the likings for animals, again, which often take what seem to us capricious and quaint directions, we may see rudiments of æsthetic perceptions half hidden under a lively sense of absolute lordship tempered with affection.

Perhaps the nearest approach to a pure æsthetic enjoyment in these first experiences is the love of flowers. The wee round wonders with their mystery of velvety color are well fitted to take captive the young eye. I believe most children who live among flowers and have access to them acquire something of this sentiment, a sentiment of admiration for beautiful things with which a sort of dumb childish sympathy commonly blends. No doubt there are marked differences among children here. There are some who care only, or mainly, for their scent, and the strong sensibilities of the olfactory organ appear to have a good deal to do with early preferences and prejudices in the matter of flowers.* Others again care for them mainly as a means of personal adornment, though I am disposed to think that this partially interested fondness is less common with children than with many adults. It is sometimes said that the love of flowers is, in the main, a characteristic of girls. I think, however, that if one takes children early enough, before a consciousness of sex and of its proprieties has been allowed to develop under education, the difference will be but slight. Little boys of four or thereabouts very often show a very lively sentiment of admiration for these gems of the plant world.

In much of this first crude utterance of the æsthetic sense of the child we have points of contact with the first manifestations of taste in the race. Delight in bright, glistening things, in gay tints, in strong contrasts of color, as well as in certain forms of movement, as that of feathers—the favorite personal adornment—this is known to be characteristic of the savage and gives to his taste in the eyes of civilized man the look of childishness. On the other hand, it is doubtful whether the savage attains to the sentiment of the child for the beauty of flowers. Our civilized surroundings, meadows, and gardens, as well as the constant action of the educative forces of example, soon carry the child beyond the savage in this particular.

How far can children be said to have the germ of a feeling for Nature, or, to use the more comprehensive modern term, cosmic emotion? It is a matter of common observation that they have

* See Perez, L'Art et la Poésie chez l'Enfant, p. 90 f.

not the power to embrace a multitude of things in a single act of contemplation. Hence they have no feeling for landscape as a harmonious complex of picturesquely varied parts. When they are taken to see a "view," their eye, instead of trying to embrace the whole, as a fond parent desires, provokingly pounces on some single feature of interest, and often one of but little æsthetic value. People make a great mistake in taking children to "points of view" under the supposition that they will share in grown people's impressions. Perez relates that some children taken to the Pic du Midi found their chief pleasure in scrambling up the peak and saying that they were on donkeys.* Mere magnitude or vastness of spectacle does not appeal to the child, for a sense of the sublime grows out of a complex imaginative process which is beyond his young powers. So far as immensity affects him at all, as in the case of the sea, it seems to excite a measure of dread in face of the unknown; and this feeling, though having a certain kinship with the emotion of sublimity, is distinct from this last. It has nothing of the joyous consciousness of expansion which enters into the later feeling. It is only to certain limited objects and features of Nature that the child is æsthetically responsive. He knows the loveliness of the gilded spring meadow, the fascination of the sunlit stream, the awful mystery of the wood, and something too, perhaps, of the calming beauty of the broad blue sky. That is to say, he has a number of small rootlets which when they grow together will develop into a feeling for Nature.

Here, too, the analogy between the child and the uncultured Nature-man is evident. The savage has no æsthetic sentiment for Nature as a whole, though he may feel the charm of some of her single features, a stream, a mountain, the star-spangled sky, and may even be affected by some of the awful aspects of her changing physiognomy. Are we not told, indeed, that a true æsthetic appreciation of the picturesque variety of Nature's scenes, of the weird charm of wild places, and of the sublime fascinations of the awful and repellent mountain, are quite late attainments in the history of our race? †

We may now look at the child's attitude toward those objects and processes of human art which from the first form part of his environment and make an educative appeal to his senses; and here we may begin with those simple musical effects which follow up certain impressions derived from the natural world.

It has been pointed out that sounds form a chief source of the

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* *Op. cit.*, p. 103.

† An excellent sketch of the growth of our feeling for the romantic and sublime beauty of mountains is given by Mr. Leslie Stephen in one of the most delightful of his works, The Playground of Europe.

little child-heart's first trepidations. Yet this prolific cause of disquietude, when once the first alarming effect of strangeness has passed, becomes a main source of interest and delight. Some of Nature's sounds, as those of running water and of the wind, early catch the ear, and excite wonder and curiosity. Miss Shinn illustrates fully in the case of her niece how the interest in sounds developed itself in the first years.* This pleasure in listening to sounds and in tracing them to their origin forms a chief pastime of babyhood.

Æsthetic pleasure in sound begins to be differentiated out of this general interest as soon as there arises a comparison of qualities and a development of preferences. Thus the sound of metal (when struck) is preferred to that of wood or stone. A nascent feeling for musical quality thus emerges which probably has its part in many of the first likings for persons; certain pitches, as those of the female voice, and possibly timbres being preferred to others.

Quite as soon, at least, as this feeling for quality of sound or tone, there manifests itself a crude liking for rhythmic sequence. It is commonly recognized that our pleasure in regularly recurring sounds is instinctive, being the result of our whole nervous organization. We can better adapt successive acts of listening when sounds follow at regular intervals, and the movements which sounds evoke can be much better carried out in a regular sequence. The infant shows us this in his well-known liking for well-marked rhythms in tunes which he accompanies with suitable movements of the arms, head, etc.

The first likings for musical composition are based on this instinctive feeling for rhythm. It is the simple tunes, with well-marked, easily recognizable time divisions, which first take the child's fancy, and he knows the quieting and the exciting qualities of different rhythms and times. Where rhythm is less marked, or grows highly complex, the motor responses being confused, the pleasurable interest declines. It is the same with the rhythmic qualities of verses. The jingling rhythms which their souls love are of simple structure, with short feet well marked off, as in the favorite "Jack and Gill."

Coming now to art as representative, we find that a child's æsthetic appreciation waits on the growth of intelligence, on the understanding of artistic representation as contrasted with a direct presentation of reality.

The development of an understanding of visual representation or the imaging of things has already been touched upon. As Perez points out, the first lesson in this branch of knowledge is

* *Op. cit.*, p. 115 ff.

supplied by the reflections of the mirror, which, as we have seen, the infant begins to take for realities, though he soon comes to understand that they are not tangible realities. The looking glass is the best means of elucidating the representative function of the image or "*Bild*" just because it presents this image in close proximity to the reality, and so invites direct comparison with this.

In the case of pictures where this direct comparison is excluded we might expect a less rapid recognition of the representative function. Yet children show very early that picture semblances are understood in the sense that they call forth reactions similar to those called forth by realities. A little boy was observed to talk to pictures at the end of the eighth month. This perhaps hardly amounted to recognition. Pollock says that the significance of pictures "was in a general way understood" by his little girl at the age of thirteen months.* Miss Shinn tells us that her niece, at the age of forty-two weeks, showed the same excitement at the sight of a life-size painting of a cat as at that of real cats.† Ten months is also given me by a lady as the date at which her little boy recognized pictures of animals by naming them "bow-wow," etc., without being prompted.

This early recognition of pictures is certainly remarkable, even when we remember that animals have the germ of it. The stories of recognition by birds of paintings of birds, and by dogs of portraits of persons, have to do with fairly large and finished paintings.‡ A child, however, will "recognize" a small and roughly executed drawing. He seems in this respect to surpass the powers of savages, some of whom, at least, are said to be slow in recognizing pictorial semblances. This power, which includes a delicate observation of form and an acute sense of likeness, is seen most strikingly in the recognition of individual portraits. Miss Shinn's niece in her fourteenth month picked out her father's face in a group of nine, the face being scarcely more than a quarter of an inch in diameter.# I noticed the same fineness of recognition in my own children.

One point in this early observation of pictures is curious enough to call for especial remark. A friend of mine, a psychologist, writes to me that his little girl, aged three and a half, "does not mind whether she looks at a picture the right way up or the wrong; she points out what you ask for, eyes, feet, hands, tail, etc., about equally well whichever way up the picture is, and never asks to have it put right that she may see it better." The

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* Mind, iii, p. 393. † Notes on the Development of a Child, i, p. 71 f.

‡ See Romanes, Animal Intelligence, pp. 311 and 453 ff. The only exception is a photograph which is said to have been "large," p. 453. # *Op. cit.*, i, p. 74.

same thing was noticed in the other children of the family, and the mother tells me that her mother observed it in her children. I have found a further illustration of this indifference to the position of a picture in the two children of another friend of mine. Prof. Petrie tells me that he once watched an Arab boy looking at a picture-book. One, a drawing of horses and chariot, happened to have a different position from the rest, so that the book being held as before, the horses seemed to be going upward; but the boy was not in the least incommoded, and without attempting to turn the book round easily made it out. These facts are curious as illustrating the skill of the young eye in deciphering. They may possibly have a further significance as showing how what we call position—the arrangement of a form in relation to a vertical line—is a comparatively artificial view of which a child as yet takes little if any account. He may be able to concentrate his attention so well on form proper that he is indifferent to the point how the form is placed. Yet this matter is one which well deserves further investigation.*

A further question arises as to whether this "recognition" of pictures by children toward the end of the first year necessarily implies a grasp of the idea of a picture—that is, of a representation or copy of something. The first reactions of a child, smiling, etc., on seeing mirror images and pictures, do not seem to show this, but merely that he is affected much as he would be by the presence of the real object, or, at most, that he recognizes the picture as a kind of thing. The same is, I think, true of the so-called recognition of pictures by animals.

That children do not, at first, seize the pictorial or representative function is seen in the familiar fact that they will touch pictures us they touch shadows and otherwise treat them as if they were tangible realities. Thus Pollock's little girl attempted to smell at the trees in a picture and "pretended" to feed some pictorial dogs.

When the first clear apprehension of the pictorial function is reached it is difficult to say. Miss Shinn thought that her niece "understood the purport of a picture quite well" at the age of forty-five weeks. She draws this conclusion from the fact that at this date the child, in answer to the question, "Where are the flowers?" leaned over and touched the painted flowers on her aunt's gown, and then looked out to the garden with a cry of desire.† But this inference seems to me very risky. All that the child's behavior proves is that she "classed" real and painted

* Prof. Petrie reminds me that a like absence of the perception of position shows itself in the way in which letters are drawn in early Greek and Phœnician writings.

† *Op. cit.*, i, p. 72.

flowers together, while she recognized the superiority of the former as the tangible and probably the odorous ones. The strongest evidence of recognition of pictorial function by children is, I think, their ability to recognize the portrait of an individual. But even this is not quite satisfactory. It is conceivable, at least, that a child may look on a photograph of his father as a kind of "double." The boy C—— took his projected photograph very seriously as a kind of doubling of himself. The story of the dog, a Dandy Dinmont terrier, that trembled and barked at a portrait of his dead mistress,* seems to me to bear this out. It would surely be rather absurd to say that the demonstrations of this animal, whatever they may have meant, prove that he took the portrait to be a memento likeness of his dead mistress.

We are apt to forget how difficult and abstract a conception is that of pictorial representation, how hard it is to look at a thing as pure semblance having no value in itself, but only as standing for something else. A like slowness on the part of the child to grasp a sign, as such, shows itself here as in the case of verbal symbols. Children will, quite late, especially when feeling is aroused and imagination specially active, show a disposition to transform the semblance into the thing. Miss Shinn herself points out that her niece, who seems to have been decidedly quick, was as late as the twenty-fifth month touched with pity by a picture of a lamb caught in a thicket, and tried to lift the painted branch that lay across the lamb. In her thirty-fifth month, again, when looking at a picture of a chamois defending her little one from an eagle, "she asked anxiously if the mamma would drive the eagle away, and presently quite simply and unconsciously placed her little hand edgewise on the picture so as to make a fence between the eagle and the chamois." † Such ready confusion of pictures with realities shows itself in the fourth year and later. A boy nearly five was observed to strike at the figures in a picture and to exclaim, "I can't break them." The Worcester collection of observations illustrates the first confused idea of a picture. "One day F——, a boy of four, called on a friend, Mrs. C——, who had just received a picture, representing a scene in winter, in which people were going to church, some on foot and others in sleighs. F—— was told whither they were going. The next day he came and noticed the picture, and looking at Mrs. C—— and then at the picture, said, 'Why, Mrs. C——, them people haven't got there yet, have they?'"

All this points, I think, to a slow and gradual emergence of the idea of representation or likeness. If a child is capable in moments of intense imagination of confusing his battered doll with

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* Romanes, *op. cit.*, p. 453.

† *Op. cit.*, ii, p. 104.

a living reality, he may be expected to act similarly with respect to the fuller likeness of a picture. Vividness of imagination tends in the child as in the savage, and indeed in all of us, to invest a semblance with something of reality. We are able to control the illusory tendency and to keep it within the limits of an æsthetic semi-illusion; not so the child. Is it too fanciful to suppose that the belief of the savage in the occasional visits of the real spirit-god to his idol has for its psychological motive the impulse which prompts the child ever and again to identify his toys and even his pictures with the realities which they represent?

As might be expected, this impulse to confuse representation and represented reality shows itself very distinctly in the first reception of dramatic spectacle. If you dress up as Father Christmas, your child, even though he is told that you are his father, will hardly be able to resist the illusion that your disguise so powerfully induces. Cuvier relates that a boy of ten, on watching a stage scene in which troops were drawn up for action, broke out in loud protestations to the actor who was taking the part of the general, telling him that the artillery was wrongly placed, and so forth.* This reminds one of the story of the sailors who on a visit to a theater happened to see a representation of a mutiny on board ship, and were so excited that they rushed on the stage and took sides with the authorities in quelling the movement.

I believe that this same tendency to take art representations for realities reappears in children's mental attitude toward stories. A story by its narrative form seems to tell of real events, and children, as we all know, are wont to believe tenaciously that their stories are true. I think I have observed a disposition in imaginative children to go beyond this, and to give present actuality to the scenes and events described. And this is little to be wondered at when one remembers that even grown people, familiar with the devices of art imitation, tend now and again to fall into this confusion. Only a few days ago, as I was reading an account by a friend of mine of a perilous passage in an Alpine ascent, accomplished years ago, I suddenly caught myself in the attitude of proposing to shout out to stop him from venturing farther. A vivid imaginative realization of the situation had made it for the moment a present actuality.

Careful observations of the first attitudes of the child-mind toward representative art are greatly needed. We should probably find considerable diversity of behavior. The presence of a true art feeling would be indicated by a special quickness in the apprehension of art semblance as such.

In these first reactions of the young mind to the stimulus of

* Quoted by Perez, *op. cit.*, p. 216.

art presentation we may study other aspects of the æsthetic aptitude. Very quaint and interesting is the exacting realism of these first appreciations. A child is apt to insist on a pérfect detailed reproduction of the familiar reality. And here one may often trace the fine observation of these early years. Listen, for example, to the talk of the little critic before a drawing of a horse or a railway train, and you will be surprised to find how closely and minutely he has studied the forms of things. It is the same with other modes of art representation. Perez gives an amusing instance of a boy, aged four, who when taken to a play was shocked at the anomaly of a chambermaid touching glasses with her master on a *fête* day. "In our home," exclaimed the stickler for regularities, to the great amusement of the neighbors, "we don't let the nurse drink like that." * It is the same with story. Children are liable to be morally hurt if anything is described greatly at variance with the daily custom. Æsthetic rightness is as yet confused with moral rightness or social propriety, which, as we have seen, has its instinctive support in the child's mind in respect for custom.

Careful observation will disclose in these first frankly expressd impressions the special directions of childish taste. The preferences of a boy of four in the matter of picture-books tell us where his special interests lie, what things he finds pretty, and how much of a genuine æsthetic faculty he is likely to develop later on. Here, again, there is ample room for more careful studies directed to the detection of the first manifestations of a pure delight in things as beautiful, as charming at once the senses and the imagination.

The first appearances of that complex interest in life and personality which fills so large a place in our æsthetic pleasures can be best noted in the behavior of the child's mind toward dramatic spectacle and story. The awful ecstatic delight with which a child is apt to greet any moving semblance carrying with it the look of life and action is something which some of us, like Goethe, can recall among our oldest memories. The old-fashioned moving "*Schatten-bilder*," for which the gaudy but rigid pictures of the magic lantern are but a poor substitute, the puppet-show, with what a delicious wonder have these filled the childish heart! And as to the entrancing, enthralling delight of the story—well have Thackeray and others tried to describe this for us.

Of very special interest in these early manifestations of a feeling for art is the appearance of a crude form of the two emotions to which all representations of life and character make appeal—the feeling for the comic and for the tragic side of things. What

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* *Op. cit.*, pp. 215, 216.

we may call the adult's fallacy, the tendency to judge children by grown-up standards, frequently shows itself in an expectation that their laughter will follow the directions of our own. I remember having made the mistake of putting those delightful books, Tom Sawyer and Huckleberry Finn, into the hands of a small boy with a considerable sense of fun, and having been humiliated at discovering that there was no response. Children's fun is of a very elemental character. They are mostly tickled, I suspect, by the spectacle of some upsetting of the proprieties, some confusion of the established distinctions of rank. Dress, as we have seen, has an enormous symbolic value for the child's mind, and any confusion here is apt to be specially laughter-provoking. One child between three and four was convulsed at the sight of his baby bib fastened round the neck of his bearded sire. There is, too, a considerable element of rowdiness in children's sense of the comical, as may be seen by the enduring popularity of the spectacle of Punch's successful misdemeanors and bravings of the legal authority.

Since children are apt to take spectacles with an exacting seriousness, it becomes interesting to note how the two moods, realistic stickling for correctness, and rollicking hilarity at the sight of the disorderly, behave in relation one to another. More facts are needed on this point. It is probable that we have here to do in part with a permanent difference of temperament. There are serious, matter-of-fact little minds which are shocked by a kind of spectacle or narrative that would give boundless delight to a more elastic, fun-loving spirit. But discarding these permanent differences of disposition, I think that in general the sense of fun, the delight in the topsy-turviness of things, is apt to develop later than the serious realistic attitude already referred to. Here, too, it is probable that the evolution of the individual follows that of the race: the solemnities of custom and ritual weigh so heavily at first on the savage mind that there is no chance for sprightly Laughter to show himself. However this be, most young children appear to be unable to appreciate true comedy where the incongruous coexists with and takes on one half of its charm from serious surroundings. Their laughter is best called forth by a broadly farcical show in which all serious rules are set at naught.

Of no less interest in this attitude of the child-mind toward the representations by art of human character and action are the first rude manifestations of the feeling for the tragic side of life. A child of four or six is far from realizing the divine necessity which controls our mortal lives. Yet he will display a certain crude feeling for thrilling situation, exciting adventure, and something, too, of a sympathetic interest in the woes of mortals, quadrupeds as well as bipeds. The action, the situation, may easily grow too painful for an imaginative child disposed to take all representative spectacle as reality; yet the absorbing interest of the action where the sadness is bearable attests the early development of that universal feeling for the sorrowful fatefulness of things which runs through all imaginative writings from the "penny dreadful" upward.

THE FIFTH INTERNATIONAL PRISON CONGRESS.

By SAMUEL J. BARROWS,
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IN no country ought the results of the International Prison Congress, held last summer at Paris, to be received with more interest than in America, for it was an American pioneer in prison reform, the late Dr. E. C. Wines, who took the lead in organizing this series of international prison congresses. The way had been prepared by the formation of local associations in Europe and in this country. Dr. Wines's plan to have a grand international conference was fostered by correspondence with Count Sollohub, of Russia. The American Government backed up the enterprise by appointing Dr. Wines a commissioner to go to Europe a year in advance and secure the co-operation of other governments. The result was the holding of an international congress in London in 1872, and its organization upon a permanent basis, with Dr. Wines as president of the permanent commission. The second congress was held in Stockholm in 1878, the third in Rome in 1885, the fourth in St. Petersburg in 1890, and the fifth in Paris in 1895.

These conferences have steadily grown in interest and influence. The title of the congress hardly gives a full idea of its scope. This international gathering is not merely an assemblage of prison wardens to discuss the subject of prison management, though that alone would be well worth doing; it is as well a gathering of distinguished jurists, legislators, doctors, sociologists, magistrates, the heads of prison administration, and writers and experts on related branches of applied philanthropy. In the Paris congress there were two hundred foreign delegates from twenty-five different nations. In addition to these, the number of French adherents and delegates officially enrolled and personally or formally identified with the congress numbered five hundred and thirty-seven, and included many of the most distinguished names in France. The scope of these congresses has gradually been growing broader. Every subject in any way related to criminology now comes within their field. One of the things which distinguished the Paris congress from its predecessors was the greater emphasis laid upon preventive work and the establishment of a special department for the discussion of all questions relating to children and minors.

An important feature of these conferences is the large amount of preliminary work that is done in preparation for the quinquennial gathering. The permanent international commission, consisting of eight of the most prominent penologists of Europe, with Dr. Guillaume, of Switzerland, as its efficient secretary, is the organic bridge which unites one congress with the next and gives continuity, unity, and development to the work. This commission has to prepare a programme more than a year in advance. Specialists in all parts of the world are invited to write papers on questions chosen for discussion. The reports for the present congress represented the opinions and experience of two hundred and forty writers, and amounted to twenty-five hundred pages in print. They were all printed in French three months before the opening of the congress, and were sent in advance to the official delegates. Thus every delegate knew beforehand not only the subjects on the programme, but the line of argument which would be advanced and the evidence for and against certain conclusions. Instead of being overloaded by a great mass of papers, the decks were kept clear for discussion. This gave warmth and vivacity to debate. In addition to these reports, the commission secured monographs from many different countries giving facts and statistics in regard to their prison systems. The questions carefully prepared by the commission on which these monographs were framed were uniform throughout, so that the penological student has an opportunity for comparative study not easily secured elsewhere. I am inclined to think that this large amount of preliminary material will prove to be quite as valuable as the proceedings of the congress itself.

Next to the work of the permanent commission, the success of the congress was largely due to the strong official backing and the lavish hospitality of the French Government. The Minister of the Interior, M. Leygues, was the official host. For a year or two in advance M. J. Duflos, the chief director of prison administration in France, aided by his secretaries, had devoted himself to completing arrangements for the congress. This unremitting labor was cordially recognized in the choice of M. Duflos as president. Everything possible was done by the Government to give character and interest to the meeting. The President of the Republic honored the opening occasion by his presence. The Minister of the Interior welcomed it in an admirable address. The College of France was opened for the sessions of the different sections, and the general assembly was held in the amphitheatre of the Sorbonne. Excursions to prison establishments were made, brilliant receptions were extended by the President of the Republic, the Minister of the Interior, and the city of Paris, and a series of complimentary banquets tested the digestive capacity of the delegates to the utmost.

The session of the congress extended over ten days. It was divided into four sections. The first related to penal legislation, the second to prison administration, the third to preventive means, and the fourth to juvenile offenders. Separate sessions of each section were held every morning. In the afternoon there was a general assembly of the whole congress and reports from the work of each section were heard, discussed, and voted upon.

The first section, dealing with questions of penal legislation, drew together a fine array of legal talent. Nice questions of theory came up for discussion, but they were generally obliged to yield to practical considerations. The great plague of penologists as well as of society is the *recidivist,* or the "repeater," or "rounder," as he is more familiarly called in this country. He is the man or woman who has been in prison half a dozen, or it may be fifty or a hundred, times. The sentiment of the congress was in favor of a gradual accumulation of penalties and of long sentences for professional criminals. The laws of different countries differ in the classification of these *recidivists.* But the congress wisely decided that the dangerous attitude of the criminal toward society was the main thing to consider. It did not present a scheme of penalties, it did not decide in favor of definite or indefinite sentences; it left much to the discretion of the judge, though the feeling was expressed that judges are often more influenced by the gravity of the special act or by the circumstances of the crime than by facts which may clearly reveal the dangerous character of the criminal.

A hot debate, continued through several sessions, occurred on transportation. Though we have long since settled this question in England and America, it is a practical question with France and Russia. In Russia transportation has existed for three hundred years, but it has not tended to reduce crime. None are better aware of this than many prominent Russian jurists and penologists, and an interesting phase of the discussion was the presence of a distinguished representative from Russia, Prof. Ivan Foinitski, Professor of Law in the University of St. Petersburg and general advocate of the Court of Cassation, who led the battle against transportation. Prof. Foinitski has written an important work on the subject, which has just been made available in French through a translation by M. G. Bonet-Maury. In this volume, after an elaborate description of transportation in England and Russia, he shows that it has nothing but negative results to offer, and rejects entirely the arguments advanced for it. In France transportation was adopted about forty years ago, and still exists in the penal colonies of Guiana and New Caledonia. The French system has strong advocates, and found one of its warmest defenders in Prof. Leveillé, of the faculty of law of Paris.

The subject of compensation or restitution for injured parties has been commended at previous congresses. It has long been felt that modern laws do not sufficiently indemnify the victim of crime. The difficulty is to show practically how this may be done. It might be possible to apply a portion of the prisoner's earnings to the relief of his victim, but the amount thus gained would not be large. It is suggested that by combining conditional liberation with the idea of reparation much more might be effected. In some respects the laws are harder upon the victim than upon the offender. Thus in France, while in a case submitted to a jury costs are not assessed upon the complainant if the complaint is sustained, in all other cases the complainant is obliged to defray the costs of the process whether for or against him. The congress passed resolutions looking for a change in such laws, and decided to take into serious consideration at its next session, in 1900, various propositions for the relief of the injured party.

Imprisonment is not the only means of checking crime; and no question more important came before the congress than the subject of probation for first offenders. On this subject America has some experience to offer, and Mr. Charlton T. Lewis, of New York, and the writer had the honor of presenting to the congress brief expositions of the method and results of the probation system in Massachusetts. That State now has a probation officer attached to each criminal court in every city and county, and there are seven in the city of Boston. In the year 1893–'94 47,249 cases passed under their examination before going into court, and 5,317 were placed on probation. This probation system deserves wider attention. One of its most important features is not only the examination by the officer before trial, which induces the judge to place the accused on probation, but the visitation and surveillance exercised by the officers during the probation period.

In the whole matter of prison administration the congress had the advantage of the presence of a large number of practical and experienced prison directors. Politicians on this side of the water are fond of tampering with the subject of prison labor. But labor in prison was recognized by this, as indeed by every prison congress, as an essential element in discipline and reformation. To deprive prisoners of labor is simply inhuman, and in the end results in transferring the criminal from a prison to an insane asylum. The need of special prisons for women with women directors was affirmed, and while the right of a prisoner to wage was not conceded, it was agreed that it was for the interest of the state to give him gratuities. As a matter of fact, the system of allowing the prisoner a portion of his earnings obtains all over the Continent. Half of the amount thus earned may be expended by him, under supervision of a director, or may be applied to the relief of his family. The other half is retained until the time of his discharge.

In Europe the cellular or separate system of imprisonment prevails much more extensively than in this country. Indeed, our only example of such a prison is that of the Eastern Penitentiary of Philadelphia. The reformatory system as developed in this country and illustrated by such institutions as those of Elmira, Concord, and Pontiac was ably presented to the congress by General R. Brinkerhoff, President of the National Prison Association of the United States, and by Mr. R. W. McClaughry, who, having had experience as chief of police of Chicago and as the head of several prison institutions, is one of the highest authorities in this country on the treatment of criminals.

Discussion on the treatment of the criminally insane brought out different points of usage in different countries. A large amount of information was gathered. Some questions were formulated for the next congress, among them the following: What rule should be adopted to insure the possibility of a permanent medical control over the mental state of prisoners? How should asylums or quarters for insane criminals be organized so that the necessities for treatment may be combined with the idea of repression? In the case of irresponsible delinquents and those who commit crimes under temporary aberration, the congress expressed the view that special asylums or quarters should be provided for them, that they should be committed by judicial authority, and only released upon the concurrence of a threefold authority—namely, the authority of the court, that of the administration of the institution, and of its medical council.

Under the head of "Preventive Means" were considered those influences not only which would keep men out of prison, but those which would tend to prevent them from becoming habitual criminals. The whole treatment of the subject of discharged convicts received serious consideration. It is somewhat surprising that Europe is far better organized than the United States for the care of the discharged convict. There are but four or five really active societies of this kind in the United States. There are ninety in England alone, and fifty in France. They abound in Holland and Denmark, and are being developed in Germany, Austria, Russia, and Italy. In Spain, work of this kind scarcely exists; in Switzerland, it is seen at its highest degree of efficiency. In a country but half the size of the State of

Ohio there are fourteen societies for discharged convicts, and some of these societies are organized with committees in every district of the canton in which they are established. But the most valuable and distinctive feature of the Swiss system is the appointment of a person, called a patron, who makes the acquaintance of a prisoner before he is discharged, and who becomes his guardian after his liberation. This system of personal and friendly supervision is infinitely better than almsgiving, and its value has been shown in the great reduction of recommitments to prison in the districts where it is best established. These foreign societies are supported by government aid as well as by private subscriptions, and a part of their work consists in guarding the earnings which the prisoner has accumulated during his detention against wasteful expenditure.

The value of prison libraries was recognized, and the desirability of a weekly publication in prisons under the special control of the administration. In this country good examples of such publications are furnished by The Summary, of Elmira, N. Y., and Our Paper, of Concord, Mass.

Alcoholism was regarded as a growing danger, especially with reference to its influence on criminology. Reports from inebriate asylums in Europe show that habitual drunkenness may be treated with success if the victim can be retained sufficiently long. With a view of reducing intemperance in Russia, the Government has already begun to acquire the entire monopoly of the liquor traffic. Among preventive measures, the congress commended the regulation and the limitation of saloons, the multiplication of temperance *cafés,* the establishment of inebriate asylums, and the association of public authority with private agitation in the temperance cause.

No discussions were more earnest than those which related to juvenile offenders. The presence of women of experience in this and every other section of the congress was warmly encouraged, and they were gallantly welcomed by M. Pols, vice-president of the commission, who frankly said that the solution of these questions could not advance without the co-operation of women. The multiplied aspects of vagabondage and mendicity, the subject of prostitution and the measures to be taken to break up the systematic trade carried on between various countries through the decoy of young girls, the establishment and regulation of houses of correction, the need of appropriate physical as well as mental education, the relation of parental responsibility and the question of farm school and agricultural colonies, the placing out of children in families, and the supervision of children thus placed were discussed as important phases of child-saving work.

It is not a criticism of the congress of 1895 to say that it opened more questions than it decided. Penology, like every other science, must advance by interrogations even more than by affirmations. With the growth of knowledge problems multiply and become more complex. But we are better prepared to grapple with difficult conditions when we know what they are; and one of the most hopeful elements in dealing with the subject of criminology in all its varied and elusive relations is the existence of an organized international corps of men and women who approach the matter in a calm, judicial, scientific, and humane spirit.

BOTH SIDES OF PROFIT-SHARING.

By FREDERIC G. MATHER.

THERE seems to be no immediate prospect of ending the contest between capital and labor. No matter how strikes or lockouts are settled, they leave a bad feeling behind them that will be shown as soon as another opportunity offers. Mutual distrust and jealousy mark the situation to-day as they have marked it for many years past. The capitalist votes one way, and the employees vote another, so that they may not oblige him. In every dealing between the two sides the opposition is carried so far that a good understanding seems more remote than ever. Nor does there appear any hope for improvement till each party is ready to make concessions.

The old system of apprenticeship drew more closely the bonds of common interest between the employer and the employee, and with benefit to both. It was comparatively easy for apprentices to become employers. But labor-saving machinery has made the workman an attendant upon the machine, and it has destroyed that sympathy between him and his employer which was the strength of the apprentice system. The blame for this rests upon neither side exclusively. The system may have been too slow to satisfy modern conditions, but the departure of it has made the situation worse. No longer do workmen, as a rule, educate themselves in schools of technology and by the reading of books. There is no inducement for doing better things while the doctrine holds that one man's work is as good as another's, and while labor organizations restrict the number of youth who shall learn trades, thereby keeping all on the same level and giving none an incentive to rise.

The establishment of boards of arbitration will not meet the present difficulties. Those who adopt the idea, on the strength of declarations made by both sides, of a desire for a reasonable settlement of disputes should reflect that the same definition is not given to the words "reasonable" and "equitable" by either the labor unions or the employers. Each side has its own definition, and until that is known everything is uncertain. Neither side would consent to have a course dictated by any form of official authority, because everybody knows his own business best. No rational man can believe that any large business can be conducted upon lines laid down by outsiders. Much less can he believe that workmen can be forced to respect the decision of an official board when they do not cordially accept that decision.

The fatal defect in treating the labor problem thus far has been the stress laid upon the change of method, when the needful thing is a change of spirit in both parties to the controversy. The friction has a moral cause that is common to both, and it will continue as long as mere gain is held to be the measure of success. It can not be stopped by any mechanical contrivance of system or method. But when success and use are made synonymous, the friction will yield, because the moral and sympathetic forces have begun to work upon a higher plane. This idea was well expressed about fifty years ago in Boston, when the Rev. Dr. Channing delivered a course of lectures on The Elevation of the Working Classes. In one of them he said: "There is but one elevation for a laborer and for all other men. There are not different kinds of dignity for different orders of men, but one and the same for all. The only elevation of a human being consists in the exercise, growth, and energy of the higher principles and powers of his soul. A bird may be shot upward to the skies by a foreign power; but it rises, in the true sense of the word, only when it spreads its own wings and soars by its own living power. So a man may be thrust upward into a conspicuous place by outward accidents, but he rises only in so far as he exerts himself and expands his best faculties; and he ascends by a free effort to a nobler region of thought and action. Such is the elevation I desire for the laborer, and I desire no other."

There seems to be but one practicable method of reaching this elevation, and even that method is practicable only within certain limits. Profit-sharing or wage-sharing may be that method, if the respective shares due to employer and employee can be adjusted equitably. The method has been tried with success in several branches of productive industry.

In 1844 the Paris and Orleans Railway Company adopted the principle. Between 1844 and 1882 about twelve million dollars were distributed as profit dividends among the employees, while the wages paid to them were equal to those paid by roads that gave their employees no share in the profits; and, at the same time, the dividends to the stockholders were as large as they would have been had there been no profit-sharing. Students of political economy are familiar with the Ateliers Socialistes of Paris. Many of the smaller enterprises in the same city have also applied the system of profit-sharing with remarkable success, one of the most conspicuous being the Atelier de Broderies of M. Nayrolles. In this establishment the system is carried out among a *personnel* composed exclusively of women, and with astonishing results both with the quality of the work and the increased wages of the workers.

A notable scheme, recently tried in England, is that of the South Metropolitan Gas Company of London, as a sequence to the successful campaign of the dock laborers. The company proposes to pay an annual bonus, based upon a sliding scale and regulated by the price paid for gas by the public. At the present price the bonus would amount to five per cent on the wages of the twelve months ending on the 30th of June. In addition, to give the system a start, and in order that the workmen shall derive a substantial benefit at once, the bonuses are to be calculated for three years back. The men who have been in the regular employ of the company for the past three years will thus have sums varying from twenty-five to thirty dollars placed to their credit at once. It is stated that if all the workmen take advantage of this offer it will cost the company fully sixty thousand dollars a year, all of which is a clear gain to the men over and above their regular rate of pay. Another late example comes from a factory of wood pulp in Norway, where nearly sixty men are employed. The gross profit of the first year amounted to about seventy thousand dollars, from which three thousand dollars was taken out for interest on the capital, and fifteen thousand dollars for working expenses. The remainder has been distributed to the men, giving them about one hundred and fifty dollars each. Nearly all of them have used the money in making payments on houses for themselves, thus leading to contentment and industry.

Within the past four years a prominent firm of clothiers in New York city has declared dividends of three and five per cent on the wages of its employees; and a leading merchant of Philadelphia divided \$109,439 and \$104,345 among his employees in two successive years. After several experiments in other lines, a publishing house in Chicago adopted profit-sharing about fifteen years ago. The house has increased its capital stock more than once; and many of its men, who were ordinary workmen under the old system, now own their homes and are worth from five thousand to fifty thousand dollars each. In another establishment, also in Chicago, those who had been in the employ of the company for one year or more were informed that if the amount of their sales for six months should exceed the total for the same period of time in the previous year, they would be allowed a commission on the excess. The commission averaged two and a half per cent. The employees at once increased their efforts to sell; and when the first distribution was made, last July, it was found that several of the girls had drawn nearly one hundred dollars as their share of the profits for six months.

The Bodwell Granite Quarry, in Maine, adopted the profit-sharing system in the year 1885. As a result, the output of the works has increased, and the employees are sober, contented, and industrious. The arrangement is this: Ten per cent of the profits is laid aside every year. The remaining profits are divided equally between the employer, the men, and a contingent fund. When the latter reaches more than one per cent of the loss in any one year, the surplus of the fund is divided equally between the employers and the men. It is not probable that there could be losses larger than the contingent fund, unless the business were very poorly managed, or unless a financial crisis came over the whole country.

The largest manufacturer of felt shoes in the United States, after experiment with several forms of profit-sharing, has recently formulated rules and regulations for the just distribution of the net earnings among his employees. There are to be three classes for this distribution: first, pension; second, life insurance; third, endowment. The share of the net earnings to be set aside every year shall be calculated upon the positive results of the records of the actual work done by the employees. Against this distribution account the amounts paid for life insurance, under the provisions of the insurance law, and the amount necessary to maintain the pension fund are to be considered fixed charges. As soon as the workman is made a partner in the business, so that a loss to his employer is a loss to him, it will make him more careful of his time. He will see that his fellow-workman performs his duty, and that there is no waste by any one. Such an arrangement is profitable to the employer in the end, because every man in his employ will have some incentive to work. The employer thus guarantees extra pay to the employed.

But can any one guarantee to the employer that every year will be a profitable one? And if there are losses, who shall make them up? Shall the employers make them up by themselves, or shall the men, having once been taken into a partnership upon the profits, still continue that partnership by making up their share of the losses? There are many employed men who are the owners, or the partial owners, of their homes. They would gladly enter into an arrangement for the division of the profits, but they would hesitate to mortgage their homes as security for their proportion of the losses in a bad year. Other employees could offer no security whatever in such a case; therefore, the losses must come upon the employers in the end. It is this fact, more than any other, that hurts the prospects of profit-sharing. Such an arrangement can not be in the nature of a true partnership, because, as noted above, there is a partnership so far as the gains are concerned, but the partnership ceases when there are losses. Hence, as at present tried, the system of profit-sharing is really a gratuity on the part of the employers, most of them having taken the ground that they must average their good years with their poor years in order to keep their men employed uniformly.

The machinery of profit-sharing is not complete without some provision for a contingent fund to tide the employer over his bad years; and even then it is a question whether the profits should not be disposed of on a basis of piecework instead of time. In a bad year the capitalist should accept a smaller percentage on his investment; and the workman, a smaller compensation for his labor. It may be hard for the employer to send his children to cheaper schools, but it is no harder than it is for the employee to go without butter and other necessaries of life.

Even with the instances of profit-sharing that have been tried there has been little gain in bringing about a true sympathy between the employers and their men. Without such sympathy, it is impossible for capital and labor properly to understand each other, or to work in harmony. A careful study of the instances in which profit-sharing has been a success shows that the employers who have succeeded were the small employers of a generation ago, before the advent of the great corporations. There could be no greater enemy to the cause of the workingmen than the prevailing idea of to-day to combine everything in the shape of trusts. Edward Bellamy and other writers carry more truth in their predictions than will be admitted by those who have made no study of the facts. Some day there may be a revulsion of feeling against such combinations that may lead to the more simple and direct methods of employment in practice two generations ago, when strikes were almost unknown. The present tendency toward trusts is wholly away from any form of profit-sharing, and this is one of the worst signs of the times.

We are led irresistibly to the conclusion that neither profit-sharing nor any other device will improve the present situation, so long as there is a lack of sympathy in either side toward the other. The employers and the holders of great wealth should regard themselves not as mere irresponsible giants of finance, but as sacredly responsible to society for the large interests that have been intrusted to them. The too frequent want of such a broad idea of his functions has led the public to believe that the capitalist is a man who absorbs all the toil of the laboring man, leaving to the latter a very uncertain subsistence. Nor does the capitalist have credit for the fact that, without him, labor would not be so productive, and for the further fact that his share is taken from a product that was created largely through his direction, his enterprise, and his resources. It makes a vast difference whether an army has a skillful general at the head, or only an ordinary leader.

On the other hand, the employee should remember that, as things are now constituted, there is no employment without the use of capital. He must not consider the capitalist as his enemy, but rather as his friend. Nor should he close his organizations against all who do not work with their hands. His own day of labor measures eight or ten hours. There are other laborers in the field to whom a day's work means from twelve to sixteen hours. They are none the less laborers because they work with their heads, and it is a narrow definition of the "workingman" that rules them out.

When De Tocqueville studied the institutions of the United States, in 1835, he gave a broad view of labor as he wrote, "Every honest occupation in the United States is honorable." The same view must be taken by both the capitalist and the workingman before true sympathy between them can be assured. Until that day comes, neither profit-sharing nor any other form of effort will be able to bridge the chasm.

SKETCH OF EBENEZER EMMONS.

AUTHORITIES differ as to the year in which EBENEZER EMMONS was born. The first General Catalogue of Williams College, published in 1880, puts "*æt.* 65," after the year of his death. In Durfee's Williams Biographical Annals the year of his birth is given as 1799, while, according to Prof. Jules Marcou, in Science, Prof. Emmons always stated to his children that he was born in 1800. His sister has informed the writer that 1799 is the correct year. The month and day were May 16th, and the place was Middlefield, Mass. He was an only son, but had two sisters older and two younger than he. Prof. Emmons's father, who also bore the name of Ebenezer, was a farmer. His mother's maiden name was Mary Mack. The Rev. Dr. Nathaniel Emmons, who was quite a noted preacher in his day, was an uncle. The first ancestor in America of this branch of the family came from England, and settled at East Haddam on the Connecticut River. A brother who came with him settled in Boston.

Young Eben's interest in Nature appeared at an early age. The doors in his room were covered with bugs and butterflies pinned on when he was a small boy. His mother often used to say: "Eb, why do you always have your pockets filled with stones? I have to mend them every week." His birthplace and the adjoining town of Chester were noted for rare minerals. When he came home for a vacation from school or college he generally brought some fellow-student with him. He and his friend would set off for the mineral localities and be gone all day, coming back tired and hungry, but were always ready to go again the next morning.

He was fitted for college under the instruction of the Rev. Moses Halleck, of Plainfield, Mass., a well-known educator of his time, and was graduated from Williams College in due course. Prof. Marcou gives 1820 as the year of his graduation, but the General Catalogue has him in the class of 1818, which seems to be conclusive. As a college student his interest in the sciences was quickened by the instruction of Prof. Amos Eaton and Prof. Chester Dewey, and he subsequently had a large share in introducing the study of these subjects among the young men of the country. After completing his college course Mr. Emmons continued his favorite studies at the Rensselaer School, graduating there with the class of 1826. In the same year he published his Manual of Mineralogy and Geology for the use of the students of that institution. He also studied medicine at the Berkshire Medical School, and established himself as a practicing physician in Chester, Mass.

In 1818, at the age of nineteen, Mr. Emmons married Miss Maria Cone, of Williamstown, and at the age of thirty-seven became a grandfather by the birth of a son to his eldest daughter.

In 1828 Dr. Emmons removed to Williamstown, where he continued to practice medicine, and in the same year was appointed lecturer on chemistry in Williams College. A cabinet of mineralogical and geological specimens which he began to collect here was presented by him to the college after it had received the valuable accretions of twenty years. He resided in Williamstown until 1838, becoming the most eminent practitioner in Berkshire County. In 1830 he was appointed junior professor in the Rensselaer School and held the position till 1839. He was also a lecturer in the Medical School of Castleton in the days of its renown. His chair in Williams College was enlarged in 1833 * to a professorship of Natural History, which he held till 1859, when the department was divided, he retaining the mineralogy and geology till his death.

Having been appointed upon the Geological Survey of New

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* The History of Williams College, another book by the Rev. Calvin Durfee, D. D., above quoted, gives 1848 as the year of his election to the professorship of Natural History.

York in 1836 and Professor of Chemistry in the Albany Medical College in 1838, Dr. Emmons removed in the latter year to Albany. He was afterward transferred to the professorship of Obstetrics, and remained on the faculty of the Medical College till 1852. During this period he used to go to Williamstown each year to deliver the course of lectures belonging to his professorship there. His position on the New York survey enabled him to make the valuable present of a suite of the minerals of that State to his *alma mater* in 1842. One of his Williams College students—now himself a venerable though young-hearted professor—well remembers the strong face and beetling brows of Dr. Emmons, and his manner of giving instruction. His disposition was kindly. Being a non-resident, not much was seen of him by the students; he would appear at the lecture room, give his lecture, and disappear. There was not much of the pedagogue about him. Students who had a special liking and capacity for his subject profited much from his instruction; but his enthusiasm in telling the wonders of the rocks carried him along at a rate which left the indifferent student far behind. If only a fraction of his class appeared at the lecture, or if he projected a question at Brown and a response came from Jones or Robertson, he seemed not to notice the difference. Williamstown is in the heart of the Berkshire Hills. One of the summits of East Mountain, a neighboring eminence, is the only place in that region where gneiss crops out, and here Prof. Emmons used to bring his students to display to them as best he could the relations of his much-disputed Taconic System to the other and then better known geological formations. Very likely only a couple of the class would reach the summit with him, yet he would discourse just as earnestly to these as to the whole party that set out with him. This height, says Prof. Arthur L. Perry, in his Origins in Williamstown, "has been justly designated Mount Emmons, by one who was once a pupil and later a colleague and always an admirer of the distinguished Professor of Natural History in the college, Ebenezer Emmons."

It is related of Prof. Emmons, as illustrating his enthusiasm, that once when on a journey with President Hopkins, of Williams, and the president's brother, he asked his friends to turn aside with him to visit a certain cave. They consented to the delay, although the brother was on his way to be married, and waited just within the entrance of the cavern while Emmons penetrated to its inmost depths. After a time they heard the excited cry, "I've got it! I've got it!" and out rushed the geologist, bearing triumphantly a muddy fragment of rock. He had secured a piece of evidence in support of his Taconic System.

In 1836 a law was passed providing for a geological survey of the State of New York, and in the organization of the staff for carrying on that work Dr. Emmons was appointed by Governor Marcy to the charge of the second district, which included the northeastern counties of the State. This district was chosen by Dr. Emmons as a field more especially interesting to him on account of its mineral localities and minerals, and giving him a field more congenial to his tastes and experience. He made the public acquainted with the Adirondack region and named its principal mountains. In 1837 he named, described, and classified the celebrated Potsdam sandstone. Among the other rocks and divisions to which he gave a name or a place in geology are the Chazy limestone, black marble of Isle la Motte, Lorrain shales, Champlain group, Ontario group, Helderberg series, and Erie group. During the progress of this survey, also, he made the important discovery that is most closely associated with his name. In 1842 he pointed out a great system of stratified rocks under the Potsdam, which he called the Taconic System. This announcement brought upon him a storm of contradiction and ridicule, and for a time he was scientifically ostracized. Subsequent discoveries by the Canada Survey, and by Barrande, in Bohemia, however, as well as the investigations of later eminent geologists, have completely sustained him. In propounding the term Taconic* System Prof. Emmons was following the instruction and views of his teacher, Prof. Amos Eaton, who promulgated his opinions regarding the age of these rocks in his lectures at Williams College from 1817 onward; and subsequently in his lectures at the Rensselaer School to the end of his life, although never having published any satisfactory account of the relations of these rocks to the formations above or below them.

Two years later Dr. Emmons described the primordial fauna, thus preceding the celebrated discoveries of Barrande, who recognized the priority of Emmons in the following courteous language:

"In comparing these dates it is clear that Dr. Emmons was the first to announce the existence of a fauna anterior to that which had been established in the Silurian System as characterizing the Lower Silurian Division, and which I have named the Second Fauna. It is, then, just to recognize the priority, and I think it all the more fitting to state it at this time, that it has not hitherto been claimed."

Prof. Emmons's Report on the Second District of the New York Geological Survey was published in 1842. In the autumn of that year his colleagues presented his name to Governor Seward as a proper person to act as custodian of the collections of the geologi-

* From the Taghkanic Mountains.

cal survey, then arranged, and in progress of arrangement, in the old State Hall on State Street, which building had been assigned for that purpose by the Legislature of 1840. He was appointed to this position by Governor Seward and assumed charge of the collections in the latter part of 1842. On the same occasion on which this recommendation was made it was also recommended by the staff that the work in agriculture and paleontology which had been left unfinished should be assigned to Dr. Emmons and Prof. Hall.

In the spring of 1843 Governor Bouck directed Dr. Emmons to investigate the agricultural resources of the State; and the paleontology was placed under the charge of Prof. Hall, while Dr. Emmons still retained his position as custodian of the collections of the survey until 1845. The five volumes of his report on the Agriculture of New York appeared in 1846, 1849, 1851, and 1854. The first was devoted to a "topographical sketch of the State, climate and temperature, agricultural geology, the Taconic System, and the soils of New York"; the second to analyses of grains and other vegetable products; the third and fourth, one consisting of text, the other of plates, to cultivated fruits; and the fifth to injurious insects. This fifth volume has been severely criticised, but it should be remembered that the writer to whom its preparation was intrusted, not being versed in entomology, could only compile from the best sources at his command, at a time when the science was in its infancy, and comparatively little was known of the insects of the State. The many illustrations, which are well colored in the larger portion of the edition, were mainly drawn from Nature, and in some of the orders, as in *Coleoptera* and *Hemiptera*, have a degree of excellence which is rarely surpassed even at the present day.

About the time the third volume came from the press he was appointed State Geologist of North Carolina. In his new field he made further important contributions to the advance of American geology. In the coal measures of the Deep and Dan Rivers he discovered a grand Triassic flora, and a fauna that included among many ancient vertebrates the *Dromatherium sylvestre*, the oldest mammal yet found anywhere in the world. His description of the new red sandstone flora of North Carolina proved so valuable that twenty years after his death the United States Geological Survey reproduced all the plates and descriptions given by him in the sixth part of his American Geology. Three volumes of North Carolina reports were published by him. One on the Geology of the Midland Counties was issued in 1856; a volume devoted to the Agriculture of the Eastern Counties, with descriptions of the fossils of the marl beds, in 1858; and a second part of his report on the agriculture of the State, "containing a statement of the principles of the science upon which the practices of agriculture as an art are founded," appeared in 1860. The civil war interrupted his labors. The anxieties and separation from friends occasioned by it probably hastened his death, which took place at his residence in Brunswick County, N. C., October 1, 1863. His wife, a son, and two daughters survived him.

Besides the works already mentioned, Prof. Emmons published an account of the Taconic System (Albany, 1844). Having been commissioned by Governor Edward Everett to report upon the Zoölogy of Massachusetts, he prepared a volume, devoted to the quadrupeds, which was printed at Cambridge in 1840. His American Geology, which appeared in 1855, was supplemented by a Manual of Geology in 1859.

A clear-sighted and energetic worker, Dr. Emmons was a living force for the advancement of his chosen science. The Rev. Mark Hopkins, President of Williams College from 1836 to 1872, said of him: "Emmons was a man of remarkable power and great accuracy of observation. He seemed to have an intuitive perception of the differences in natural objects. He possessed an intense enthusiasm in his work, but in his manner was remarkably quiet. I have never seen the two things combined to the same extent. His perseverance knew no limit. It ought to be added that, in connection with his science, he was deeply religious. Williams College is greatly indebted to him for its collections in natural history."

Several instances of the European survival of practices that probably originated in cannibalism were cited in a discussion on that subject at the meeting of the British Association. Mr. Elworthy said that in one part of France the last of the harvest corn is baked into a loaf shaped like a human figure. This is supposed to represent the spirit of the corn—the spirit of vegetation, reproduction, fertility—and is broken up, distributed among the villagers, and eaten. Mr. E. S. Hartland said that not long ago, in upper Bavaria, when a man died and had been laid out, a cake was made of ordinary flour. The corpse was placed before the fire, and this cake, called the corpse cake, was put upon his breast to rise. The dough, in rising, was believed to absorb all the virtues of the deceased, and the cake was afterward eaten by his nearest relatives. In the Balkan Peninsula an edible image of the dead was carried in the funeral procession. When the body was buried the mourners ate this image above the grave, saying, "God rest him!" In Wales the function of the "sin-eater" has only ceased within the memory of men still living. It was the custom for the nearest relative, usually a woman, to hand across the bier, or place upon the breast of the corpse, bread, cheese, and beer, which were eaten by the sin-eater, who pronounced everlasting rest to the departed. It was believed that the sin-eater thus appropriated to himself all the sins which the deceased had committed.

PROFESSIONAL INSTITUTIONS.

IX.—ARCHITECT.

By HERBERT SPENCER.

BUILDING of the kind dignified by the name architecture, can not exist during early stages of social development. Before the production of such building there must be an advance in mechanical arts greater than savages of low type have made—greater than we find among the slightly civilized.

It is true that constructions of unhewn stones arranged upon the surface into some order, as well as rude underground stone chambers, have been left by prehistoric peoples, and that incipient architecture is exhibited in them. If we extend the conception to take in these, however, we may remark as significant, that the art was first used either for preservation of the dead or as ancillary to ceremonies in honor of the apotheosized dead. In either case the implication is that architecture in these simple beginnings fulfilled the ideas of the primitive medicine-men or priests. Some director there must have been; and we can scarcely help concluding that he was at once the specially skillful man and the man who was supposed to be in communication with the departed spirits to be honored.

But now, saying nothing more of this vague evidence, let us pass to evidence furnished by those semi-civilized and civilized peoples who have left remains and records.

We are at once met by the broad fact, parallel to the fact implied above, that the earliest architecture bequeathed by ancient nations was an outcome of ancestor-worship. Its first phases were exhibited in either tombs or temples, which, as we have long ago seen, are the less developed and more developed forms of the same thing. Hence, as being both appliances for worship, now simple and now elaborate, both came under the control of the priesthood; and the inference to be drawn is that the first architects were priests.

An illustration which may be put first is yielded by Ancient India. Says Manning:—"Architecture was treated as a sacred science by learned Hindus." Again we read in Hunter—

"Indian architecture, although also ranked as an *upa-veda* or supplementary part of inspired learning, derived its development from Buddhist rather than from Bráhmanical impulses."

In Tennent's *Ceylon* there are passages variously exhibiting the relations between architecture and religion and its ministers. By many peoples the cave was made the primitive tomb-temple; and in the East it became in some cases largely developed. A stage of the development in Ceylon is described as follows:—

"In the *Rajavali* Devenipiatissa is said to have 'caused caverns to be cut in the solid rock at the sacred place of Mihintala'; and these are the earliest residences for the higher orders of the priesthood in Ceylon, of which a record has been preserved."

"The temples of Buddha were at first as unpretending as the residences of the priesthood. No mention is made of them during the infancy of Buddhism in Ceylon, and at which period caves and natural grottoes were the only places of devotion."

Referring to later stages, during which there arose "stupendous ecclesiastical structures," Tennent adds:—

"The historical annals of the island record with pious gratitude the series of dagobas, wiharas, and temples erected by" Devenipiatissa "and his successors."

A dagoba "is a monument raised to preserve one of the relics of Gotama . . . and it is candidly admitted in the *Mahawanso* that the intention in erecting them was to provide 'objects to which offerings could be made.'"

Here though we do not get evidence that the architects were the priests, yet other passages show that Buddhist temples were the works of converted kings acting under direction of the priests. Moreover, the original development of architecture for religious purposes, and the consequent sacredness of it, is curiously implied by the fact that the priesthood "forbade the people to construct their dwellings of any other material than sun-baked earth."

This last extract recalls the general contrast which existed in ancient historic kingdoms between the dwellings of the people and the buildings devoted to gods and kings. The vast mounds from which Layard exhumed the remains of Babylonian and Assyrian temples are composed of the *débris* of sun-dried bricks, mingled, doubtless, with some decomposed wood otherwise used for constructing ordinary houses. Layers upon layers of this *débris* were accumulated until the temples were buried, as some temples are even now being buried in Egypt. Whether it was because of the costliness of stone, or because of the interdict on use of stone for other than sacred purposes, or whether these causes co-operated, the general implication is the same—architecture began in subservience to religion (comprehending under this name ancestor-worship, simple and developed); and was, by implication, under the control of the priesthood. Such further evidence as Ancient Babylonia yields, though indirect, is tolerably strong. Saying of the temple and palace "solemn rites inaugurated its construction and recommended its welfare to the gods," and implying that its plan was governed by established tradition (of which the priests were by implication the depositaries) Perrot and Chipiez write:—

"Whether they belonged to the sacerdotal cast, we do not know. We are inclined to the latter supposition in some degree by the profoundly religious character of the ceremonies that accompanied the inception of a building, and by the accounts left by the ancients of those priests whom they called *the Chaldæans.*"

And since "when it [architecture] is carried so far as it was in Chaldæa it demands a certain amount of science," the priests who alone possessed this science must have been the architects.

Sufficient proofs of the alleged relation among the Egyptians are supplied by ancient records. Rawlinson says:—

"Although their early architecture is almost entirely of a sepulchral character, yet we have a certain amount of evidence that, even from the first, the TEMPLE had a place in the regards of the Egyptians, though a place very much inferior to that occupied by the Tomb."

Summing up the general evidence Duncker writes:—

"In the achievement won by Egyptian art the priests took a leading part. The buildings of the temples and the tombs of the kings could only be erected after their designs; for in these essentially sacred things, sacred measures and numbers, were concerned."

Some special illustrative facts may be added. Of Mentuhotep it is recorded that—

"As chief architect of the king he promoted the worship of the gods, and instructed the inhabitants of the country according to the best of his knowledge, 'as God orders to be done.'"

Here are passages relating to the 19th and 21st dynasties respectively. Bekenkhonsu, on his statue is made to say:—

"'I was a great architect in the town of Amon.' 'I was a holy father of Amon for twelve years.' 'The skilled in art, and the first prophet of Amon.'"

"Hir hor, first of a succession of priest-kings, calls himself, when represented by the side of the king:—'Chief architect of the king, chief general of the army.'"

And that the priest, if he did not always design, always directed, may be safely inferred; for as Rawlinson says, "it is . . . tolerably certain that there existed in ancient Egypt a religious censorship of Art."

Of evidence furnished by Greek literature, the first comes to us from the Iliad. The priest Chryse, crying for vengeance, and invoking Apollo's aid, says:—

"O Smintheus! If ever I built a temple gracious in thine eyes, or if ever I burnt to thee fat flesh of thighs of bulls or goats, fulfill thou this my desire; let the Danaans pay by thine arrows for my tears."

By which we see that the priestly function of sacrificer is joined with the function of architect, also, by implication, priestly. Later indications are suggestive if not conclusive. Here is a sentence from Curtius:—

"But the immediate connection between the system of sacred architecture and the Apolline religion is clear from Apollo being himself designated as the divine architect in the legends concerning the foundation of his sanctuaries."

And further on he writes—

> Thus "schools of poets came to form themselves, which were no less intimately connected with the sanctuary than were the art of sacred architecture and hieratic sculpture."

But, as we have before seen, the lack of a priestly organization in Greece obscured the development of the professions in general, and that of architects among others.

That much of the Roman cult was not indigenous, and that importation of knowledge and skill from abroad confused the development of the professions, we have seen in other cases. The influence of the Etruscans was marked, and it appears that of the religious appliances derived from them, architecture was one. Duruy writes:—

> "Etruria also furnished the architects who built the *Roma quadrata* of the palatine, and constructed the first temples; she provided even the flute-players necessary for the performance of certain rites."

But the identity eventually established between the chief priest and the chief architect, in the person of the *Pontifex maximus*, while it illustrates the alleged connection, also reminds us of one of the original causes for the priestly origin of the professions—the possession of learning and ability by priests. Among primitive peoples, special skill is associated with the idea of supernatural power. Even the blacksmith is, in some African tribes, regarded as a magician. Naturally, therefore, the Roman who either first devised the arch, or who first conspicuously displayed skill in constructing an arch, was supposed to be inspired by the gods. For though the arch is now so familiar that it does not excite wonder, it must, when first used, have appeared an incomprehensible achievement. Hence a not unlikely cause, or at any rate an ancillary cause, for the union of priest and bridge-builder.

After the fall of the Roman Empire the social disorganization which arrested mental activities and their products, arrested architecture among them. Its re-commencement, when it took place, was seen in the raising of ecclesiastical edifices of one or other kind under the superintendence of the priestly class. Referring to the state of things after the time of Charlemagne, Lacroix writes:—

> "It was there that were formed the able architects and ecclesiastical engineers who erected so many magnificent edifices throughout Europe, and most of whom, dedicating their lives to a work of faith and pious devotion, have, through humility, condemned their names to oblivion."

Speaking of France, and saying that up to the tenth century the names of but few architects are recorded, the same author writes:—

"Among them, however, are Tutilon, a monk of Saint Gall, . . . Hugues, Abbot of Montier-en-Dèr; Austée, Abbot of St. Arnulph, . . . Morard, who, with the co-operation of King Robert, rebuilt, toward the end of the tenth century, the old church of St. Germain-des-Prés, at Paris; lastly, Guillaume, Abbot of St. Benignus, at Dijon, who . . . became chief of a school of art."

And he further says:—

"In the diocese of Metz Gontran and Adélard, celebrated Abbots of St. Trudon, covered Hasbaye with new buildings. 'Adélard' says a chronicler 'superintended the construction of fourteen churches.'"

This association of functions continued long after. According to Viollet-le-Duc, the religious houses, and especially the abbey of Cluny, during the eleventh and twelfth centuries, furnished most of the architects of Western Europe, who executed not only religious but also civil and perhaps military buildings.

The differentiation of the architect from the priest is implied in the following further quotation from Lacroix:—

"It was, moreover, at this period [of transition from Norman to Gothic] that architecture, like all the other arts, left the monasteries to pass into the hands of lay architects organized into confraternities."

Similar is the statement of Viollet-le-Duc, who, observing that in the thirteenth century the architect appears as an individual, and as a layman, says that about the beginning of it "we see a bishop of Amiens . . . charging a lay architect, Robert le Luzarches, with the building of a great cathedral." A curious evidence of the transition may be added.

"Raphael, in one of his letters, states that the Pope (Leo X) had appointed an aged friar to assist him in conducting the building of St. Peter's; and intimates that he expected to learn some 'secrets' in architecture from his experienced colleague."

Passing to our own country we find Kemble, in *The Saxons in England,* remarking of the monks that—

. . . "painting, sculpture, and architecture were made familiar through their efforts, and the best examples of these civilizing arts were furnished by their churches and monasteries."

In harmony with this statement is that of Eccleston.

"To Wilfrid of York and Benedict Biscop, Abbot of Wearmouth in the seventh century, the introduction of an improved style of architecture is due; and under their direction several churches and monasteries were built with unusual splendor."

And afterward, speaking of the buildings of the Normans and of their designers, he says of the latter—

"Among the foremost appeared the bishops and other ecclesiastics, whose architectural skill was generally not less effective than their well-bestowed riches."

How the transition from the clerical to the lay architect took place is not shown; but it is probable that, eventually, the clerical architect limited himself to the general character of the edifice, leaving the constructive part to the master-builder, from whom has descended the professional architect.

Chiefly for form's sake reference must be made to the gathering together and consolidation which, in our times, has been set up in the architect's profession. There is little to remark further than that the members of it, having been but few during earlier periods, when the amount of architectural building was relatively small, segregation and association of them could scarcely occur. Recently, however, there has been formed an Institute of Architects, and the body of men devoted to the art is tending more and more to make itself definite by imposing tests of qualification.

At the same time cultivation of the art and maintenance of the interests of those pursuing it are achieved by sundry special periodicals.

THE ELECTRIC FURNACE IN CHEMISTRY.

By M. H. MOISSAN.

THE reverberatory electrical furnace with movable electrodes, which we devised in 1892, and in which we have made many improvements, is very simple in construction, has been of great service, and has permitted us to deal with problems which have been hitherto insoluble. By means of this apparatus we have been permitted, by obtaining a sufficient temperature, to produce the diamond, to crystallize metallic oxides, to reduce those which have hitherto been refractory, to melt metals heretofore infusible, to distil lime, silica, zirconia, and carbon, and to cause an abundant volatilization of such metals as platinum, copper, gold, iron, manganese, aluminum, and uranium. Some bodies that could not be brought to a condition of fusion, like magnesia, uranium, tungsten, and molybdenum, could be made to assume the gaseous state in the electric furnace. In our studies we have frequently dealt with the vapor of lime and silica.

When using the currents of machines of from one hundred to three hundred horse power, we have in the midst of the furnace the temperature produced by the electric arc; a few centimetres beneath, the crucible containing the matter to be experimented upon; and at the bottom, a mass of quick-lime in full ebullition. The imperfect conducting power of this substance is a fortunate quality for us. It isolates the heat which the electric arc can furnish into the smallest possible cavity.

This new apparatus permits us to approach the study of a whole series of simple bodies which have been till now mere laboratory curiosities, because of the want of adequate means of obtaining them.

It is easy, with the aid of the electric furnace, to produce abundant meltings of chromium by reducing the sesquioxide. This melting, refined, yields chromium, an unoxidizable metal very different from the specimens which have been hitherto obtained. It can be filed like iron, and takes a fine polish. Chromium, then, more infusible than carbon, can now be used in preparing alloys without the need of the intervention of ferro-chromium, which has the disadvantage of containing up to ten per cent of carbon.

This preparation opens the way for the effective study of the alloys of chromium. In combination with aluminum or copper, it gives interesting results. Pure copper, alloyed with 0·5 per cent of chromium, assumes a double resistance and suffers less change than copper in contact with moist air.

Molybdenum, previously unfused, can also be obtained in notable quantities. By heating, in a continuous electric furnace, a mixture of oxide of molybdenum and charcoal, a melting of the metal is obtained which flows readily and can be easily molded. It furnishes a definite carburet, very well crystallized. It is refined by a new heating in the electric furnace, with an excess of oxide of molybdenum. The melted metal thus obtained has a fine grain and a brilliant surface. It can be filed, and forged, at a red heat, upon the anvil; and with iron it furnishes a steel that can be tempered. These are all new properties.

Tungsten has been heretofore known to chemists only as a powder. Under the action of the electric arc, the oxide of tungsten is reduced by means of carbon, and gives in a few minutes a well-melted bottom, covered with a fine layer of the blue oxide of tungsten. This metal, which is still more infusible than chromium and molybdenum, can be liquefied with great facility. It does not seem to have a strong affinity for carbon, and is obtained without special precautions as one of the purest metals we have prepared.

The different oxides of uranium can not be reduced by carbon at the ordinary temperatures of our furnaces; but when a mixture of the sesquioxide of uranium and carbon is subjected to the high temperature of the electric furnace, the reduction takes place in a few instants. After cooling, an ingot may be drawn from the crucible possessing a brilliant fracture and great hardness. When this uranium is slightly carbureted, it presents the property of striking fire in contact with flint. The particles thrown off burn with an intensity and an energy far superior to those exhibited by a piece of iron.

All these simple bodies melt at more or less high temperatures.

By the side of them we may place other metals the minerals of which are rare—such as zirconium and vanadium.

Vanadium, on which Prof. Roscoe has made some interesting studies, was not known, except as a gray powder including hydrogen, oxygen, and a little of some alkali metal as impurities; but Prof. Roscoe has had the pleasure of seeing in my little laboratory at the École de Pharmacie several hundred grains of it, under the form of cast metal pieces, having a crystalline and brilliant fracture. This simple body, the mineral of which occurs more extensively than is generally supposed, is very difficult to melt, it hardly liquefying in the current produced in the Edison dynamo by an engine of forty horse power.

In our studies of titanium, a mixture of charcoal and titanic acid gave, with a machine of four horse power, protoxide of titanium; with a machine of forty-five horse power we obtained only nitride of titanium; under the action of currents of from one hundred to three hundred horse power we prepared by kilogrammes a crystallized carbide, and then real titanium, the properties of which are wholly different from those formerly attributed to the gray powders that bore that name. This substance takes fire in fluorine; decomposes water only at a bright-red heat; and possesses the curious property of burning in nitrogen at a high temperature, yielding the nitride of titanium studied by Friedel and Guérin. It readily combines with carbon and silicon, but does not unite with argon. Its melting point is very high, it resembling carbon in that respect. It differs from carbon, however, in the fact that while carbon under the ordinary pressure and at a great elevation of temperature passes from a solid to a gas without becoming liquid, titanium can, in the electric furnace, be liquefied and then volatilized.

Most of the simple bodies furnish, with carbon, well-defined combinations, crystallized and stable, at a high temperature, which are destined to furnish a new chapter to mineral chemistry.

All these simple bodies which we have obtained by kilogrammes in the electric furnace form also borides and silicides finely crystallized and so hard that some of them easily cut the diamond. What part they are to have in the manufacture of steel, and whether they are destined, like chromium, to give new properties to iron, are questions for the future to answer. But a new chemistry of high temperatures is forming, from which industry will most likely draw numerous applications.

It is recognized on all sides that some of our industries are about to suffer important modifications through the use of electrical forces. We ask of the forces of Nature all they can yield; and they are capable of easy use when transformed into electricity. —*Translated for the Popular Science Monthly from La Nature.*

Correspondence.

THE DRIFT OF POPULATION IN FRANCE.

Editor Popular Science Monthly:

SIR: My article entitled Has Immigration increased Population? having been sent to you two years ago, contains some observations the force of which has been greatly modified by time, and would have been omitted or expressed very differently if I had been writing now. I had corrected them on the proofs, but the corrections unfortunately failed to reach you before you were obliged to go to press. Waiving consideration of the lesser errors which have thus arisen, I write you this letter as my only means of correcting the one of greatest importance. In speaking of France, I said that it could not be used as an example to show that advanced civilization lessens the rate of increase of population, because, although "the French annual rate of increase sank very low during the four or five years previous to the Prussian War, being only seven per thousand inhabitants in 1870, it has since then steadily risen and in 1890 was thirty-seven per thousand."

At the time I was writing, the statistics obtainable in this country seemed to bear me out in the above assertion. But since then we have the French statistics down through 1893, which show that the population has again declined. It is rather strange, by the way, that some of these statistics should be so uncertain. For example, some authorities tell us that in 1890 the French population increased 38,446, and others tell us that in that year it diminished by that same figure. But, nevertheless, the statistics taken as a whole seem to show a decided falling off since 1890. This, however, does not alter my main argument, and if my corrections had been in time the passage above quoted, and the paragraph in which it occurs, would have been replaced by the following:

"But civilization is a broad term and has different meanings in different countries. While it may be true that the form of civilization which prevails in France, or certain ideas and habits of the French people, may cause a decrease in population, it does not necessarily follow that civilization in other countries has that effect; and as a matter of fact it does not."

I should also have inserted this:

"More than one hundred years ago Franklin noticed that countries many of whose people migrate are not thereby depopulated, but on the contrary often increase their population much more rapidly than would be expected. His observation has been confirmed by later experience (Mayo-Smith's Statistics and Sociology, pp. 319, 336). The emigration merely makes room for a greater number of births, so that population increases as fast as it otherwise would, if not faster. It is the country to which the emigrant goes that is more likely to suffer. Immigrants take the place which would otherwise be filled by the natural increase of the natives. The pressure of the immigration decreases the size of the native families; and in the case of the United States, although the foreigner may, under many circumstances, have a higher birth-rate, yet the mortality among his children is so much greater than among the children of the natives that there is no gain in population."

Yours truly, SYDNEY G. FISHER.

December 1, 1895.

Editor's Table.

PAUSE, PERHAPS, NOT REACTION.

IT is freely alleged in various quarters, occasionally with regret but more frequently with more or less exultation, that the present is a period of intellectual reaction. Science, it is said by some, has been moving too fast and has not made good its more advanced positions. It has attacked questions that were beyond its grasp, and has had to retire in discomfiture. It has made promises to mankind which it has not fulfilled, and which evidently it is not going to fulfill. Its watchwords have lost their power—so we are assured—and the comfortable doctrines of the past are in a fair way to recover their former prestige and influence. It is needless to say that we do not accept this view of the situation. In cosmic and in human affairs there is certainly a law of rhythm, as Mr. Spencer has so copiously proved in a celebrated chapter; but rhythm is one thing and reversal of a main movement is another. There will come times when men will in a measure tire of speculation, and seek rather to rest in a partial conclusion than to pursue further voyages of discovery into the unknown; and such a time may be expected after a period of active and rapid theoretical advance. At such a moment of lull it is not surprising if the Philistines of the intellectual world, who had been more or less in hiding while the forward movement was at its greatest intensity, should venture from their fastnesses and indulge in a few songs of triumph; but this need not disturb the serenity of the army of progress. In due time the order to march will be given, and then the Philistines—will keep out of the way.

Such, we think, is the situation at the present time. The third quarter of the century was a period of almost if not of quite unparalleled scientific activity. It gave birth to the most important work of Spencer, Darwin, and the rest of the evolutionist school. It brought important discoveries in chemistry and biology, and rendered a great deal of so-called orthodox opinion in many departments of knowledge forever obsolete. The impetus of this great movement lasted undiminished for several years longer, and, if it has now slackened in any degree, it is that the specific need of the present day is rather a careful survey and classification of the results already obtained than a further development of theory. We want to know just where we are before we start again. To say that no opinions which were held with a good deal of confidence ten or twenty years ago have undergone any modification would be foolish. That is not the way in which science advances; it advances through constant rectification of its observations and adjustments of its point of view. A change of opinion may involve loss, perhaps fatal loss, to a system of thought founded on authority, but it means no loss to science, whose vitality can never be impaired by additional knowledge. As Mr. Spencer has lately found occasion to say, there may be much difference of opinion as to how species originate, but this does not in the least invalidate the great law of evolution, which finds illustrations on every page of the book of Nature. The heritage of Darwin may be divided, but at least no part of it is in possession of an antiscientific or antinaturalistic school. All who to-day grapple with the question of the origin of species do so on a basis of purely scientific observation and reasoning; and even if the problem had to be given up as too obscure—and it is quite possible that we do not even yet know how obscure it is—it would still remain a problem of science, not a problem of theology or metaphysics.

One most important characteristic of science is that it can never really be idle. If it is not doing one thing, it is doing another; and its humbler work—or what seems so—may be not less useful, may indeed be more useful, than its more ambitious efforts. There is no department of natural knowledge that is not day by day receiving accretions which all go to better in some way the position of man upon the earth. It will do no harm if for a time there is less vague talk in regard to the theoretical conquests of science; but there need be no abatement of the confidence with which we hold that science is the power which transforms impressions of sense into conclusions of reason, which alone throws light on the constitution of the world in which we live, and which confers upon all human effort its highest possible efficiency. Knowing this, we know that the so-called "bankruptcy of science" is a contradiction in terms, the flippant invention of those with whom the wish is father to the thought. In a word, all is well; for whether the time be seed-time or harvest, whether the field, as we see it, be lying fallow or carrying a bounteous crop, science, the one abiding power and principle of fertility, is present with mankind, and its promise will not fail.

THE PROBLEM OF LIFE.

IN the October number of the International Journal of Ethics Prof. William James, of Harvard, comes forward with his contribution to the much-discussed question, "Is Life Worth Living?" The conclusion, a sufficiently simple one, at which Prof. James arrives, is that life may be made worth living; but he only arrives at this very true conclusion after a considerable amount of laborious and, in our opinion, not wholly sound argumentation. It may be worth while, therefore, to go over the ground—so far as it can be done within our narrow limits—and see what view can reasonably be taken of the whole subject.

We are told by the writer mentioned that there are two recognizable sources of pessimism—or, in other words, of the feeling that life is not worth living—sensualism and overstudy, particularly of an abstract kind. It seems to us that a statement of this kind irresistibly suggests the corollary that pessimism, with its sickening doubts as to the value of life, may be avoided by avoiding its causes. Then, if so, why discuss it as if it were a substantive system of philosophy? It either is or is not a pathological condition: if it is, let us seek to remove it; if it is not, then it is all right. "It is a remarkable fact," says Prof. James at a later point in his article, "that sufferings and hardships do not, as a rule, abate the love of life; they seem, on the contrary, usually to give it a keener zest. The sovereign source of melancholy is repletion." Very true again; but what is the lesson? Simply that we should not abandon ourselves to repletion, and that in the interest of our children we should not satiate them with enjoyments. But elsewhere (page 7) the professor tells us that "pessimism is essentially a religious disease," consisting, in the form at least in which it attacks over-reflective minds, "in nothing but a religious demand to which there comes no normal religious reply." This, of course, sounds very philosophical; but it does not seem to be quite in agreement with the proposition so distinctly laid down, that pessimism may spring either from sensualism or from overstudy—"grubbing," as the writer expresses it, "in the abstract root of things." Supposing he who has been so "grubbing" stops doing it, or stops doing it in excess, and, by proper attention to hygiene, gets himself into capital physical and mental condition, what then becomes of the religious disease? Will it not vanish with its cause?

We fail to see, however, why pessimism should be considered as a religious disease in the case of the over-studious man and not in that of the over-sensual? By different routes both have arrived at the same goal—exhaustion; and it is hard to see why the pessimism of the one should have a more religious character than that of the other. Each has been brought through his own injudicious courses into the same morbid condition of mind; each, consequently, on the strength of his own feelings asserts that life is not worth living; and each says what is not true. Each in his own way has disturbed, if not destroyed, the natural balance of his faculties and functions, so placing himself in a wrong and painful relation to the world in which he lives; and the true remedy would therefore seem to lie in undoing, if it be at all possible, the mischief that has been done. To trace pessimism, as Prof. James does, to certain specific causes, and then to propose to cure it by the application of a religious theory, is a little too much like trying to stay a pestilence by prayer instead of by sanitary measures. Supposing that a pestilence due to natural causes could be stayed by prayer, it would require a perpetual miracle to keep it from breaking out again so long as those causes were not removed. Therefore, before we can follow Prof. James in seeking a religious remedy for pessimism, we must unlearn the lesson he has himself taught us, that its origin may be found in such avoidable errors as undue self-indulgence (repletion), sensualism, and overstudy. A dyspeptic takes very gloomy views of human affairs, but what is the use of arguing with him? What he wants is new life in his digestive organs. Pessimism, as a creed, will only deserve to be argued with when it can be shown that it claims its victims, not less among those who have wisely husbanded their powers and in every way respected the laws of life, than among those who have wasted their substance and set the laws of life at defiance.

It is evident that Prof. James has been so far affected by the pessimism of studious souls as to have conceived a very unfavorable opinion of the apparent order of the universe. He does not, however, give us as clearly to understand as we could wish wherein this somewhat extensive institution fails to meet his private views—what he would like it to be that it is not, or not to be that it is. He quotes with evident sympathy some appalling verses by the author of The City of Dreadful Night—verses which would have almost sent a shudder through the rebellious soul of Omar Khayam himself; and he tells us that he fairly rejoices over the downfall of that form of natural religion—fit only for backward and barbaric peoples—which consists in "the worship of the God of Nature, simply taken as such." "There were times," he says, "when Leibnitzes, with their heads buried in monstrous wigs, could compose Theodicies, and when stall-fed officials of an established church could prove by the valves of the heart and the round ligament of the hip joint the existence of a 'Moral and Intelligent Contriver of the World.' But those times are past, and we of the nineteenth century, with our evolutionary theories and our mechanical philosophies, already know Nature too impartially and too well to worship unreservedly any god of whose character she can be an adequate expression. . . . To such a harlot" (as Nature) "we owe no moral allegiance. . . . If there be a divine spirit of the universe, Nature, such as we know her, can not possibly be its ultimate word to man." This, on the whole, does not seem to us very convincing writing for a Harvard professor. The "monstrous wig" of Leibnitz did not so stifle his brains as to prevent his discovery of an admirable form of the calculus; and, among the "stall-fed officials of an established church," the first that occurs to mind—certainly the most illustrious—was precisely he who pointed out (Samuel

Butler was his name) the many difficulties and perplexities which confront us in our study of the order of Nature. What special advantage flows from calling Nature a "harlot" we are at a loss to imagine; but we do not find it hard to imagine what evil may ensue therefrom. If that Ultimate Power into communion with which the professor is so anxious to bring us has really given us a harlot world in which to pass our probation—well, it would really seem as if, to put it mildly, our education has not been well provided for. Human parents do not choose such associations for their sons and daughters. And yet, in spite of its harlotry, "this world of Nature," we are told, "is a sign of something more spiritual and eternal than itself." It is also spoken of as "a mere sign or vision of a many-storied universe in which spiritual forces have the last word," and this in spite of the assertion made in the same sentence, that "circumstances on the natural plane" create the strongest presumption that life is not worth living. Verily, "too much grubbing in the abstract root of things" does produce a somewhat tangled condition of the understanding, as well as an ugly bent toward pessimism.

If we once settle it in our minds that pessimism, or, as Prof. James otherwise describes it, the suicidal tendency, is a disease, there is only one question worth discussing in connection with it, and that is how to prevent it. It seems to us that the way is indicated with great clearness and simplicity by the philosopher who, anticipating the Harvard professor by over two thousand years, briefly announced that "much study is a weariness of the flesh." What does that philosopher further teach? He teaches the lesson that has never yet sunk deeply enough into the general mind, that youth is the time when the character should be fortified against the trials and disappointments of later life. His simple but expressive language may perhaps be not improperly recalled: "Remember now thy Creator *in the days of thy youth*, while the evil days come not, nor the years draw nigh when thou shalt say, I have no pleasure in them." Will any one say that the doctrine of evolution has rendered such advice as this obsolete? It would be a shallow person, in our opinion, who would raise such an objection. What the preacher saw and felt was that youth was a period which, if rightly used, would establish the whole life on sure foundations. The remembering of one's Creator means little if it does not mean acquiring a knowledge of and reverence for the laws which ought to govern human life, the formation of sound physical and intellectual habits, and of pure and wholesome associations. It means, if it means anything, the discerning of a true ideal of life, and the earnest and loyal adoption of that ideal as something to be sacredly guarded to life's end. Youth is the one period of life that is fully capable of this, and therefore it is in youth and only in youth that our nature can be rendered, as it were, immune against pessimism. Prof. James may say that this is taking a religious view of life, and that so far we agree with him. We claim that if our view is religious it is also scientific, inasmuch as it takes, or aims at taking, full account of all the conditions of the problem. The difference between us, however, is, as we think, real and important. He prescribes religion somewhat as a doctor would a drug, as a tonic for exhausted minds. We postulate a certain view and government of life, not as a remedy for existing disease, but as the condition and guarantee of mental, moral, and physical health. And—what we think is not unimportant—our point of view exempts us from all temptation to malign the world, which is the theater of our efforts, or to perform a war dance over the downfall of natural theology. We believe Prof. James could preach a much better and more useful sermon from the verse above quoted than he has done in the essay that has been the subject of our remarks. Or, if he wants a classical authority, let him take the words of Sophocles, who says that, "of those whose lives are kept in the right course, the majority are saved through obedience." Here we have the true counter-blast to pessimism in a simple declaration of the law of life: whoso heeds it is wise; whoso heeds it not will not be won to happiness by argument.

SCIENCE AND TEMPERANCE.

We commend to the attention of our readers an article in this number of the Monthly, by President Jordan, of Stanford University, on the subject of "Scientific Temperance." An organization noted more, perhaps, for its emotional than for its rational impulses has, it seems, taken into its own hands the direction of what shall be taught in the schools of the country regarding the effects of alcohol on the human system. If such teachings were characterized by that avoidance of excess which is so desirable where the appetite for drink is concerned, there would be little occasion to complain. Indeed, we believe an honest zeal in the cause of temperance is entitled to the highest respect and to a whole-hearted support. There is no denying that much the greater part of the crime and misery with which society is afflicted is caused by the use of alcohol in one form or another, and it has always been the practice of this magazine to aid in the enlightenment of the public on this class of questions whenever the facts warranted such a course. But, on the other hand, we are equally ready to condemn a kind of teaching that tends to dwarf the truth, or to dress it up in a fictitious garb, no matter how good in itself the object may be that it is sought to promote.

In the present case, with the desire apparently to make the instruction concerning the effects of stimulants and narcotics more potent for good, altogether erroneous ideas are conveyed to the pupil regarding the science of the subject. What is tacitly represented as the established results of scientific research is embodied in so-called scientific text-books as a part of the truths of physiology, but this so much exceeds the facts that the pupil, if not actually misled, is likely to carry away distorted impressions, or wholly lose sight of the modicum of truth which science has been able to work out of the problem. If it were the science of the matter pure and simple that our reformers were after, the two pages of the Indiana text-book that President Jordan quotes would amply cover the ground, and leave space for a few facts that bear the other way, which as a part of the results of research deserve to be impartially presented. Such a treatment might fitly be labeled "scientific," and escape the charge of false pretense. On the contrary, to give the subject sixty pages out of four hundred, with its moral and social aspects lugged in, and to call that "human physiology," is a lesson in deceit that should be denied a place in our public schools. No competent physiologist would make such a book, and no conscientious teacher of science, if permitted the right of choice, would place it in the hands of his pupils, yet either is certainly better fitted to judge what shall be taught as physiology than the indifferent legislator or the reckless reformer.

From the point of view of the temperance cause itself the case seems little better. The false notions of physiology that this kind of instruction is calculated to foster are sure sooner or later to react. The child learns the pseudo facts. They are so striking and so frequently reiterated that he remembers them. But at a later period he discovers that some of them are doubtful, that others were greatly exaggerated, and that not a few were wholly erroneous. Further study will only confirm this conclusion, when it is not unlikely that he will go to the other extreme and reject all he has learned on the subject as unworthy of respect—a state of mind the very opposite of the one intended. But this is not the worst of it. The discredit into which it tends to bring the study of physiology itself is still more unfortunate. The widespread ignorance of this subject is responsible for a vast amount of suffering and disease, much of which might be avoided and some perhaps removed were a knowledge of physiology more generally diffused. To convey such knowledge uncolored and without exaggeration is a worthy object; but to falsify it, calling the falsification science, and compel its acceptance as such by authority of law, is very much like causing the state to join hands with the counterfeiter, and is scarcely entitled to more respect.

Scientific Literature.

SPECIAL BOOKS.

In three consecutive volumes of the International Education Series an abundant supply of material is furnished to the kindergartner or the mother who would use kindergarten methods.* The first consists of fifteen of Froebel's essays which, in the original tongue, were collected into a volume by Dr. Wichard Lange. From these essays may be learned Froebel's own ideas of the significance of the first five "gifts" of the kindergarten. The ball, he says, gives the child a welcome opportunity to contemplate, to grasp, and to possess a whole; it develops the muscular sense and the control of the muscles of the hand and arm; and the various plays with the ball in which the mother may lead the child tend to awakening and fostering the powers of its mind to compare, to conclude, to judge, and to think. The contrast between the sphere and the cube is highly instructive: the one having each part of its surface of the same form as every other part, standing on a point, and easily movable, the other with sharp edges and corners, resting on a broad base, and requiring some force to move it. From the cube, variously divided, the child learns the ideas of parts making up a whole, of one form appearing in different sizes,

* Friedrich Froebel's Pedagogics of the Kindergarten. Translated by Josephine Jarvis. Pp. 337, 12mo.

The Mottoes and Commentaries of Friedrich Froebel's Mother Play. Translated by Henrietta R. Eliot and Susan E. Blow. With an Introduction. Pp. 316, 12mo.

The Songs and Music of Friedrich Froebel's Mother Play. Prepared and arranged by Susan E. Blow. Pp. 272, 12mo. New York: D. Appleton & Co. Price, $1.50 each.

of a form bounded by unequal faces, etc. The various modes of using the gifts, which are depicted in illustrations, suggest many movement plays, and these Froebel describes, giving also the words of songs to accompany them. He also describes a pleasant way of learning to write and read. Froebel was a pioneer in child study, and in his description of kindergarten plays he is constantly calling attention to the development of the child's faculties which the attentive kindergartner may observe.

In the other two volumes we have Froebel's Mutterspiel and Koselieder reproduced in English. Froebel indicated how each of the mother-plays should be played by means of a group of pictures surmounted by a "motto" consisting of eight or ten lines of verse. These quaint pictures and the mottoes in the original language are reproduced in each volume. The first, which may be called the mother's volume, contains also free renderings of the mottoes in English verse, by Mrs. H. R. Eliot, together with prose translations, by Miss Blow, of the commentaries that accompanied the plays. Miss Blow has also furnished an introductory essay on the philosophy of Froebel, and, that nothing of the master's thought may be lost through rendering his homely lines into English verse, she has given prose translations of the mottoes in an appendix. The companion or children's book contains the same pictures with short pieces of verse on their subjects by Emily H. Miller, Emilie Poulsson, Laura E. Richards, and other writers. Following these is music for them and for some others to the number of eighty-three in all. In this volume many of the pictures in the groups are repeated on a larger scale, so as to bring out their details more clearly. Many of the melodies originally used in the mother-play having been pronounced unsuitable by competent judges, other music is here supplied from sources of recognized merit. In every part of these two volumes the directing hand of that able kindergartner, Miss Susan E. Blow, is apparent. Kindergarten teaching can be conducted by those who have a genius for it without such helps as these books afford, but it is hard to imagine that a teacher who had once used them would be willing to give them up.

In his work on *Money and Banking** the editor of the New York Evening Post gives connected form to the principles of finance which he has studied and discussed for many years past. His method is that of the historian who accounts for an event by circumstance, pressure, ignorance—occasionally by knowledge fortunately joined to courage. His book is a mine of sifted fact, with clear and convincing deductions wherever these are warranted, with a judicial presentation of both sides of a case where a decision is as yet to be found.

Stripped of its entanglements the money question is simple enough. Mankind has chosen precious metals among commodities as means of exchanging all the rest and as standards of value. Real money, then, is metallic coin, authenticated by the stamp of a mint as to quantity and fineness. For generations down to 1873, both gold and silver circulated together in civilized countries at a ratio of about one to fifteen, the fluctuations from that ratio being too inconsiderable to cause serious difficulty. With the discovery in 1873, and since, of new and rich deposits of silver,

* Money and Banking illustrated by American History. By Horace White. Pp. 488, 12mo. Boston and London: Ginn & Co. Price, $1.50.

with constant improvement in processes for separating the metal from its ores, silver in twenty years fell one half in value as compared with gold. The difficulty inherent in trying to keep two commodities at a fixed relation to each other—that is to say, the attempt to maintain an unchanged price for silver in terms of gold—plainly had passed beyond the utmost power of legislation. Nevertheless, at the instance of mine owners legislation in 1878 and 1890 was invoked against facts geological and chemical, with the result that the Federal Treasury bought a mass of silver to-day worth $234,000,000 less than it cost. The new plentifulness of silver has strengthened the preference for gold as the sole standard of value—a preference always felt by the richer among the nations from the great value which the yellow metal possesses in small bulk. And what if silver should become cheaper still? It is the fear that something short of 23·22 grains of gold will be paid by the borrower of a dollar that has tightened the purse-strings of capital just at the time when good faith toward creditors would have bred a confidence indispensable for an assured revival of business. Of equal moment with the agitation for the free coinage of silver as a source of financial misgiving, Mr. White stigmatizes the Legal-Tender Act. This Act has led the American people to believe that the Federal Government has only to set a printing press in motion to create money, as by Heavenly fiat. But the paper representatives of money inspire no confidence unless they stand for a commodity, gold, in the full measure to which at a time of panic that commodity will be demanded. What makes this matter of sound money of supreme importance is that on money as on a pivot turns so much more than itself—the whole fabric of manufacture, trade, and commerce. To tamper with the standard of value, to debase it, to lay undue burdens upon it, is as mad as the act of an engineer who skimps substance for his fly-wheel, scamps its workmanship, and who, defying the laws of poise and strain, brings a vast network of machinery to ruin.

Mr. White outlines the salient features of American banking, with its dreary record of overreaching, ignorance, and recklessness, relieved here and there by examples of sound principle and careful practice as in New York, Massachusetts, and Louisiana. He gives reasons for regarding Scotch banking as the best in the world, and points to Canada as successfully copying many of its methods. A great bank with many branches, on the Scotch plan, is a chain of lakes, each borrowing or lending with mutual benefit; the American method of isolation exposes every bank to alternate drought and flood. That it is no proper function of government to be a banker Mr. White abundantly proves. As the bonds upon which the existing national bank notes are based are disappearing, it is imperative that a new basis for this note issue be found. Mr. White presents the "Baltimore plan" and Secretary Carlisle's proposal, leaving the decision with those who must arrive at it.

Any one who wishes to know what can be said for the single-tax idea clearly and soberly, with the aid of statistics, and quite apart from any demagogic appeals to class prejudice, would do well to read Mr. *Shearman's* book in the Questions of the Day Series.* The author starts with

* Natural Taxation. By Thomas G. Shearman. Pp. 239, 12mo. New York and London: G. P. Putnam's Sons. Price, $1.

the proposition, which many economists deny, that taxation can be based on scientific principles; in other words, that money for the needs of government can be so raised as to take advantage of the natural laws that operate in society instead of running counter to them. The principle of plucking the greatest quanitity of feathers with the least squawking is certainly antiquated and unworthy of a mature and intelligent people. Our taxation should be scientific, and if the scheme advocated by Mr. Shearman really has that character, he has brought the right article to market. Many persons who are not prepared to accept the single tax as a remedy will admit most of what he says in regard to the evils of indirect taxation. He affirms that direct taxation is practicable, but of the three forms now in use—the income, succession, and general property tax—he deems the second useful only as an adjunct, while the other two, because of the premium they put on fraud and other objections, should never be used. A tax on land he calls the natural tax, because it can not be evaded, and because its proper distribution is automatically determined very much as ground rent is regulated by the market. In reply to the objection that such a tax would be shifted upon tenants, he cites "not only the entire school of Ricardo and Mill, but also nine tenths or more of other economic writers," as denying the possibility of such a transfer. In this respect he notes a difference between a tax on land and one on buildings. It is obvious that the landless class would be greatly benefited by exemption from all direct or indirect taxation. Mr. Shearman also maintains that the landowners, taken as an entire class, would also bear a smaller burden than now, because they would be exempt from taxes on personal property, indirect taxes, and the cost of collection and other burdens incidental to these modes of taxation. Some of the landowners would have a heavier burden than now. Mr. Shearman estimates that this would fall on fifty thousand of the six million families in the United States who own land. These fifty thousand own thirty per cent in value of all the land in the country, and also get almost all the benefits arising from the monopolies fostered by the present mode of taxation. He takes especial pains to show that the farmers need have no alarm at the land-tax proposition, and affirms that this plan, in addition to its other benefits, " would bring about a just distribution of wealth, would give a perpetual stimulus to industry and production, would greatly increase wages, would increase the profits of capital, would give a security to property now unknown, would encourage manufactures, commerce, and agriculture, and would incidentally solve many social problems which under present conditions seem almost insoluble." Mr. Shearman has not made his programme attractive enough, or, rather, he has not given it the right kind of attractions. The masses do not want a just division of wealth any more than the classes. Every mother's son of them is perfectly willing that a few shall have big prizes at the expense of the many, if only he can be one of the few; and in a democratic country, where it is possible for a poor boy to become president of a railroad, he is constantly hoping that next week or next year will bring him some undeserved advantage over his fellows. Even if a majority of the voters in the United States were convinced that any economic reform would benefit them all, they would need to have the lottery spirit educated out of them before they would adopt it.

GENERAL NOTICES.

Since the establishment of the cell theory by Schieden and Schwann in 1838–'40, it has been recognized that a clear understanding of the processes which go on in the body, both physiological and pathological, and of their relations to parent and offspring, can only be obtained through a study of the cell. This study has thrown new light on many obscure points in heredity, and has revolutionized our theories of the "vital process." Such books as the one before us * are the cause as well as the result of such investigations—through their attractiveness stimulating the student to renewed effort. This one is a series of micro-photographs taken from sections of the eggs of the sea urchin and so arranged as to illustrate the principal phenomena in the fertilization and early development of the animal egg. The photographic reproductions are accompanied by a critical description and drawings illustrating every stage, and are preceded by a simple introductory account of the recent history and growth of the science. The refined histological technique and the manual skill necessary for original work of this quality are rarely at the command of the student. He has to get his knowledge from text-books, hence an accurate reproduction of the various specimens is quite essential. The photographs in this work were taken with especial care, not retouched, and reproduced in the prints as closely as possible. The book is unique in containing the first satisfactory series of photographic representations of the early history of the ovum. Prof. Wilson is to be congratulated both as to his own work and in having so skillful a collaborator as Dr. Leaming.

The author of this book,† who is the instructor in physics in the English High School of Boston, has been before the public as an author of text-books on physics for the past thirteen years. His latest production is characterized by a fullness which he intends to be a protest against "smaller books," "cheaper books," and "primers of science." "Education in physics," he affirms, "implies the presentation of the great truths of that science in their *unmutilated* form, the indication of their relations to one another, and the furnishing the student an opportunity of observing and exercising the logical processes that have led to the discovery of those truths. Any text-book that aims to introduce the student to a study of such importance and such inexhaustible possibilities should not lose sight of this truth and encourage mere *dilettanteism*." Accordingly, he supplements his statement of physical laws by a store of concrete applications and other illustrative matter. The book contains a "high-school" course and an "advanced" course, the latter comprising the former and additional matter distinguished by indenting. Some illustrative experiments are given, but the work is not intended to serve as a laboratory manual. A considerable number of problems and exercises have been inserted, a key to which is furnished to instructors. There are nearly five hundred illustrations, and a colored chart showing spectra and combinations of colors.

An experimental laboratory has, with the growth of modern methods of teaching, become almost a necessity in the study of botany. The book before us * is designed to aid and direct experimental study. As to the scope of his book the author says: "With the rapid advance of investigation it is next to impossible that an elementary laboratory manual should include the latest results, especially when the essential points of many of them may yet be in controversy, and need the critical treatment which is certainly not within the province of a work of this character. In the hands of an instructor in touch with current botanical thought such deficiencies are easily supplied. The present work consists of a series of ex-

* Atlas of the Fertilization and Karyokinesis of the Ovum. By Edmund B. Wilson, Ph. D., with the co-operation of Edward Leaming, M. D. Pp. 32, quarto. New York and London: Macmillan & Co. Price, $4; 17*s*.

† The Principles of Physics. By Alfred P. Gage. Pp. 634, 12mo. Boston, U. S. A., and London: Ginn & Co. Price, $1.55.

* Experimental Plant Physiology. By D. T. Macdougal. Pp. 85, 8vo. New York: Henry Holt & Co. Teachers' price, $1.

periments selected to illustrate the habits and life history of plants." The author was the translator of Oel's *Pflanzenphysiologische Versuche*, and his book is the outcome of comments and suggestions from laboratories in which this translation has been in use. The general form of Oel's manual is followed; many cuts and a few paragraphs from the translation are used; but it has been modified and reduced in size to conform more nearly to the needs of American primary students. The text is admirably clear and the experiments instructive and easily performed.

Prof. *L. H. Bailey* has compressed a wonderful amount of information between the covers of his *Rule-book*.* While of most value to the fruit-grower, truck-gardener, or florist, many of its directions, recipes, and tables are needed by every person who has a garden plot or a lawn. It contains directions for making and applying insecticides and fungicides, for preventing the depredations of small animals and birds, and for making and taking care of paths and lawns; recipes for grafting waxes, cements, paints, and glues, tables of weights of seeds, quantities required for an acre, time for planting, time of germinating and maturing, directions for keeping fruits and vegetables, for predicting the weather, for—but we have not space to give a full table of contents. This is a third edition of the book, revised and extended, and apparently well-nigh perfected. We have not seen a better seventy-five cents' worth of handy literature in many moons.

Educational methods are being so much discussed to-day that any publication dealing with this subject is of special interest. Prof. *Munroe's* book † is a history of the changes which have come about in the pedagogist's point of view since the Renaissance. He sketches the revolt against mediævalism, with Rabelais as the moving force. Francis Bacon does the same duty in the movement against classicism. The author says that Descartes was the greater thinker, but believes that he was less of a power at the time than Bacon. In the fourth chapter he narrates the downfall of feudalism and the part which Comenius played in it. In Chapter V, The Child has Senses to be Trained, the effect of the teachings of Montaigne and Locke are reviewed. The Jansenists and Fénelon, Rousseau, Pestalozzi and Froebel, and Women in Education each have a chapter. The author's views may be seen in the following passages taken from the last page of the book: "The new conception of the schoolmaster's task makes the educational problem simpler. . . . Comenius's 'mother-school,' 'that should exist in every house,' is becoming possible; upon the fundamental plan of such a mother-school all education must be shaped. It is no longer a simple question of the intellectual value of this study and of that; it is no longer to be decided what manner and quantity of information shall be given; it is a question now of determining those subjects and those methods which shall best supplement and carry forward the training of character, the real education to true manhood and true womanhood that is or ought to be given in the home under the parents' guidance."

Biology is attracting increasing attention from students of science. In its study now lies the chief hope of solving the questions of heredity and organic evolution. The book before us * is the third publication from a series of biological lectures which are delivered every summer at the Woods Holl Marine Laboratory. The first volume was received so favorably in 1890 that the authors were encouraged to continue their publication. This number contains thirteen lectures. Among them are Life from a Physical Standpoint, by A. E. Dolbear; A Dynamical Hypothesis of Inheritance, by J. A. Ryder; On the Limits of Divisibility of Living Matter, by J. Loeb; Cell Division and Development, by J. P. McMurrich; The Problems, Methods, and Scope of Developmental Mechanics, by W. Roux; and Evolution and Epigenesis, by C. O. Whitman. The book is in no sense a popular one, and must find its readers among special students of biology and the related sciences.

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* The Horticulturist's Rule-book. By L. H. Bailey. Pp. 302, 16mo. London and New York: Macmillan &Co. Price, 75 cents.

† The Educational Ideal. By James Phinney Munroe. Pp. 262, 12mo. Boston: D C. Heath & Co. Price, $1.

* Biological Lectures delivered at the Marine Biological Laboratory of Woods Holl, 1894. Pp. 287, 8vo. Boston: Ginn & Co. Price, $2.65.

Prof. *A. Milnes Marshall's* monograph on *The Frog*, intended as an introduction to anatomy, histology, and embryology, was written to guide and direct the student through the practical part of this work, and met a want the whole ground of which was not covered by any manual existing at the time of the original publication. It gives, in the introduction, practical instruction in the methods employed in biological investigation; followed by the application of these methods to the anatomical and histological examination of the animal; the frog being selected because it is easy to get and convenient to dissect, and is a fairly typical example of the group of vertebrates. The preparation of the present, the fifth, edition was Prof. Marshall's last professional act, and was completed only a week before his death. (Manchester and London: Smith, Elder & Co. New York: Putnams, $1.40.)

An Elementary Text-book of Mechanics, by *R. T. Glazebrook*, is the latest of the Cambridge Natural Science Manuals to reach us. The most satisfactory method of teaching the natural sciences is by means of experiments which can be performed by the learners themselves. This book consists of a series of such experiments which have been used by the author in teaching his classes; the experiments are followed by an explanation and an account of the deductions to be drawn from them. (Macmillan, $1.25.)

Imagination in Dreams, by *Frederick Greenwood* (Macmillan & Co., $1.75), treats of a subject with which most of us are familiar through personal experience. Two essays, previously published in English periodicals, form the foundation for the work, which as a whole is a rather unscientific discussion of curious psychic phenomena, which are in many cases closely allied, and dependent on morbid and diseased conditions of body and mind, and very probably have little value in determining the normal working of the brain. A number of queer dreams are detailed, many of them the author's own products. He thinks that the limits generally set for the imagination are at times overleaped in sleep and that "some dream visions are creations of the mind."

Volume XXXII, Part I, of the *Annals of the Astronomical Observatory of Harvard College* contains an interesting statement of the methods in astronomical photography followed at the Harvard Observatory. There are also two chapters giving the results of researches by Prof. *William H. Pickering* on the Great Nebula in Orion and on the lunar surface. The former was conducted exclusively by photography while the latter embraced both visual and photographic observations.

Part I of Volume III of the final report on the *Geology of Minnesota* is devoted to paleontology, and is made up of contributions by Leo Lesquereux, Anthony Woodward, Benjamin W. Thomas, Charles Schuchert, Edward O. Ulrich, and Newton H. Winchell. Prefixed to the special monographs which it contains is a historical sketch of investigation of the Lower Silurian in the upper Mississippi Valley. The report is printed in large quarto form, and the present part is illustrated with about forty plates, besides figures in the text.

Prof. *N. Story-Maskelyne* describes his *Crystallography* as a treatise on the morphology of crystals (London: Frowde, 12*s.* 6*d.*; New York: Macmillan, $3.50). In addition to giving full descriptions of the several systems of crystallization, he discusses the properties of zones and the varieties of symmetry possible in a crystalloid system of planes. He also describes modes of representing crystals and of measuring and calculating angles. While the author has deemed it necessary to treat some parts of his subject in the simplest form compatible with strict geometrical methods, he hopes that his book will not be found lacking in demonstrations that will satisfy students with high mathematical training.

In an easily readable little book *Uriel H. Crocker* essays to point out *The Cause of Hard Times* (Little, Brown & Co., 50 cents). He ascribes the recent business depression and that of 1873–'76 to overproduction, and in supporting this view he comes into conflict with Mill and other authorities of the past and present. One reason that he gives why production outruns demand is that owners of factories frequently prefer to sustain a loss that may not continue so long as to be serious rather than the certainly large loss involved in shutting down their works.

The Brush Arc Light Dynamo, by *H. C. Reagan, Jr.*, is a handbook for electrical engineers and students. The author gives simple descriptions of the very latest Brush dynamos and a list of instructions for use in emergencies. A novel feature is a revolvable celluloid chart. This chart represents a Brush dynamo with a revolvable armature. It shows the manner of cutting the lines of force, the directions of the flow of current induced in the armature coils, the method of commuting the current, and the flow of current to the external circuit and return to the negative brush. The book has been approved by the Brush company. (N. W. Henley & Co., N. Y.)

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Fragments of Science.

A Device for Geological Teaching.—It is now six years since there was issued a small edition of an educational appliance invented by James T. B. Ives, F. G. S., and appropriately named by him the Strata Map. Since that time the inventor has made various improvements, and is now bringing out his map in a more completely satisfactory form than heretofore. Hanging on the wall it appears as a geological map of the United States, east of Denver, in the ten colors recommended by the International Congress of Geologists for the coloration of geological maps. On touching the fastening at the upper edge of the frame, the glazed front may be let down. It is then found that the map consists of ten cards, each of one color, all the cards being cut away so that part of each is exposed to view. The uppermost card represents the Quaternary, and all is cut away except so much as correctly represents the Quaternary beds on the surface of the region. The next card below it exhibits the Neocene areas in the same manner, cropping out from underneath, and extending beyond, the Quaternary. Then follows the Eocene, succeeded by the Cretaceous, which again is underlaid by the Jurasso-Triassic, and so forth. Finally, the foundation represents the Archæan systems collectively, and is seen exposed where the well-known Archæan areas occur. The fact of superposition of the formations is brought home to the student by this device, while denudation is illustrated by the cutting away of parts of the several cards. Such resultant phenomena as inliers and outliers are seen, also escarpments, the edge of each card forming one in miniature; while by tilting or bending the cards, dip and strike with synclinal and anticlinal folding may be illustrated as well as conformability of stratification. One important advance which the inventor has made since the earlier output of his work is the embossing of the Archæan foundation and all the superposed strata so as to bring the whole to a plane surface.

More recently Mr. Ives has been occupied with the problem of constructing relief maps combining strength and lightness with moderate cost, printed maps being used to furnish the geographical details in which relief maps are often so deficient. One novel feature is the combination of distinctive colors, to represent successive levels, with actual relief. Regions that are less than one hundred feet above sea level are colored buff; from one hundred to five hundred, light green, and so on; there being eight stages in all, represented by eight well-contrasted colors.

These maps are made of specially prepared paper, and the means by which the inventor contrives to emboss them while still retaining the register—that is to say, making the printing on the map exactly correspond to the mountain peaks and river courses of the embossed foundation—is a secret not yet divulged.

The structural and artistic finish of these maps exhibits the painstaking of one who himself appreciates the value of his work. They received a diploma and medal at the Columbian Exposition, both in the Liberal

Arts department and also in that of Mines and Mining, and have been heartily commended by many prominent geologists and educators, including the late Profs. James D. Dana, Alexander Winchell, and John S. Newberry, Profs. James Hall, E. D. Cope, and N. S. Shaler, and President D. C. Gilman.

The Davenport Academy of Sciences.—The Davenport Academy of Natural Sciences has just received a legacy of ten thousand dollars from Mrs. Mary Putnam Bull, of Tarrytown. N. Y. It is given as a memorial to her brother, Charles E. Putnam, and his son, J. D. Putnam, who were, during their lifetime, among the chief promoters of the academy. Wisely the gift is made a Permanent Publication Fund. The academy has already published five volumes of Proceedings, and a sixth volume is in progress. Among many valuable papers in these volumes the entomological studies of Mr. J. D. Putnam and the archæological discussions of Dr. Farquharson are notable. Through exchange of its Proceedings the academy has acquired a valuable library comprising some forty thousand books and pamphlets. The last paper published by the academy was a seventy-two-page Summary of the Archæology of Iowa, by Prof. Frederick Starr. The academy is now organizing a comprehensive archæological survey of that State, which if fully carried out will be one of the most important archæological enterprises ever undertaken in this country. The academy is now working for a permanent fund of fifty thousand dollars, for the better equipment of its work. With its creditable past and its worthy present it may well hope for success in securing the funds necessary to insure a brilliant future.

The Growth of Preventive Medicine.—There came a time in the medical ranks, fifty odd years or so ago, says Dr. Cameron in a recent article in the Lancet, when the classification of disease threatened to become a mere cataloguing of the phenomena immediately preceding death. Indeed, a certain hopelessness, begotten of this mistake, threatened to sap the energies of the physicians. When Sydenham had, two centuries ago, introduced a rational and hygienic element into treatment, he had also, as it were, pointed in the direction to which, when the hopelessness referred to came upon us, we might look for the prevention of disease itself. A belief, therefore, in the value of cleanliness, fresh air, and reasonable diet, along with a certain not altogether unhealthy skepticism as to the need in every case of drugs, was not the least important weapon in the armament of the young physician of thirty years ago. And although new drugs always find new votaries, and many of them have great value, the absolute usefulness of all mere remedial measures is at the present time looked upon as very slight compared with the shielding influence which the physician exercises in placing his patient under the most favorable circumstances for Nature to effect her cure. And it is largely this belief in conquering Nature by obeying her, lighted up by a certain afterglow of the hopelessness already spoken of, which has caused so much of the energy of the medical profession and the sanitary authorities to be thrown into the preventive service. While, therefore, the ancient physician was strong chiefly in his acquaintance with and prophecy as to the probable results of the diseases which he was called upon to treat, the modern hygeist attempts to grapple with the remoter causes of those processes themselves, not in the individual alone, but also in the community.

Color Nomenclature.—In music and form we have specific and generally accepted terms for describing definite sense perceptions, but in the case of color nothing that can be called even a system exists. The terms vermilion and ultramarine, which have been used by many of our best authorities, for want of anything better, are nevertheless used for very variable concepts. The difference between a Chinese and a German vermilion in pigments is very noticeable. A Winsor & Newton chrome yellow and a German chrome yellow differ by more than twenty-five per cent of yellow. Among several samples of blue pigments a still greater variation is generally found; while such terms as olive, citrine, russet, crushed strawberry, baby blue, ashes of roses, peacock blue, and a host of others, have practically no exact significance whatever. This uncertainty and lack of a standard have caused naturalists much inconvenience in botanical, entomological, ornithological, and zoölogical descriptions. In applied science, in the arts, and in chemistry the inconvenience has, if possible, been even greater, and the rapid advance in the art of dyeing alone makes some system of color nomenclature absolutely necessary. Mr. J. H. Pilsbury, who has been working for some years to perfect a practical system, contributed an article on the subject to a recent copy of Nature. He says: "In order that any fixed scheme of color nomenclature may be of some practical value, it must of course be readily understood by people of ordinary intelligence, and must be complete enough to meet the ordinary wants of everyday life. There must be something that is so completely fixed as to be perfectly trustworthy for present and future needs. In the solar spectrum we have an invariable source from which to derive our spectrum standards, and upon these the whole scheme is to be based. Since the six spectrum standard (red, 6,587; orange, 6,085; yellow, 5,793; green, 5,164; blue, 4,695; violet, 4,210—the numbers indicate the wave-lengths in ten millionths of a millimetre) do not give a very extensive *répertoire* for common use, to say nothing of the needs of the more artistic, it was proposed to introduce between each two spectrum standards two intermediate hues to be formed by the union of two spectrum standards in definite proportions. Thus between orange and red would be introduced an orange-red and a red-orange. . . . It is also very desirable that the standards be produced in some material form in order that it be of any practical value. The task of reproducing the brilliant hues of the solar spectrum in pigmentary material or in glass is much more difficult than one not acquainted with the matter would suspect. In order to accomplish this, it has been found necessary to use the somewhat fugitive aniline colors." The colors thus produced, with the addition of black and white, give a fairly satisfactory system. In a later number of the same journal Herbert Spencer has a letter in which he suggests a scheme for color-naming, composed of terms patterned after those used in the compass for denoting direction; giving a form: Red, red by blue, red red blue, red blue by red, red blue, red blue by blue, blue red blue, blue by red, blue. He says: "Of course, these names would be names of pure colors only, the primaries and their mixtures with one another; but the method might be expanded by the use of numbers to each, 1, 2, 3, signifying proportions of added neutral tint subduing the color, so as to produce gradations of impurity."

Kindergartening in a New Role.—There is to be opened in Boston this fall a kindergarten settlement, to be known as the Elizabeth Peabody House. It is designed as a memorial to Elizabeth Peabody, who did so much, in the early days of kindergartening, to help the cause. The plan is to take a house in some poor and crowded quarter, and officer it with a group of eight or ten kindergarteners, normal students, and teachers. They will conduct a kindergarten, and through acquaintance with the children enter into friendly and helpful relations with the people of the neighborhood. Interesting plans are under consideration for a cooking school, a training class for nursery maids, and for mothers' clubs and classes, where helpful hints may be given as to the care of children and of the home.

Fish-bait Farms.—Fine openings for new industries are discovered by Dr. W. A. Herdman, President of the Zoölogical Section of the British Association, in the cultivation of supplies for fishermen. The Scotch long-line fishermen alone, he says, use nearly a hundred millions of mussels every time all the lines are set, and many tons of them have to be imported every year. If squid could be obtained reasonably and in sufficient quantity, it would probably prove more valuable even than mussels. A fishing firm in Aberdeen last winter paid more than two hundred pounds for squid bait for a single boat's lines from October to December, and there are fifty such boats north of the Tyne. "Here is a nice little industry for any one who can capture or cultivate the common squid in quantity." Innumerable young mussels perish around the coasts every year for want of suitable objects to attach to. The erection of proper stakes or plain *bouchots* would serve a useful purpose, at any rate in the collection of seed. Dr. Herdman further pointed out the opportunity that exists for opulent landowners to erect sea-fish hatcheries on the shores of their estates, and for rich merchants to establish agriculture in neighboring estuaries, and so instruct the fishing populations, resuscitate declining industries, and cultivate the barren shores, in all reasonable probability to their own ultimate profit.

The Sage School of Philosophy.—The Sage School of Philosophy in Cornell University is devoted "to the free and unhampered quest and propagation of truth" in regard to all those questions of human inquiry which are embraced by logic, psychology, ethics, pedagogics, metaphysics, and the history and philosophy of religion. Its aim is to secure comprehensiveness and thoroughness. It is founded on an endowment by the Hon. Henry W. Sage, the proceeds of which are supplemented, when necessary, with appropriations from the general funds of the university. Six scholarships and three fellowships are open to graduates of Cornell and other universities; four progressive courses of study are given, corresponding with the four years of the college course, and also seminary courses in experimental psychology, ancient and mediæval philosophy, modern philosophy, ethics, pedagogics, and the history of religion. The students are further free to select any of the courses given in the university. A psychological laboratory is attached to the institution; a philosophical club has been formed; and a periodical—the Philosophical Review—is published under the editorial direction of two of the professors, assisted by their associates.

Face-Reading.—In the acquisition of the art of speech-reading by sight, the eye of the deaf pupil becomes accustomed to certain positions of the organs of articulation, and he thus learns to understand the spoken words of others, although he does not hear them. In teaching this art, Lillie Eginton Warren has found that the forty odd sounds of the English language are revealed in sixteen outward manifestations or pictures, and practice in following them as they rapidly appear in a face enables us to understand what is said. Some faces differ from others in strength of expression, and thus many show less action in the lower part. Nevertheless, there is in all persons a general approach to a certain definite movement of muscles, particularly when in animated conversation, and the trained eye notices what the inexperienced one fails to discover. After attaining a degree of proficiency in this art of expression-reading, persons seem to feel that they hear instead of see the words spoken. Reading our language in this way may be said to be mastery of a new alphabet, the rapidly moving letters or characters of which are to be found upon the page of the human countenance.

A Dream of Railroad Development.—Forecasting, in the Engineering Magazine, the future of American railroading, Mr. H. D. Gordon assumes that the lines on which our inventors will have to do their work hereafter seem to be far more clearly defined than ever before. There is no engineering reason why a speed of one hundred miles an hour should not be maintained on fast trains; the objections are commercial rather than technical. The chief obstacle lies in the ponderous and wasteful mechanism needed to generate the requisite amount of steam under even the best methods. The remedy may be found when electric energy can be generated in a simpler and less expensive manner than hitherto. In passenger trains too many horse powers are needed to carry each ticket-holder to his destination, and too many hundredweight of dead material have to be dragged along with him. Within the carriage he is entitled to better ventilation and better light than he is apt to get, and electricity is looked to to provide him with both. Some benefit has been derived, and much more may be reasonably expected, from the experiments made in introducing steel frames into cars, and otherwise improving their structural resistance to abnormal shock or accident. Outside of the train, in signaling, a considerable advance has already been made toward having the semaphore raised and lowered by directly applied electric force; and the author anticipates that it will not be many years before a train may be seen through its successive blocks by the glare of electric lights, leaving each block in darkness as it enters and lights the next. What has already been done in railroad invention in the United States is but an earnest of what the future holds in reserve.

The Ball Nozzle.—Mr. Arthur Kitson, in an address on the ball nozzle, published in the Journal of the Franklin Institute, gives the following explanation of its apparent contradiction of natural laws: The problem connected with this invention may be put thus: Why does the ball adhere to the nozzle when there is behind it a force aggregating as high as hundreds of pounds pressure? The explanation usually given is that the atmospheric pressure holds the ball in its place and prevents it from falling or leaving the mouth of the nozzle. To this others answer that the pressure behind the ball far exceeds the atmospheric pressure; for instance, there is an exhibition given daily in New York with one of these nozzles where the water pressure equals a hundred pounds per square inch, and as the atmospheric pressure is only about fifteen pounds, it would at first sight seem that the excess of pressure on the under side of the ball was eighty-five pounds, and ought, therefore, to expel the ball. The error, however, in this argument arises from failure to distinguish between the pressure of the water when confined in the pipes and when issuing around the ball. It is very certain that if a hundred pounds pressure were acting directly upon the ball, it would be blown out of the nozzle, but it does not appear to me to act in this way. When the ball is confined to the mouth of the nozzle and pressed against it, it is undoubtedly subjected to the pressure of the water, but the moment it is raised slightly from the mouth, it is no longer subjected to this pressure, since the water is escaping all around it. In this respect it resembles the lid of a teakettle when the water is boiling. By plugging the spout, the lid will be raised by the steam pressure sufficiently to allow the steam to escape at the sides. The explanation that seems to me to be the correct one is as follows: The ball is acted upon by three forces: first, gravity; second, atmospheric pressure; and, third, the force of the issuing stream. At first, the atmospheric pressure is the same at all points, and hence gravity has free play; but as soon as the stream passes through the nozzle, the atmospheric pressure from the under side is counteracted by the momentum of the issuing water, and the ball rising to a point where the water can pass freely around the sides, without pressing materially upon the ball, we have the full pressure of the atmosphere on the under half-side of the ball resisting the force of gravity. The ball, therefore, simply serves as a deflector to divert the current of water or to spread it out, and the resistance of the atmosphere against the ball suffices not only to perform this operation but also to sustain its weight.

It is possible that the density of the air may also be somewhat increased under the ball by the action of the spray. With a heavy pressure, the ball is farther removed from the nozzle than with a light pressure. The same holds good respecting a heavy ball and a light ball.

Native Sulphur in Michigan.—Beds of native sulphur are described by W. H. Scherzar in the American Journal of Science as having been discovered during the past year in the upper Helderberg limestone of Monroe County, Mich. They lie from sixteen to eighteen feet below the surface, between a compact, dolomitic limestone and a calcareous sand rock. They consist of a yellowish-brown, impure limestone, containing fossils, and giving here and there a strong, oily odor, which, wherever exposed to view, appears to be cavernous in structure, having pockets of from a fraction of an inch up to three feet in size. These pockets contain scalenohedrons of calcite or tabular crystals of celestite, or both together; while the sulphur generally occurs in bright, lustrous masses toward the center of the cavity, intermatted frequently with the lime minerals. Fragments as large as one's fist are readily removed. Some of the smaller cavities contain nothing but pure sulphur. Nearly one hundred barrels of pure sulphur have been obtained from about an acre of this bed.

Antirabic Serum.—In the light of some of the recent experimental work of Tizzoni and Centanni, published in the Lancet, there seems little doubt that a great advance has been made in the treatment of rabies. Instead of manufacturing the antitoxic material in the body of the patient, by a process of vaccination as in the Pasteur method, Tizzoni and Centanni prepare this substance in an animal, from which it is conveyed to the individual to be treated, in the blood serum as a vehicle. In place of using Pasteur's method of protective vaccination for the animals from which the serum is obtained, they, by a process of peptic digestion, attenuate the virus to be used. It is possible by drying to prepare a permanent form of this serum which will, if kept from air and light, remain active for a long period. It is very portable, is readily dissolved, and may be used by any one who is capable of sterilizing a hypodermic needle and syringe. The treatment, therefore, can be commenced almost as soon as the patient has received the bite, and it is not necessary that he should leave his home or his own medical attendant.

The Meaning of Race.—Attempting to frame a definition of race, Mr. W. M. Flinders Petrie remarked in the British Association that when only a few thousand years had to be dealt with, nothing seemed easier or more satisfactory than to map out races on the supposition that so many million people were descended from one ancestor and so many from another. Mixed races were glibly separated from pure races, and all humanity was partitioned off into well-defined divisions. But when the long ages of man's history, and the incessant mixtures that have taken place during the brief end of it that is recorded, come to be realized, the meaning of "race" must be wholly revised. The only meaning that a "race" can have is that of a group of persons whose type has become unified by their rate of assimilation and of their subjection by their conditions exceeding the rate of change produced by foreign elements. If the rate of mixture exceeds that of assimilation, then the people are a mixed race, or a mere agglomeration.

MINOR PARAGRAPHS.

The Belgian Astronomical Society, founded a year ago, for the advancement and popularization of that science and of meteorology, has recently become much extended. At the meetings in May, June, and July, 1895, papers were read on the history of astronomy at the time of the Renascence, by M. Doiteau; on the observation of the scintillation of the stars, by M. Vincent; on the application of the spectroscope to the study of the constitution of Saturn's rings, by M. Stroobant; on the theories of atmospheric circulation, by M. Marchal; and on other subjects. A co-operative system of observations of shooting stars, clouds, etc., was decided upon. An annual volume of the year's results is to be published in November, and a periodical bulletin has been arranged for.

A French journal, the Chasseur illustré, tells of a Russian gentleman who, wishing to ascertain where the birds go in winter, caught a number and attached to their tails a tube containing his address and a request in four languages that whoever might find the bird again would write him concerning the place and time of the finding. He waited long for an answer, but only recently received a letter from a European prisoner captured by the Mahdi at the taking of Khartoum, relating that a follower of the Mahdi in Dongola had killed one of the birds in November, 1892, and, not being able to read the paper, had brought it to him. The prisoner, in his glad surprise at receiving a letter from Europe in so strange a way, embraced the first opportunity on regaining his liberty to answer it.

The influence that the bearing of one man or nation may exert upon another is exemplified by what Mr. W. M. Flinders Petrie said in the British Association concerning the condition in the East, where an interminable system of reprisals in defrauding and exacting prevails. "The Egyptians are notorious for their avarice, and are usually accredited with being interminable money-grabbers; yet no sooner do they find that this system of reprisals is abandoned and strict justice maintained than they at once respond to it; and when confidence has been gained, it is almost as common to find a man dispute an account against his own interest as for himself, and scarcely ever is any attempt made at false statements or impositions. Such is the healthy response to straightforward dealing with them."

The purpose of the new division of agrostology in the United States Department of Agriculture is investigation and experiment upon grasses and other forage plants, in order to determine their adaptability to cultivation and use in this country; to inform the people concerning them; and to introduce those which promise well—whether native or foreign—into cultivation. A small plot has been furnished on the grounds of the Department of Agriculture on which four hundred varieties of grasses and forage plants are growing for the testing of their qualities, and a larger garden has been established in one of the Southern States. The division has in preparation a popular book on the grass and forage plants of the country, also a larger illustrated handbook on the grasses of North America.

A curious system of water cure is practiced by Sebastian Kneipp at Woerishofen, Bavaria. Its most striking feature is the importamce it attributes to the action of water on the lower extremities. Patients are caused to walk in running water or on the dewy turf, or on flagstones freshly watered; and baths are prescribed without after-use of the towel or rubbing, the bather being instructed to dress himself as quickly as he can, and let the reaction take place in his damp shirt. The system is mentioned by M. E. Bottey in his theoretical and practical treatise on the water cure (Paris, 1893) as possibly affording the hygiene and *régime* which some diseases require, but as dangerous in most cases.

NOTES.

Considerable attention has lately been given in London to the question of the spread of infectious diseases among horses through the public watering troughs. There seems good reason to believe that this is a common source of infection, especially for glanders. One parish has gone so far as to abolish the ordinary troughs and replace them by a stopcock and a pail.

In speaking of Prof. Ludwig, one of the most persistent of vivisectors, Dr. Mosso says: "Ludwig, the greatest of vivisectors, was president of the Leipsic Society for the Protection of Animals, and remained to the last one of its most active members. Germany owes to him that her horses and beasts of burden are now humanely treated. To him is due the awakening of the true humanitarian spirit toward the brute creation that culminated in the 'Union of German Societies for the Protection of Animals.'"

Prof. Charles S. Minot, of the Harvard Medical School, has arranged a course in embryology for students wishing to make a special study of this branch. The course is open to registered students of the graduate department of the Faculty of Arts and Sciences, and will be offered hereafter also as a special course to graduate students of the medical school. The course extends through a year of two terms, and will consist of lectures and laboratory work. Students taking the course will be expected to devote to it not less than eighteen hours a week. For persons having medical degrees the fee for one term is seventy-five dollars; for the whole year, one hundred and twenty-five dollars. Others must enter the university as graduate students under the Faculty of Arts and Sciences.

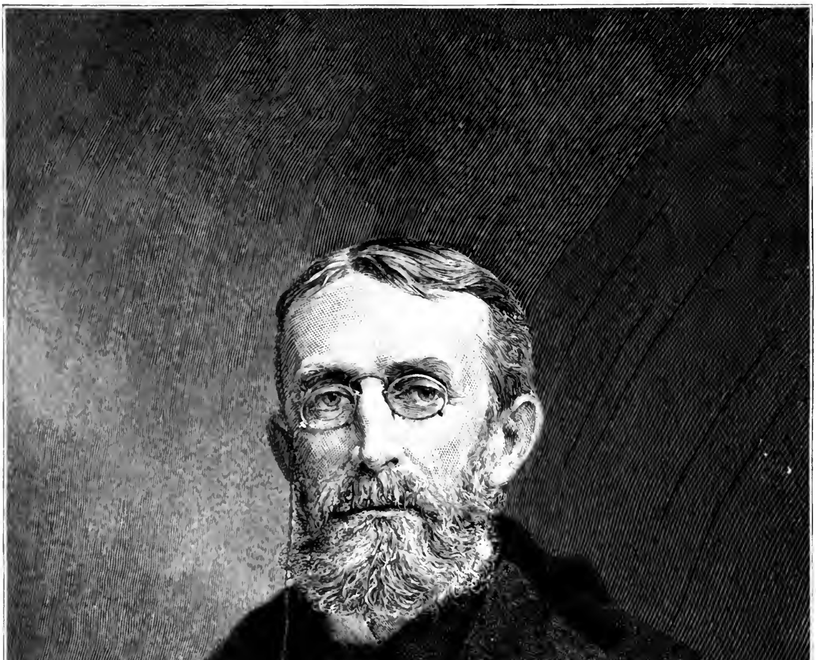
At a recent meeting of the Berlin Pharmaceutical Society, Dr. Seidler read a paper on the bacteria in mineral waters. He had made an elaborate series of experiments and found bacteria in all the bottled mineral waters, artificial as well as natural. The waters, as a general thing, were practically germ-free as they emerged from the earth, but bacteria developed rapidly, through carelessness in washing the bottles, corks, etc.

The mineral statistics of the United Kingdom of Great Britain for 1894 have been issued as a blue book. The total production of coal for the year was 23,125,983 tons; the approximate price at the pits about $1.75 per ton.

The seventh session of the Australasian Association for the Advancement of Science will be held in Sydney, from the 3d to the 10th of January, 1897, under the presidency of A. Liversidge, Professor of Chemistry, University of Sydney. Communications and papers for the meeting, or inquiries, may be addressed to the permanent honorary secretary, The Chemical Laboratory, The University of Sydney, N. S. W.

Dr. Albert E. Foote, of Philadelphia, a distinguished mineralogist, died at Atlanta, Ga., where he had gone in charge of the Pennsylvania mineral exhibit, October 10th. He had been in feeble health for some time. He was born in Hamilton, N. Y., in 1846; was graduated in medicine from the University of Michigan in 1867; taught at Ann Arbor; and was for five years Professor of Chemistry and Mineralogy in Iowa State College. In 1876 he removed to Philadelphia and became a professional mineralogist and a dealer in minerals and scientific books.

Prof. H. Hellriegel, an active and efficient investigator in agricultural chemistry, died at Bernburg, Anhalt, Germany, September 24, 1895. He was best known for the researches into the fixation of nitrogen by leguminous plants, in which the joint agency of microbes and nodules on the roots of the plants was determined.



ANDREW DICKSON WHITE.

APPLETONS' POPULAR SCIENCE MONTHLY.

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PRINCIPLES OF TAXATION.

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

II.—THE PLACE OF TAXATION IN LITERATURE AND HISTORY.

ONE of the great historians of the present century has expressed disappointment at what he terms the "emptiness" of historical study, and accordingly inclines to the opinion that guidance in respect to human affairs in the future is to be sought for in present rather than in past experiences. Nevertheless, it would seem to stand to reason, that when any department of knowledge, especially one characterized by controverted questions, is to be comprehensively examined, with the prime object of determining the best methods for human action, it would not be expedient to attempt to discover or discuss any abstract principles which ought to govern such action, until at least a summary of facts derived from experience and essential to correct conclusions had been presented and made familiar, and, acting on this assumption, it is proposed next to ask attention—*first*, to the place of taxation, considered as a department of knowledge, in general literature; and, *second*, to some points of historical interest, growing out of the appropriation of states or rulers of the property of their citizens or subjects for real or assumed public purposes. It is believed that in this way the discussion at a later period of the principles growing out of the exercise by governments of this great prerogative may be facilitated and rendered more attractive.*

* "No man can learn what he has not preparation for learning, however near to his eyes is the object. Our eyes are holden that we can not see things that stare us in the face, until

Position of Taxation in General Literature.—All general treatises on political economy devote more or less space to the consideration of taxation; and there have been many publications in the nature of official reports, compendiums of tax laws, and their interpretation by legal tribunals, and special essays on particular forms of taxes. But, at the same time, notwithstanding the vastness and importance of the subject, its symbolism and exemplification of sovereignty, its influence for weal or woe on every citizen and on every industry, according as the power involved is properly or improperly exercised, and the part it has played in history, its position in economic literature is so comparatively insignificant that there is not a single publication at present in the English language which is entitled to be considered as a full and complete treatise; certainly none such as are readily at the command of every person desirous of becoming reasonably proficient in any of the other leading branches of learning. Prof. Cossa, of the University of Pavia, Italy, in a bibliography of taxation incorporated in a brief treatise on the Science of Finance, published in 1882, and brought up to the times by an American translation in 1888,* does not mention even one title of this character. And, although there are works on taxation more or less general in their scope in other languages—especially in French and German—and to some of which high merit is accorded, there are none which any considerable number of economists are willing to accept as standard or authoritative in all departments; the chapter on taxation in Adam Smith's Wealth of Nations constituting the only treatise which can possibly be regarded as an exception.† For such a result it is not easy to account. Possibly, owing to the want of accord among writers on economic and financial subjects, an opinion has come to prevail that no consistent treatment of the subject, as a whole, is possible; that the financial and industrial condition of nations or states differs so widely that no uniform rules of practice for the raising of revenue can be established; and, finally, if such a code of rules were universally accepted, the varying necessities of nations would com-

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the hour arrives when the mind is ripened; then we behold them."—*Emerson, Spiritual Laws, First Series of Essays, p. 139.*

* Taxation, its Principles and Methods. Translated from the Scienza delle Finanze of Dr. Luigi Cossa, Professor of the University of Pavia, Italy; with an Introduction and Notes by Horace White. New York: G. P. Putnam's Sons, 1888.

† "It is well known that during the period from Adam Smith to the close of John Stuart Mill's activity—that is, for fully one hundred years—English political economy treated the science of finance" (embracing the raising of revenue) "as nothing better than a scanty appendage. It is a significant fact that no work worth mentioning on the science of finance has yet (1889) been published in the English language, though some considerable contributions have been made to financial history."—*Cohn's Science of Finance.*

pel its violation, or complete abandonment, in periods of great emergency.

In the case of the United States the condition of the country previous to the civil war, as already pointed out, was very curiously such as to create great indifference to this, in common with almost every other economic or financial topic. The nation and the several States composing it were at the period referred to comparatively free from debt. All taxation was light. *Direct* taxation by the Federal Government had become a matter of history, no taxes of this character having been imposed for nearly half a century. Pauperism was mainly restricted to persons of foreign nativity, while to all who were willing to practice industry and economy, the ability to command a good subsistence, if not an ultimate competence, seemed comparatively easy. Why should a nation under such circumstances trouble itself about difficult and intricate problems in finance or political economy? And taking counsel of the proverb, "Sufficient unto the day is the evil thereof," the nation did not. But, with the advent of war in 1861, the creation of an enormous national debt, and a gigantic, unsystematic, and complex system of taxation, a resort to irredeemable paper money and the suspension of specie payments, the condition of things as above stated rapidly changed; and the questions and problems which in popular estimation were before insignificant have rapidly become so important, as to constitute not only the theme of never-ending popular discussion, but also the issues which mainly divide the national political parties of the country. And as illustrating in some degree the nature and strength of what may be termed the motor or impelling influences which have forced these changes in public opinion, what can be more pertinent than the fact that the State of New York alone now annually raises by taxation to meet the expenditures of State and local governments a sum ($91,232,012 in 1890) more than one half in excess of the net ordinary expenditures of the Federal Government in 1860 ($60,086,754). In this latter year the cost to the people of the United States for the maintenance of their national, State, and local governments was probably less than three dollars *per capita*. For the year 1890, an approximately correct estimate for like expenditures was $13.65 *per capita*.

These questions and problems have not, however, come up simultaneously for consideration, but have been gradually evolved, as it were, from the changing condition of affairs, and somewhat in the following order: *First*, the national debt and its transition from a miscellaneous to a consolidated character; *second*, the readjustment of the war system of internal taxation; *third*, the question of currency, specie redemption, and legal tender—on which topics alone more than three hundred separate publications, books and pamphlets, exclusive of congressional speeches and newspaper articles, have been issued from the American press; *fourth,* the "Free Trade" and "Protection" question; *fifth,* the monetary metallic standard question; *sixth,* the relations of the State to common carriers, and the methods of internal intercommunication; *seventh,* the subject of local or State as contradistinguished from national or Federal taxation; on which latter topic, although it relates to methods by which the people of the United States at present annually contribute to local or State governments a sum nearly equal to the present total annual revenue of Great Britain from all imperial taxes, there had not been up to 1870, a single publication in the United States apart from official reports that pretended intelligently to discuss it. Since this date, however, a much greater interest has been manifested on this subject. Several publications of great merit, exhibiting the situation in its legal aspects, and the theories, controversies, and experiences of the past, have appeared;* and this interest has been especially intensified and popularized by the scheme of the so-called "single tax," which, if not originated by Mr. George, has been so ably advocated by him as to have attracted, previous to the development of the silver problem, more of popular attention on both sides of the Atlantic than any other economic topic brought forward during the present century.

Some better acquaintance with the literature of taxation than has hitherto been acquired by most educated men would seem to be essential to a full understanding of many of the great events in the world's history, inasmuch as nearly all great political revolutions have been primarily occasioned by the exercise of arbitrary power in compelling contributions of property from the masses by those in authority. Thus, going back to ancient history, the disruption of the Jewish monarchy and the secession of the ten

* Of such publications the following are specially worthy of notice: A Treatise on the Law of Taxation, including the Law of Local Assessment, by Thomas M. Cooley, one of the justices of the Supreme Court of Michigan, 1876; A Treatise on the Law of Taxation, as exercised by the Government of the United States, by W. M. Burroughs, 1877; The Law of Taxation, by Francis Hillard, 1875 (three publications in which questions of political economy, as not necessarily involved in discussion of legal points, have received little consideration); The Shifting and Incidence of Taxation, 1892, Progressive Taxation in Theory and Practice, 1894, Essays on Taxation, 1895, by Prof. Edwin R. A. Seligman, of Columbia College, N. Y., three publications characterized by great historical research, and a repertory of information not otherwise readily accessible. Cohn, Science of Finance, a recent work of sufficient merit to warrant its translation from the German under the auspices of the University of Chicago, is nevertheless of such a character that it will never be generally read, or have the slightest influence on the mass of the people of a country like the United States, who select the legislators who determine what shall be the policy of their Government in respect not only of taxation but of all other fiscal or economic subjects.

tribes were due to the refusal of the successor of Solomon to accede to the demands of their representatives that he should abate the (tax) exactions of the preceding reign; and to his threat in response that he would make his yoke even heavier in this particular than his father's. And the first significant act recorded of the revolt that followed was the stoning to death of the man Adoram, who "was over the tribute," or the chief of the tax collectors.

After the Persian war, the states of Greece, united under what was termed the confederation of Delos, agreed to make contributions—i. e., pay taxes—to Athens, to be used by her for the common defense; and these contributions, assessed in the first instance by Aristides, whose reputation for justice commanded the confidence of all, occasioned no complaint. But finally Athens, having assumed the direction of the confederacy, not only increased the contributions beyond the assessments of Aristides, but also assumed the right to use them arbitrarily, notably for fortifying and beautifying the city. The result was a revolt, followed by the Peloponnesian war, and from that date and occurrence the decline of Athens, and indeed of all the states of Greece, is traceable.

Oppressive taxation prompted the so-called massacre of the "Sicilian Vespers" in 1282, resulting in the slaughter or expulsion of all the French from the island of Sicily.

The assumption and exercise of authority on the part of Pope Leo X in 1517, to enforce contributions for the rebuilding of the cathedral of St. Peter's at Rome was, as is well known, the primary cause of the disruption of the Roman Catholic Church, the Protestant secession led by Luther, and the almost innumerable wars and social disturbances that followed in consequence.

The history of the struggle of the people of England against arbitrary taxation is the history of the English Constitution. Thus, the attempt to arbitrarily collect an unjust poll tax was the primary cause of the rebellion of Wat Tyler in England in 1378, in the reign of Richard II; as was the "misuse of taxes" the occasion of the rising of the commons of England in the next century (1450) against the government of Henry VI, and under the leadership of Jack Cade.*

Shakespeare, who apparently analyzed and comprehended the subtle philosophy of all human motives and tendencies, seems also in the play of Henry VIII to ascribe the fall of his great minister, Wolsey, to abuse of the power of taxation; and whether

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* Recent historical investigations favor the idea that the leader of this rebellion was not an illiterate rascal and buffoon—one of "the filth and scum of Kent," as portrayed by Shakespeare in Henry VI—but rather a gentleman of gentle and possibly of noble birth.

in this he was historically correct or not, his utterances respecting the effect of such abuse are as pertinent to-day as ever, and in some respects remarkably applicable to the depression that in recent years has come to one great department of the domestic industries of the United States through injudicious taxation of the crude material—wool—that constitutes its foundation:

> "The subject's grief
> Comes through commissions, which compel from each
> The sixth part of his substance, to be levied
> Without delay; . . . this makes bold mouths:
> Tongues spit their duties out; and it's come to pass,
> This tractable obedience is a slave
> To each incensed will."
> "For, upon these taxations,
> The clothiers all, not able to maintain
> The many to them 'longing, have put off
> The spinsters, carders, fullers, weavers, who,
> Unfit for other life, compelled by hunger,
> And lack of other means, in desperate manner
> Daring the event to the teeth, are all in an uproar,
> And Danger serves among them."

The great revolution in England (1642–1659), by which the constitutional rights of her people were finally established, wherein Charles I lost both his crown and his head, was caused by a question of taxation. And subsequently the attempt of Great Britain to tax her American colonies without their consent was also the primary cause of the American Revolution; * while later the demonstrated inability of maintaining a harmonious and efficient government under the Articles of Confederation, which per-

* Recent historical investigations (by Prof. Tyler) have shown that the demand "no taxation without representation," which has been popularly regarded as one of the prime causes that contributed to the revolt of the British American colonies in 1775 and their subsequent independence, " did not mean that the colonies could not be lawfully taxed by Parliament when they had no representatives in Parliament. It was a demand applicable to the three orders of the English body politic—king, lords, and commons—and meant that the commons could not be taxed when they were not represented. But the commons represented the cities of Leeds, Halifax, Manchester, Birmingham, and Liverpool in Parliament, although none of them had any vote or personal representation in it at the time of the American revolt or for a long time afterward. Indeed, only one tenth of the people of the United Kingdom had then any vote. The commons represented Massachusetts in the same way that they represented Manchester. That this was an unsatisfactory kind of representation will be admitted without argument, but it was not in contravention of the maxim quoted, which has come down to us as a legal justification for the war. It would have been strange indeed if the English Constitution had contained within itself a justification for breaking up the British Empire." The separation of the colonies from the mother country was therefore not a legal step, but an act of revolution, and suggests a remark attributed to Mr. Lincoln at the outbreak of our civil war, that " it was a constitutional procedure for overthrowing the Constitution."

mitted the several States that were parties thereto to interfere with their mutual trade and commerce by multiple and conflicting systems of taxation, was one of the principal factors that led to the formation and adoption of the Federal Constitution.

It is also now generally admitted that to the cruel and extraordinary abuse of the power of taxation, more than to any other one agency, is attributable not only the French Revolution, but the extraordinary ferocity with which it was conducted.

No text in the New Testament has been so little understood for want of any recognition of its connection with the subject of taxation, as that one which declares that "it is easier for a camel to go through the eye of a needle than for a rich man to enter into the kingdom of God." By many theologians and secular advocates of social reform—the Russian Tolstoi being a recent notable example of the latter—it has been regarded as a disapproval of the attainment or accumulation of wealth, and has doubtless served as the basis for innumerable sermons on the "sin of riches;" when a little reflection and acquaintance with social economy would have led to the conclusion, as Buckle has clearly expressed it, "that of all the results which are produced among a people by their climate, food, and soil the accumulation of wealth is the most important. For, although the progress of knowledge eventually accelerates the increase of wealth, it is nevertheless certain that in the first formation of society, wealth must accumulate before knowledge can begin, because without wealth there can be no taste or leisure for that acquisition of knowledge on which the progress of civilization depends." And surely a disapproval of this almost self-evident truth could not have been the intent of an inspired teacher. To understand the true meaning of this text it is necessary to go back and consider the time and circumstances under which the declaration it embodies was made. Judea at this period was a subjugated Roman province, and what the wisest and best men of Rome thought of the people of such provinces and of the right of Rome to grind down the nations that it had subjugated, is clearly shown by the following extract from the oration of Cicero against Verres, who was prosecuted for extortion when governor of the province of Sicily: "If," he said, "we have esteemed the revenues of the provinces as the nerves of the republic, we shall not hesitate to say that the order which raises them is the mainstay of the other orders. The provinces and countries subject to tribute are the lands of the Roman people. If Verres is guilty, it is not because of his rapacious exactions, but because he diverted them to his own use rather than to that of the republic." And as for the sufferings of the tributary people, he alludes to them for the necessities of his cause, but he regards them of so little importance that in his oration for Fonteius he exclaims: "Who are his accusers? Barbarians! Men who wear breeches and smocks! Can the most reputable of the Gauls be placed on a par with the least and most wretched of Roman citizens?" The Romans, in fact, regarded their provinces as valuable only to the extent that they could make them available for extorting tribute (taxes), and the most effective instrumentalities they could employ for this purpose were unpatriotic or renegade citizens of the provinces who understood the habits, pursuits, and amount and distribution of the property of their fellow-countrymen. These in the case of Judea were Romanized or apostate Jews, who, in accordance with the Roman custom, were invested with a power, which they undoubtedly exercised, to administer torture in case it was found necessary to enforce payments from unwilling or impoverished subjects.

Again, as there was little industry at the time save agriculture, and markets were limited, there was little opportunity for a Jew to become rich, except by favor of the Romans and plunder of his people; and with these latter the publican or tax-gatherer and the rich man, who must have been often one and the same, became so abhorrent, that they naturally classified and placed them upon the same plane with notorious sinners and the most despised and degraded members of society—the harlots*—for whom an entrance into the kingdom of heaven was regarded as an impossibility.

And in this connection it is pertinent to recall that Jesus visited the house of "a man named Zaccheus, which was the chief among the publicans, and he was rich." . . . "And when they" (the people) "saw it they all murmured, saying that he was gone to be guest with a man that is a sinner. And Zaccheus stood and said unto the Lord: Behold, Lord, the half of my goods I give to the poor; and if I have taken anything from any man by false accusation, I restore him fourfold." And evidently in consequence of this declaration, "Jesus said unto him, This day is salvation come to this house, forasmuch as he also is a son of Abraham" (and not a foreigner). "For the Son of man is come to seek and to save that which was lost" (i. e., the publicans).

In ancient Greece also there was a familiar proverb that used the term "publican" as synonymous with that of "robber"; and Tacitus, the Roman historian, in his description of the German people, regards them as fortunate in having no publicans to impoverish (*atterit*) them.

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* "Verily, I say unto you, that the publicans and the harlots go into the kingdom of God before you."—*S. Matthew, xxi, 31.*

"For John came unto you and ye believed him not; but the publicans and the harlots believed him."—*S. Matthew, xxi, 32.*

On the other hand, in the case of the Romans, who had little sensitiveness as to the manner in which public revenue or private wealth was attained, the publicans who collected the customs were held in high honor, and were characterized as the flower of the nobility ("*flos equitum Romanorum*").

Another point of interest in connection with this immediate subject, and one which has been generally overlooked, is that the answer which Jesus gave to the Jews, who put to him the question, "Is it lawful to give tribute to Cæsar?"—namely, "Render unto Cæsar the things that are Cæsar's"—expresses a fundamental principle in political economy, in that it enjoins payment on the part of citizens or subjects of such tribute (taxes) as the government (typified by Cæsar) under which they live, may lawfully be entitled to demand for its support; and at the same time withholds sanction from, and so by implication denies, the right of a government to take that to which it is not entitled (or which is not Cæsar's), which it does when it exacts tribute or taxes for any other purpose than its legitimate support, or, what is the same thing, for the benefit of individual or private interests. In other words, the answer recognizes a broad line of distinction between the rights of Cæsar, or the government, and other rights in respect to property; and indicates that Cæsar, or a government, can find no justification, in virtue of power to compel the payment of tribute or taxes, to appropriate property (of the people) under circumstances in which similar action on the part of a private citizen would be considered robbery.

The casual observer would hardly imagine that there was any relation between anthropology (the science of man) and taxation; and yet writers on the laws of nations from an early period, and economists of a later day,* have called attention to the circumstance that different races seem to possess different moral aptitudes for different forms of taxation. Thus it is claimed that in countries inhabited by the pure Germanic race, or its leading branches—in Germany, Scandinavia, Great Britain, and the United States—the desire and ability for self-government, and the disposition to place authority near to the individual or in his town or locality, favors voluntary taxation and a great endurance of burden in view of the attainment of a right result; whereas among the Latin races the tendency is to concentrate all authority, and generally in a military form, in the state, and require passive submission to the exercise of it on the part of the people. Hence, general taxes on property and income, which require for their successful application a certain degree of loyalty, of pa-

* Macchiavelli and other Italian publicists in the seventeenth century, and M. de Parieu, a French economist, in 1855.

tience, and even of voluntary co-operation on the part of taxpayers, and which find favor among the former races, hardly exist among the latter. It is interesting also to note, in connection with this subject, that the restitution to the government of what is termed "conscience money," which is of constant occurrence in Germany, Great Britain, and the United States, is said to be very inconsiderable or wholly lacking in the States of the Latin races.

The comparatively insignificant position which the subject of taxation holds in economic literature has already been pointed out. Its relation to general literature is similar, and perhaps even more remarkable. Since sin came into the world, there has probably been no one purely human agency more prolific of crime and human suffering and of temptation to do wrong than the multitude of arbitrary, impolitic, and absurd laws which have been enacted to unjustly exact from the people contributions of their labor and property under the name of taxation, and yet the utilization of these experiences by novelists and dramatic authors has been almost entirely restricted to the comparatively petty transactions of smugglers and the illicit producers of distilled spirits. Even the terrible tax incidents which preceded and in fact occasioned the great French Revolution, have not entered largely as an element into more than one or two works of fiction of acknowledged merit in the English language.* As a field of morals also, this subject has been almost entirely ignored, and rarely entered upon by theologians; and yet under the tax laws of the United States, to say nothing of other countries, the practice of perjury is encouraged and tolerated to a degree that is utterly inconsistent with the existence of any high standard of public morality, or any rational religious belief.† And so also in the department of history. How few of those who consider themselves well read and well informed, recognize that the terrible decadence

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* The only work of fiction of this character known to the writer is Gabrielle André, by S. Baring-Gould (D. Appleton & Co., New York, 1871), in which the conditions of taxation existing in France, prior to the Revolution of 1788–'89 are instructively used as the basis of a historical story.

† On this topic a leading American clergyman writes as follows: "It is probably a good thing that clergymen have not preached numerous sermons on taxation, even on its moral and religious aspects. That they have hitherto been ignorant on the subject is not so much their fault as their misfortune, and being ignorant on the details of this matter they have not taken it as the theme of set discourses. But, judging by my own experience, they have preached on the application of moral principles to every department of life, and on the obligation of a man to be honest in his dealings with government no less than with individuals. That taxation has moral relations and qualities they have perceived and stated, and that probably was as far as their qualifications authorized them to proceed. Whether the present encyclopedic education will give us the more serviceable clergymen remains to be seen."

of Spain up to 1808 is attributable more to the influence of a tax on sales than to any other one cause; and that, on the other hand, the great wealth and prosperity of Holland in the sixteenth, seventeenth, and eighteenth centuries, and the control of a commerce that made its ships the chief carriers and their ports the chief depots of the products of the world, were due mainly to a system of taxation that imposed the minimum of restriction on exchanges, domestic or foreign, and entailed the least friction upon its own people; while in all other and competitive countries the direct reverse of such a fiscal policy found favor and existed.

THE PLACE OF TAXATION IN HISTORY.—A clear and exhaustive statement of the world's experience in respect to what is called taxation would be almost equivalent to a universal history; and in default of this, a review of the most prominent features of such experience is the only alternative, and is capable of being made in the highest degree interesting and instructive.

While the farthest reach of history touches no period when government or the state has not appropriated for its maintenance or pleasure the property or services of its subjects or citizens, the present ideas respecting taxation are so essentially modern that little or no recognition of them can be found in either ancient or mediæval history. In fact, no taxes, in the present ordinary sense of the term, were needed in ancient times to carry on government or public institutions. The monarch, king, chief, lord, or other sovereign of any particular district or country was generally the owner of all the landed property within his empire or domain; and the people who cultivated it were his villeins, serfs, or tenants. "The theory of English (and also of Chinese) land tenures to-day is, that the original title is in the king or emperor, and that everybody who has an interest in land is a tenant. There is no such thing known to this day in England as an *allodial* title—that is, one which is absolute as to the ownership of the soil, and which is mainly the one recognized in the United States. As a consequence, all land in England is held mediately or immediately of the king, and there is no allodial tenure." *

A sovereign who owned all the land of a country, and could at his will take any portion of the labor products of the people who cultivated or occupied it, obviously was exempt from the necessity of resorting to any other form of levy upon persons or property for the support of the state or for his pleasure; and this

* Miller, on the Constitution of the United States. "Out of this fact come many of the difficulties American students find in regard to the doctrines pertaining to estates and tenancies. Our laws have been freed from a large part of these intricacies and traditional requirements, which were the outgrowth of centuries of development among our English ancestors regarding the holding of land, but their influence still embarrasses our judicial system" (ibid., pp. 231, 232).

mode of appropriating property by the governing power has prevailed in almost every country of the Old World of which we have any fiscal record, at some period of its history. At the same time all history teaches that the actual administration of such governments has been very generally, and perhaps as a rule unnecessarily, oppressive by reason of the manner of collecting or exacting the tribute or contributions from the people, or by the spoliations of the officials to whom the business was intrusted. Throughout the Eastern world the general practice under its native princes has been, and even still is, for the tribute or tax collectors to pay themselves by peculations, and to extort from the cultivator the utmost farthing that could be taken without compelling him to abandon his fields. Thus under the Sikh dynasty of India, which was founded by a petty chieftain on the ruins of the Mogul Empire at the close of the last century and continued until 1846, the custom was to take from the peasant the equivalent of six shillings out of every twelve shillings' value of his produce in the name of rent; but under the present British rule the government takes from the descendants of these same peasants only one or two shillings in the form of taxes. It is not necessary, however, to go to Eastern experiences for illustrations of how the burden of taxation can be made terribly oppressive by the method of taking, inasmuch as in 1598 (according to Sully *), out of one hundred and fifty millions extorted from the taxpayers of France in that year, only thirty millions found their way into the public treasury. It is stated as a not infrequent occurrence that prior to the great Revolution of 1789, a duty was levied twenty-seven times on a barrel of wine in the course of its transportation from the place where it was grown to that where it was sold; so that it was said to be cheaper to send wine from China to France than from one of the departments of France to Paris.

It is also to be noted that in ancient times war, both in Eastern countries and in Europe, was almost the normal state of mankind, and victorious nations supported and enriched themselves from the plunder and tribute of the vanquished. The land especially of subjected people became the property of the conquerors, and payments in the nature of rents rather than taxes were exacted from its occupants and cultivators.

Taxation in China.—A curious perpetuation in many respects of these ancient methods is yet to be found in the present system of raising funds for defraying the expenses of the Government in China, and concerning which little has been definitely known until within a very recent period. With the exception of certain limited grants held by Manchu princes in consideration of

* Memoirs of Sully; quoted by McCulloch in Treatise on Taxation, p. 30.

remote military services, all the land of the empire is regarded as the property of the emperor, and all original titles to land are held directly from him subject to three conditions:* *First*, the payment of a land tax; *second*, the payment of fees when the crown title-holder or his successors sell mortgages, or leases; *third*, the supplying of certain labor service when demanded by the authorities. The land tax, which is exacted from all arable land, varies in amount according to the productiveness of the land, and does not ordinarily exceed one twentieth of the gross product. There is no tax on waste and uncultivated land, and rights in common exist in respect to waste land adjoining villages. The fees incident to the alienation of land are *nominally* about three per cent of the purchase money, but usually, by extortion, range from five to six per cent. The supplying of labor, when demanded by the authorities, is not well defined, and is apparently limited to furnishing the Government with transportation and labor on the public works, especially the repairing of dikes and canals. If these conditions are complied with, the state rarely interferes with the possession, alienation, or rental of land by its subjects. When land is rented the Government tax is paid by the landlord, and not by the tenant. The district magistrate is tax assessor, tax collector, judge, and administrator. A board of revenue fixes the amount that each district shall return to the state, and the district magistrate is liable for this sum whether he collects it or not. Any surplus collected, on the other hand, in excess of what is due the state is his private perquisite. Remission of land taxes is made when any great calamities occur, as floods, famines, and fires, and in such cases the tenant has the benefit of three tenths of the remission.

The other chief sources of imperial revenue in China are from a monopoly of salt; from taxes on goods brought through the gates of towns and cities, which appear to be analogous to the European *octroi* taxes; from taxes known as *likin* on the transit of goods through the provinces; from export and import duties, which are of modern origin; and from the sale of honors or titles.† There appear to be no taxes on personal property in China; but in Pekin, and probably in other cities, small license fees are required from certain occupations and manufactures, ostensibly for defraying municipal expenditures.

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* It is even asserted that there is at the present time but one person in all China who holds an absolute freehold title to any real estate, and he in virtue of being a lineal descendant of the Ming dynasty which the Manchus supplanted.

† The *customs* revenue of China for the year 1893 was reported as £3,646,350 (or $18,331,750), of which fully one third was derived from the duties on opium. The average rate of duties on other importations was about six per centum of their entered valuation.

The imperial revenue of China is believed to be about 85,000,000 taels, or $118,750,000, per annum, although the sum actually collected is probably much greater, the part that is unaccounted for being absorbed in the taking by the prominent officials. Under any circumstances, however, the great mass of the people of China are not heavily taxed; and their system of administration has few inquisitorial and annoying features; and to the absence of these the permanency of the Chinese Government for so long a period, and the tranquillity and contentment of the Chinese people may, in a great degree, be attributed. As the chief source of revenue to the state or Imperial Government, furthermore, is the direct and indirect land tax, the existing system of China may be regarded as a living, practical example of the single-tax system.

Taxation in Japan.—Another example of an ancient system of taxation, which until a recent period has been subjected to very little change, is to be found in the case of Japan. In this country, as in China, the system of taxation is now, as it always has been, essentially a land tax, but greatly modified in recent years to conform to modern conditions. During the feudal period in Japan, taxes were for the most part paid in kind by the cultivators of the soil, and were in fact a form of rent due to the lord of the soil. Under the oldest *régime*, when the emperor was the real as well as the nominal head of the government, the land was divided into nine squares, the central one of which was cultivated by the holders of the other eight, for the use of the emperor, who thus received one ninth part of the total product of the soil. During the fifteenth century, when the military chieftains—the Daimios or Shoguns—had gradually usurped the real power of the emperor, a much larger proportion of the produce of the land was exacted; seldom less than four tenths of the total crop, and sometimes as much as two thirds. The staple food of the country being rice, the taxes were almost invariably collected in that commodity. The amount paid, however, was not fixed by any national measure, but varied from province to province, depending on local customs, the humor of the Daimio, or other circumstances. Moreover, as the established policy of the ancient feudal government was to preserve and fix the status of all classes and conditions of men, it laid down a multitude of vexatious and arbitrary rules regulating every kind of production, which in turn prevented everything in the way of independent action and progress on the part of the producers. Thus, the Japanese farmer without government permission could neither increase nor decrease the amount of his cultivated land; nor could he change from the cultivation of rice requiring a wet or marshy soil to some other agricultural product requiring a drier soil. In short, all the conditions of land cultivation were so carefully prescribed that the farmer had nothing to do but follow a routine that deviated little from generation to generation. Under such a condition of things, especially under such a system of land tenure and taxation, population obviously could not, and in fact did not, increase either in wealth or numbers; and taken in connection with the circumstance that each of the many daimios or feudal lords maintained great retinues of wholly unproductive retainers, we find an explanation of the fact that Japan continued a poor country with a very slowly increasing population even in times of profound peace. During the century and a quarter from 1721 to 1846, the increase is reported by Japanese authorities to have not been in excess of five per cent.*

After the restoration in 1873 of the authority of the emperor, and the abrogation of the daimio system or lordship, a radical change was made in Japan, not only in the general status of the farmer, but in the conditions, under which he cultivated the soil and paid his taxes. All the previous iron rules imposed upon him were abolished; he was given perfect liberty to buy and sell land or adopt new modes of cultivation. The system of payment in kind to each provincial lord was replaced by a national land tax paid in money. The value of every piece of cultivated land was appraised according to a complex and somewhat arbitrary method of valuation, and on this capitalized value three per cent was imposed, in addition to a Government tax of one per cent for local purposes. In 1876 a decree was issued reducing the general tax to two and a half per cent, and the local tax to one half of one per cent. At the same time, with a view to supplement this reduction of local taxation and increase the national revenues, taxes were imposed on spirits and tobacco, on sales (at varying rates), on contracts, receipts, land transfers, petitions (through the agency of stamps), on some professions and mechanical

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* According to a paper read by Prof. Droppers before the Asiatic Society in Tokio, June, 1894, this period was a time of only measurably suppressed anarchy and lawlessness. It was two hundred and fifty years of armed truce. It was one large dance to death. Famines were frequent and dreadful. Having no railroads or steamships, and having, in their eagerness to shut out foreigners and keep in their own people, destroyed all sea-going ships, they had no means of water transportation except by means of wretched junks. Millions upon millions died of hunger. To this day, around the cremation houses of certain inland cities there are acres of heaps of human bones mixed with ashes, the awful witnesses to the might of famine, when hundreds of bodies were burned daily to prevent pestilence. Child murder and exposure were in some provinces so common that the question which neighbors would ask of a father, whether he intended to raise the newborn baby or not, was as proper as it was common. It is estimated by medical men that fifty per cent of the people died of smallpox. Syphilis was almost a national disease. Disease, immorality only partly suppressed, anarchy, famine, social and economical antagonisms, cramped Japan as in bands of iron.

pursuits, and on the ownership and use of ships, boats, and vehicles. The land taxes, however, contribute the largest amount of revenue to the national treasury, furnishing about seventy per cent of its receipts, exclusive of the local land taxes; and in many districts of Japan the total amount yielded by the farmer to the Government, national and local, was estimated in 1891 at even more than fifty per cent of his crop.*

Very curiously, the responsibility for the existence and continuance of this extraordinary system of land taxation in Japan, which finds no parallel in any other country, and the incidence of which constitutes such a burden on the mass of its population, has until a very recent period rested with foreign nations rather than the Japanese Government, and in this wise: When treaties were first made by foreign nations with Japan, after the opening of its ports and the abandonment of its old-time system of non-intercourse with the rest of the world, it was assumed on the part of the former that the Government and people of Japan were in a semi-barbarous condition, and ought to be treated as such in all political and commercial negotiations; and that in respect to trade and commerce the greatest advantage should be taken of the weaker nation that circumstances would permit. The leading nations of Europe and the United States accordingly stipulated, in their treaties with Japan, that it should

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* "This statement, however, gives no indication of the true condition of the Japanese farmer. In this country, where the Government performs so many functions which in America are left to the individual, a high rate of taxation is not necessarily an indication of poverty or of a low standard of living. With a sufficiency of land and a variety of crops, even the Japanese farmer can live comfortably, especially if a good fraction of his land is dry field (*hata*), on which he generally raises two crops a year. Very few of the farmers of Japan, however, are in this condition of tolerable comfort. The amount of the cultivated land of the empire is so small (less than twelve per cent of the whole area) and the population so large (over forty millions) that the land belonging to each family is absurdly insufficient. The average holding is less than two acres, subdivided into smaller parcels, which vary in size in different provinces, but average nearly one eighth of an acre each. Thus, to picture a typical Japanese farm, one must imagine a piece of land less than two acres, cut up into about fourteen pieces, or bits, each separated from the other by a raised path of earth. Even then the picture is incomplete, since the bits belonging to one farmer are not necessarily adjacent to each other, but frequently many a rood apart. Such a beggarly amount of land, even under the most perfect system of cultivation, can not of course yield sufficient to bring up a family according to Western standards of comfort. The idea of wages, or remuneration for labor, scarcely enters the Japanese farmer's mind; he is content if, after paying his taxes, he can in some rough fashion merely make both ends meet. At any fair rate of wages, farming is carried on at a loss in Japan. The farmer seldom eats the rice he grows, generally using barley or millet as a cheaper means of subsistence. His expenditures are on an infinitesimal scale; the clothes of the family are often heirlooms handed down from generation to generation; and as for saving anything from year to year, the practice is so little known in this country as hardly to be considered a virtue."—*Correspondence New York Nation, 1891.*

not impose any duties on exports or imports in excess of five per cent; and the receipts from customs being thus arbitrarily made insignificant, and those from such other sources as spirits, tobacco, licenses, and the like being normally inadequate, the Government of Japan has been compelled to resort to the old feudal system of taxation as the only practical way of obtaining revenue to defray its necessary expenditures.*

But, notwithstanding this, the results that have followed the fall of feudalism in Japan in 1868 are in the highest degree interesting, and constitute an important contribution to the history of civilization. Between 1871 and 1893 the population increased eight millions, railways and steamers have annihilated famine, old epidemics have become rare, the severity of old criminal law has been greatly mitigated, while liberty has encouraged the people to a wonderful activity and progress.

THE SMITHSONIAN INSTITUTION.

PART II. ACTIVITIES OF THE SMITHSONIAN INSTITUTION.

By Prof. HENRY CARRINGTON BOLTON, Ph. D.

In our first article we attempted to show the circumstances which led to the founding of the Smithsonian Institution, to trace its growth, and to sketch the peculiar field which it occupies. The latter, however, can well be supplemented by a succinct statement of its condition at the present time, or rather in 1895, the date of the most recent Annual Report.

Members of the Institution.—Presiding officer (*ex officio*), the President of the United States; Chancellor, the Chief Justice of the Supreme Court of the United States; the Vice-President of the United States; the Secretary of State; the Secretary of the Treasury; the Secretary of War; the Secretary of the Navy; the Postmaster General; the Attorney General; the Secretary of the Interior; the Secretary of Agriculture; the Secretary of the institution.

Administration.—The business of the institution is managed by a Board of Regents, composed of the Vice-President and the Chief Justice of the United States, three senators, three members of the House of Representatives, and six other eminent persons nominated by a joint resolution of Congress. The Secretary of

* Recent treaties (1894) have in a degree abrogated the disabilities which foreign nations imposed on Japan at the time of the abandonment of its policy of non-intercourse with the rest of the world, but a denial of the right of Japan exclusively to regulate its taxes (duties) on imports is still maintained.

the institution is also secretary of this board and the principal executive officer.

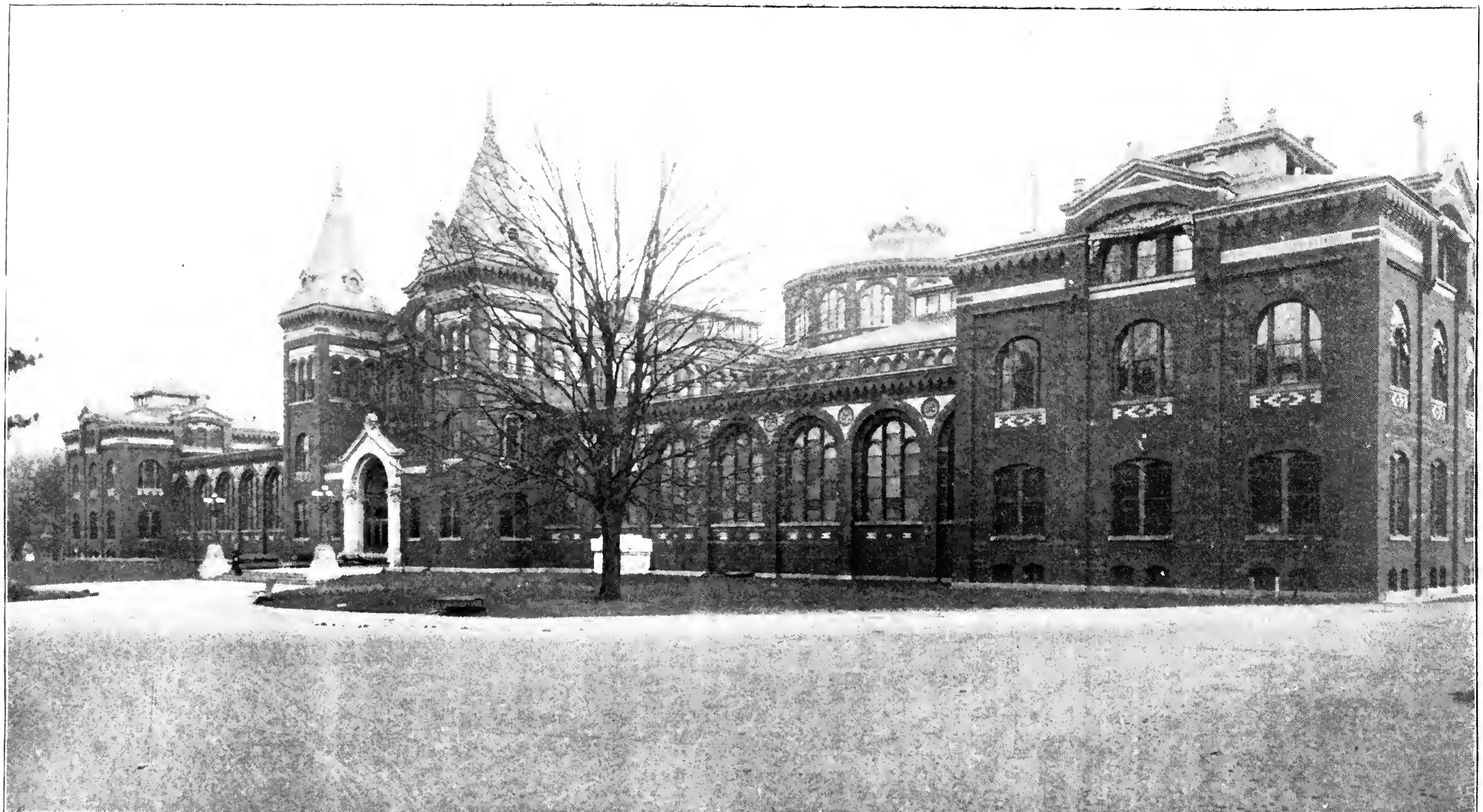
Buildings.—The Smithsonian Institution is housed in two buildings—the Norman, castlelike structure completed in 1855, and the huge one-story museum, to be noted below. The former is occupied as follows: The east wing contains the administration offices, comprising the rooms for the regents, the secretary, the editor, and other officers. A small library of reference books (thirty thousand volumes) occupies a part of the ground floor. The main central hall is filled with valuable collections in ornithology and conchology, including the Isaac Lea cabinet of shells. Above this, another large hall is devoted to prehistoric anthropology. The west wing contains ichthyological specimens, and a very beautiful collection of crustacea, batrachia, and ophidia. In the south porch is a small group of instruments of research.

Correspondence.—The official and casual correspondence of the Smithsonian Institution is no insignificant part of its daily life. Letters are addressed to the Secretary by the most learned scholars of Europe as well as by the humblest seeker after truth living in the wilds of North America, and all receive consideration and respectful answers. Tens of thousands of letters are annually received and acknowledged. If inquiries are made which the Secretary and his aids can not immediately answer, the letters are referred to eminent specialists outside of the institution.

The official list of correspondents, embracing learned societies and men of science throughout the world, numbers twenty-four thousand (1894). For a great many years the responsibility of the official correspondence devolved on the chief clerk, Mr. William J. Rhees, who is now keeper of the archives of the institution.

The International Exchange Service.—The Board of Regents in 1851 established a system of international exchanges of the transactions of learned societies and of certain other classes of scientific works. The exchange extends also to specimens in natural history. In 1867 Congress imposed upon the institution the duty of exchanging official documents printed by order of either House, or by the United States Government bureaus, for similar works published by foreign governments.

This international exchange is of the greatest service to learned societies on both sides of the ocean, and to individual men of science who avail themselves of its privileges; it involves a prodigious amount of well-directed labor, as shown by the fact that in the twelve months 1892 to 1893 over one hundred tons of books were handled; these comprised 29,500 packages and 31,850 Government documents *sent out*, besides 101,000 packages and 5,196 Government publications *received*.



United States National Museum.

Publications.—There are three distinct sets of publications issued as serials, directed by the Smithsonian Institution:

1. Smithsonian Contributions to Knowledge, a quarto series begun in 1848, and comprising thirty-two volumes to date. In these volumes are placed the monographs, articles, and papers offering positive additions to human knowledge, either undertaken by agents of the Smithsonian Institution or by persons encouraged by its assistance. These contributions correspond to the more elaborate memoirs of learned societies, and comprise treatises on anthropology, astronomy, biology, chemistry, electricity, ethnology, geology, mathematics, meteorology, natural history, palæontology, physics, and zoölogy, in all their ramifications.

2. Smithsonian Miscellaneous Collections, begun in 1862, thirty-five volumes, octavo. These contain bibliographies, tables, proceedings of Washington societies, and papers on scientific topics of value to scholars, yet not forming, as a rule, positive additions to the sum of human knowledge. These papers vary in size from a leaflet of four pages to a stout volume of twelve hundred pages. The individual articles are first issued independently, each receiving a number in course, and afterward they are bound up in volumes of suitable size, which themselves also bear numbers. This plan of publication also applies to the Contributions. The editorial work of this and the preceding series was long under the care of the late Mr. William B. Taylor, whose great erudition and skill in book-making proved invaluable to the institution.

3. Annual Reports of the Board of Regents—forty-nine volumes, octavo. These are submitted to Congress, in accordance with a clause in the act of incorporation. They contain the Journal of the Proceedings of the Board of Regents, the Report of the Executive Committee, the reports of the Secretary and of the directors, curators, or managers of the important departments controlled by the institution. In these reports are exhibited the financial affairs of the institution, its condition, its operations, and statistics of every kind connected with the same. Following the official part is a General Appendix containing a selection of memoirs of interest to collaborators and correspondents of the institution, teachers, and others engaged in the promotion of knowledge. These essays are generally reprints from divers sources, but they also include original translations and occasionally contributed articles. From 1880 to 1889 this General Appendix was chiefly devoted to an Annual Record of Scientific Progress prepared by specialists.

Library.—By exchanging the publications of the institution for transactions of learned societies, and for productions of foreign scholars, as well as by purchase, a library has been gathered of enormous value, now numbering over three hundred thousand titles. As already stated, it is merged in the Library of Congress, with the exception of a small collection for the use of the officers, partly housed in the Norman building and partly in the Museum. In the magnificent library building now approaching completion on Capitol Hill, the Smithsonian will have a separate hall for its deposit.

The National Museum at first occupied the larger halls in the Norman building, and since 1858 special appropriations have been made by Congress for its maintenance; but, outgrowing its quarters, an independent building was erected by Congressional aid in 1881. This building has an available floor space of one hundred thousand square feet, but has been greatly overcrowded for many years. The director of the museum, who is also Assistant Secretary of the Smithsonian Institution, G. Brown Goode, LL. D., is assisted by thirty-tnree curators in charge of as many departments. These are: arts and industries, embracing twelve sections; materia medica, animal products, naval architecture, fisheries, foods, historical collections, coins and medals, transportation and engineering, Oriental antiquities, graphic arts, forestry, physical apparatus, helminthology, ethnology, American prehistoric pottery, prehistoric anthropology, mammals, birds, birds' eggs, reptiles and batrachians, fishes, vertebrate fossils, mollusks, insects, marine invertebrates, comparative anatomy, invertebrate fossils—paleozoic, mesozoic, and cenozoic—fossil plants, botany, minerals, geology. This mere catalogue of departments shows the prodigious range of subjects, the total number of specimens being more than three and a half millions. Nearly a quarter million of specimens were added in the twelve months ending 1892. The growth of the museum is due to many sources; these comprise the results of exchanges both abroad and at home, explorations by different departments of Government and by the Smithsonian Institution, collections secured through gift of foreign governments, and, most important of all, the collections obtained from several local and international exhibitions, in which the museum has always taken an active part.

An important activity of the museum is its generous distribution of duplicate specimens in natural history to scientific societies, colleges, and other educational institutions throughout the United States. Between 1871 and 1890, two hundred and seventy-eight thousand specimens were so distributed.

The museum is a favorite place of resort on the part of residents in, and visitors to, the Capital. In the year ending June 30, 1893, over three hundred thousand persons availed themselves of its privileges. Their examination of the objects is much

Interior of the United States National Museum.

hampered by the overcrowded state of the building, but it is assisted by the invariable courtesy of those in charge of the sections, and by books of educational value placed in the several departments. It rests with Congress to make an appropriation for erecting another building twice the size of the existing one, and only then will it be possible to display the treasures now stored in dark corners or still resting in unpacked cases.

The publications of the National Museum comprise two series: Proceedings of the National Museum, consisting of short essays giving accounts of recent accessions or newly ascertained facts in natural history, and promptly issued to secure the earliest diffusion of the information. These proceedings were begun in 1878, and are now comprised in seventeen volumes, octavo.

Bulletins of the National Museum, consisting of more elaborate memoirs relative to the collections, such as biological monographs, taxonomic lists, etc., varying in size from a few pages to many hundred pages. The bulletins were begun in 1875 and comprise fifty numbers to date.

THE BUREAU OF AMERICAN ETHNOLOGY was established in 1879, to conduct ethnological researches among North American Indians, and is supported by annual appropriations of Congress. The work is under the immediate direction of Major J. W. Powell, who was also a long time at the head of the United States Geological Survey, assisted by eminent specialists. The bureau conducts mound explorations, studies in ethnology, archæology, pictography, and linguistics of North America. Through its medium a wealth of information concerning the aborigines of North America is being treasured and made available to present scholars and to posterity.

The Bureau publishes four series of works:

1. Annual Reports, begun in 1879, now comprise twelve volumes, royal quarto. This series is handsomely printed and illustrated, and is both creditable to the Government and well adapted to attract public attention.

2. Contributions to North American Ethnology, begun in 1877; nine volumes, quarto.

3. Introductions to the study of various topics; begun in 1877; four volumes, quarto.

4. Bulletins; begun in 1877; twenty-six volumes, quarto.

THE NATIONAL ZOÖLOGICAL PARK.—From a desire to preserve certain American wild animals rapidly becoming extinct, living animals were exhibited in temporary quarters near the National Museum for several years. In 1889 the preliminary steps for the establishment of a Zoölogical Park were taken by the appropriation by Congress of two hundred thousand dollars for the purchase of land, and the park was actually founded by an act dated April 30, 1890, providing for the "organization, improvement, and maintenance" of a National Zoölogical Park. This act places the park under the direction of the Smithsonian Institution, and orders that it be administered for the advancement of science and the instruction and recreation of the people.

As soon as surveys could be completed, about one hundred and seventy acres of ground most picturesquely situated on Rock Creek, near Washington City, were secured and preparations begun for the reception of animals. This undertaking is so recent that little more has been accomplished than constructing roads, building animal houses, fences, etc., but there are already more than five hundred animals in the embryo Zoo. The natural features of the region, with its watercourses, ravines, rocky cliffs, forest trees, open glades, and sunny southern slopes, are superior to any site occupied in this way abroad or at home, and its extent is ten to fifty times greater than that of most of the gardens of Europe. Under the management of Dr. Frank Baker, the future of the National Zoölogical Park is very great; he plans to place the animals on ground appropriate to their natural habits and instincts, so that they can live under conditions similar to those enjoyed in freedom—a scheme only possible in a park of such great extent and variety of natural features.

G. Brown Goode.

Astro-physical Observatory.—Prof. Baird had begun preparations for the establishment of an observatory for the study of the physical condition of celestial bodies, and when Mr. Langley succeeded to the secretaryship this eminent authority on solar physics soon secured its endowment by Congress. The late Dr. J. H. Kidder bequeathed five thousand dollars for prosecuting physical researches, and Dr. Alexander Graham Bell presented the like sum to the Secretary for the same purpose. In 1889–'90 a temporary wooden building was erected in the Mall south of the Norman building, and, though not entirely suitable for delicate research, much excellent work has been accomplished. In it are placed a

Grubb siderostat, a spectro-bolometer constructed by Grunow & Son, and a galvanometer. These instruments, in the hands of Prof. Langley, are producing remarkable results, considering the inferior building and unsatisfactory site. It is to be hoped that these conditions will speedily be improved through Congressional appropriations.

Hodgkins Fund and Prizes.—Previous to the year 1891 the Smithsonian Fund had received only two small additions by gifts or bequests: one thousand dollars from Mr. James Hamilton in 1875, and five hundred dollars from Mr. Simeon Habel in 1880. In the year 1891, however, Mr. Thomas G. Hodgkins, of Setauket, N. Y., made the handsome donation of two hundred thousand dollars to the general fund, with certain conditions. In the formal statement of Mr. Hodgkins, dated September 22, 1891, he used these words: "This fund, to be called the Hodgkins Fund, and all premiums, prizes, grants, or publications made at its cost, are to be designated by this name; the interest of one hundred thousand dollars of this fund to be permanently devoted to the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air, in connection with the welfare of man in his daily life, and in his relations to his Creator, the same to be effected by the offering of prizes, for which competition shall be open to the world, for essays in which important truths regarding the phenomena on which life, health, and human happiness depend shall be embodied, or by such other means as in years to come may appear to the Regents of the Smithsonian Institution calculated to produce the most beneficent results."

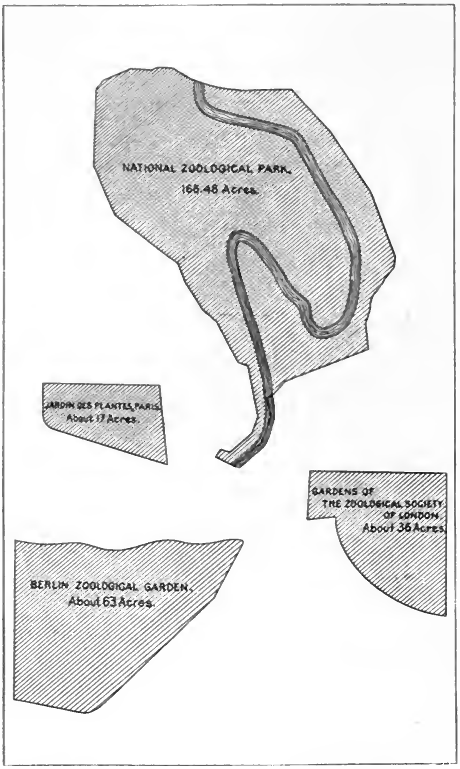
J. W. Powell.

To carry out the wishes of the donor, the following provisions for prizes, essays, and the Hodgkins medal were adopted by the institution, and announced in a circular issued in March, 1892:

1. A prize of ten thousand dollars for a treatise embodying some new and important discovery in regard to the nature or properties of atmospheric air.

2. A prize of two thousand dollars for the most satisfactory essay upon (*a*) the known properties of atmospheric air, considered in their relationships to research in every department of natural science, and the importance of a study of the atmosphere, considered in view of these relationships; (*b*) the proper direction of future research, in connection with the imperfections of our knowledge of atmospheric air, and of the connections of that knowledge with other sciences.

3. A prize of one thousand dollars for the best popular treatise upon atmospheric air, its properties and relationships (including those to hygiene, physical and mental). This essay need not exceed twenty thousand words in length; it should be written in simple language, and be suitable for publication for popular instruction.

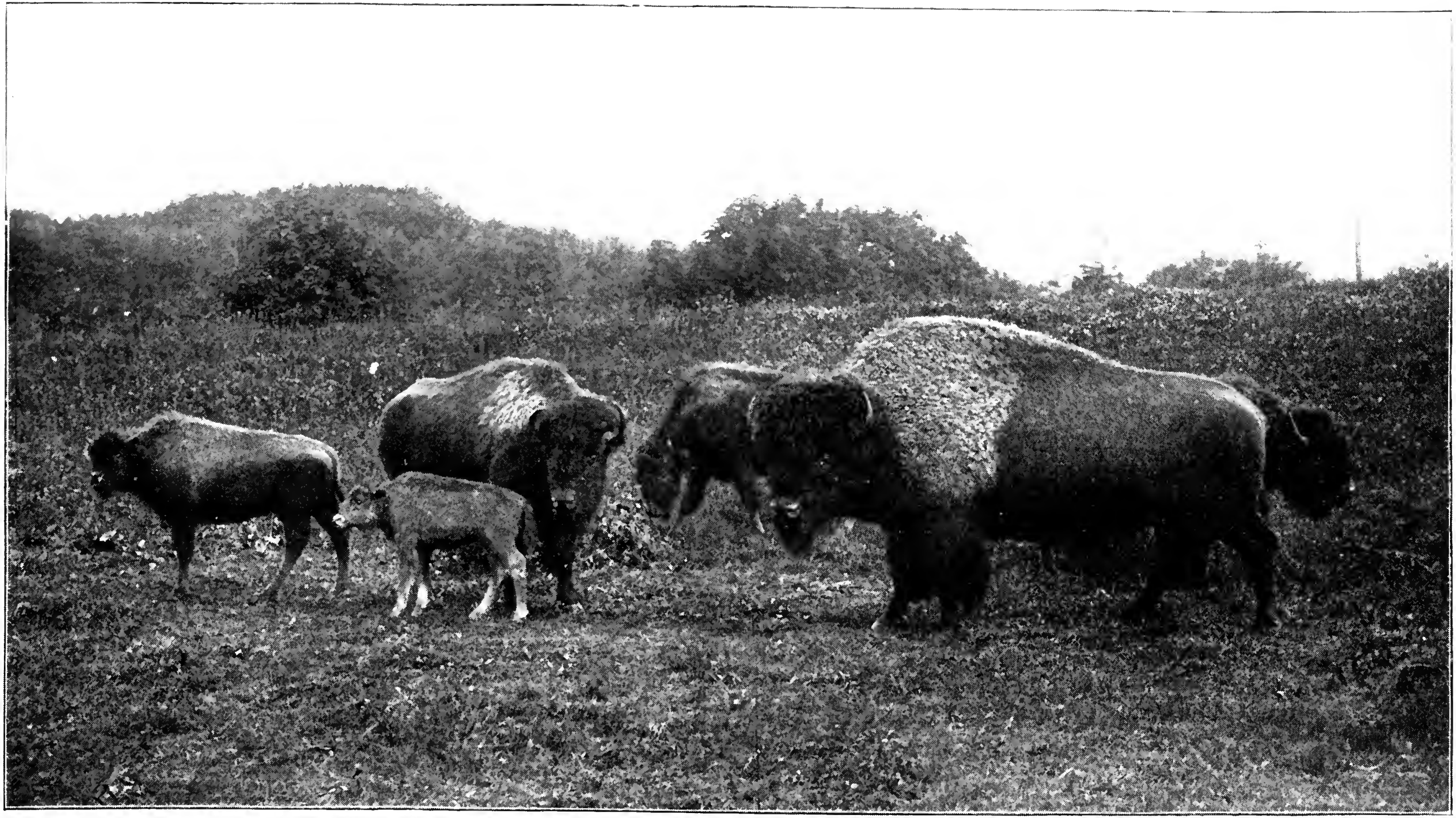


Comparative Areas of Zoölogical Parks.

4. The Hodgkins medal of the Smithsonian Institution will be awarded annually, or biennially, for important contributions to our knowledge of the nature and properties of atmospheric air, or for practical applications of our existing knowledge of them to the welfare of mankind. The medal will be of gold, with a duplicate in silver or bronze.

The treatises may be written in English, French, German, or Italian, and should be sent to the Secretary of the Smithsonian Institution before July 1, 1894; except those in competition for the first prize, which may be delayed until December 31, 1894. The time was subsequently extended to December 31, 1894, for all prizes.

Provision was made in the circular for a committee of award, for extending the dates above named, and for modifying the conditions prescribed. The circular also stated that special grants of money will probably be made to specialists engaged in original investigation upon atmospheric air and its properties.



View in National Zoölogical Park.

In a supplementary circular, issued in April, 1893, it was stated that any branch of natural science may furnish subjects of discussion for the Hodgkins prizes, provided the subjects are related to the study of the atmosphere in connection with the welfare of men: "Thus, the anthropologist may consider the history of man as affected by climate through the atmosphere; the geologist may study in this special connection the crust of the earth, whose constituents and whose form are largely modified by atmospheric influences; the botanist, the atmospheric relations of the life of the plant; the electrician, atmospheric electricity; the mathematician and physicist, problems of aërodynamics in their utilitarian application; and so on through the circle of the natural sciences, both biological and physical, of which there is perhaps not one which is necessarily excluded.

"In explanation of the donor's wishes, which the institution desires scrupulously to observe, it may be added that Mr. Hodgkins illustrated the catholicity of his plan by citing the experiments of Franklin in atmospheric electricity and the work of the late Paul Bert upon the relations of the atmosphere to life as subjects of research which, in his own view, might be properly considered in this relationship."

Eight thousand copies of these circulars were sent to institutions and investigators throughout the world, and applications for grants soon reached the Secretary of the Smithsonian.

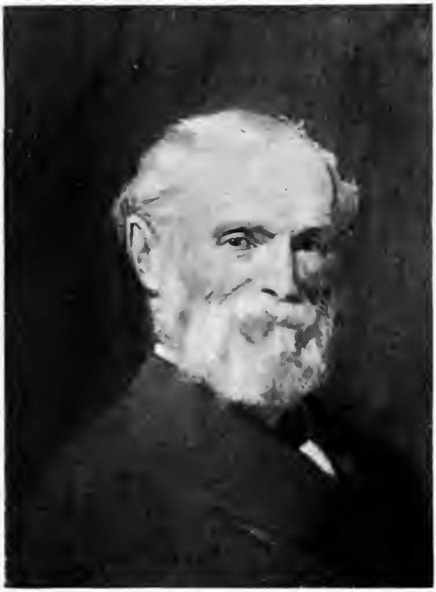
In 1893 two grants were made: one of five hundred dollars to Dr. O. Lummer and Dr. E. Pringsheim, of the Physical Institute, Berlin University, for researches on the determination of an exact measure of the cooling of gases while expanding; and a second grant of one thousand dollars to Dr. J. S. Billings, United States Army, and Dr. Weir Mitchell, of Philadelphia, for investigations into the nature of the peculiar substances of organic origin contained in the air expired by human beings, with specific reference to the ventilation of inhabited rooms.

Mr. Thomas George Hodgkins died November 25, 1892, at the advanced age of nearly ninety years; being, next to Smithson, the most generous benefactor of the institution. A brief sketch of his life is appropriate. He was born in England in 1803, of highly respectable ancestry; his early education was in France, where he acquired language, habits, and manners influencing all his later life. At the age of seventeen, led by a youth's love of adventure, and seeking relief from domestic unhappiness, he shipped before the mast on a trading vessel bound for Calcutta. The vessel was wrecked near the mouth of the Hoogly and the young man found himself penniless, friendless, and ill in a hospital in Calcutta. While in this sad plight, he made up his mind, so he said, to acquire a fortune and to devote it to philanthropic

Deer House in National Zoölogical Park.

ends. After recovering he returned to England, then visited Spain, and after marrying in England he came to the United States in 1830. He immediately engaged in business and after thirty years of successful ventures he retired on a handsome fortune. The fifteen years following this he spent in traveling over Europe and America, and in 1875 settled on "Brambletye Farm" at Setauket, Long Island, where he led a quiet, retired life.

For more than thirty years Mr. Hodgkins made a special study of the atmosphere in its relation to the well-being of humanity. He believed that this study was important, not only with reference to man's physical health, but even in relation to his moral and spiritual nature, and he hoped that the concentration of thought upon the atmosphere and its study from every point of view would in time lead to results which would justify his almost devout interest in the subject.



Thomas George Hodgkins.

Mr. Hodgkins had no family and no known blood relations, and, recognizing the difficulties which often arise over the settlement of large estates, he chose to be his own executor; he therefore gave away his entire wealth to various public institutions; these gifts included large sums to the American Society for the Prevention of Cruelty to Children, and the similarly named society for protecting animals; and one hundred thousand dollars to the Royal Institution of Great Britain.

Since writing the foregoing pages, the Committee of Award for the Hodgkins Prizes has completed its examination of the papers submitted in competition. These papers were two hundred and eighteen in number, and were sent from almost every quarter of the globe. The committee consisted of Prof. S. P. Langley, *ex officio*, Prof. G. Brown Goode, Dr. John S. Billings, Prof. M. W. Harrington, together with a foreign Advisory Committee, composed of the late Prof. T. H. Huxley, M. J. Jansen, and Prof. Wilhelm von Bezold.

On August 6, 1895, the committee announced the following awards:

First Prize, of ten thousand dollars, for a treatise embodying some new and important discoveries in regard to the nature and properties of atmospheric air, to Lord Rayleigh, of London, and Prof. William Ramsay, of the University College, London, for the discovery of argon.

Second Prize, of two thousand dollars, not awarded, owing to the failure of any contestant to comply strictly with the terms of the offer.

Third Prize, of one thousand dollars, to Dr. Henry de Varigny, of Paris, for the best popular treatise upon atmospheric air, its properties and relationships. Dr. de Varigny's essay is entitled L'Air et la Vie.

Besides these capital prizes, three silver medals and six bronze medals, coupled with honorable mention, were awarded to gentlemen for essays of great merit. To name all those awarded honorable mention would occupy more space than at our command.

On November 7th, Lord Rayleigh and Prof. William Ramsay called at the United States embassy, London, and received from the Secretary a check for ten thousand dollars, communicated by the Smithsonian Institution. It was a fortunate circumstance that the Smithsonian had the opportunity of awarding the first prize for so momentous a discovery as that of argon.

FINANCES.—The Annual Report of the Executive Committee of the Board of Regents for the year ending June 30, 1895, gives the following as the financial status of the institution:

Total Funds in 1895.

Bequest of Smithson, 1846	$515,169
Residuary legacy of Smithson, 1867	26,210
Savings from income, 1867	108,620
Bequest of James Hamilton, 1875	1,000
Accumulated interest of the James Hamilton fund, 1895	1,000
Bequest of Simeon Habel, 1880	500
Sale of bonds, 1881	51,000
Gift of Thomas G. Hodgkins, 1891	200,000
Residuary legacy of T. G. Hodgkins, 1894	8,000
	$911,499

Receipts in 1894–'95.

	Interest on fund, one year	$54,473
Appropriated by Congress.	International exchanges	17,000
	Bureau of Ethnology	40,000
	National Museum	166,500
	Astro-physical Observatory	9,000
	National Zoölogical Park	50,000
		$336,973

In addition to the above funds the Smithsonian Institution will soon receive the proceeds of a bequest made by the late

Robert Stanton Avery, of Washington City, who died in 1894. The property bequeathed is estimated to be worth about seventy-five thousand dollars, and the income is to be devoted to special investigations in magnetism and electricity.

Finally, the position of the Smithsonian Institution is that of a "ward of the Government, having property of its own for which that Government acts as trustee, leaving its administration wholly with regents." Its most important function is to promote original research, reflecting thus the sentiment which occurs in the writings of James Smithson: "Every man is a valuable member of society who by his observations, researches, and experiments procures knowledge for men." The advancement of utilitarian interests commonly finds capital, for it appeals to the avarice of man; but the advancement of knowledge in its highest and widest sense secures little encouragement from wealthy men, and it is exactly this phase which the institution makes its own. Its next function is to make known to the world knowledge thus secured, for the benefit of mankind, and this it seeks to accomplish through its publications and their wide distribution.

The influence of the institution in local education is well shown by the following circumstance: Some years ago I was standing on the porch of the Norman building as two stout African "ladies" passed by. One of these remarked, "Let us go in there," pointing to the entrance. "Oh, no," replied the lady addressed, "there is nothing in there but 'Prehistoric Anthropology,'" pronouncing the words glibly and accurately. I listened with amazement, and pondered.

THE changes in form which the bookcases underwent in monastic libraries were described by Mr. J. Willis Clark at the recent meeting of the British Royal Archæological Institute. The first form was an elongated lecturn placed at right angles to the wall between the windows, so that readers might have plenty of light to read the books that were chained to it. Splendid isolated examples remain at Lincoln, and a whole library of them at Zutphen. Owing to the large space they occupied, these lecturns were replaced by open bookcases with two shelves on each side. Of this style were the bookcases at Merton College, made in 1365, which served as the model for collegiate libraries in Oxford generally; and it is clear from contemporary documents that like bookcases were in use at Citeaux, Clairvaux, and Canterbury. The modern system of placing shelves against a wall was first adopted at the Escurial in 1584, and was introduced by Wren at Lincoln in 1675. At Trinity College, Cambridge, Wren ingeniously combined the ancient and modern methods by dividing the library into what he termed "cells," or places of study, formed of bookcases against the walls, and others at right angles to them.

THE EFFECT OF PROLONGED DROUGHT UPON ANIMAL LIFE.*

By Dr. CHARLES C. ABBOTT.

FROM July 6 to October 31, 1895, both inclusive, a period of one hundred and eighteen days, there were but seven days when brief showers occurred, no one exceeding one tenth of an inch of rain; and there were four days when prolonged, heavy showers occurred, no one exceeding seven tenths of an inch of rain; and three days, or parts of twenty-four hours, when the fog condensed and for a brief time a drizzle or "Scotch mist" prevailed.

The more prolonged rains occurring September 26th and October 13th caused little brooks, that had been dry for several weeks, to "run" for forty-eight hours, but there was no freshening of the weeds or grass on either upland or meadow. About our dooryards and along the headlands, even where shaded by rank weed growths and the fences, the ordinary grass was brittle, brown, and resting flat upon the earth. Before the beginning of September the landscape had a scorched appearance, this applying also to the foliage of several species of deciduous trees. By this time, too, the last trace of surface moisture had disappeared from the ordinarily wet or "mucky" meadows.

During this time, even at its close, I did not notice any appreciable diminution of the volume of water flowing from the hillside and meadow-surface springs, although I learned that many wells had partly or wholly failed. But, in all cases save one that I examined, the water did not pass over its usual course and join ordinarily permanent brooks, and through them reach the river. The extremely dry ground immediately about the springs absorbed the entire outflow at greater or less distances from their sources. Of course, near the springs there was the usual luxuriance of aquatic and semi-aquatic vegetation, and, what is of interest to the zoölogist, an abnormal abundance or overcrowding of animal life in these oasitic areas.

The continued presence of animal life depends upon the food supply. It is equally evident that no form of animal life can survive for any protracted period an absence of moisture. During the prevalence of the drought heavy dews doubtless afforded a sufficiently copious morning draught to slake the thirst for a period of twenty-four hours, and so met the needs of small mam-

* This article treats of an area of about two thousand acres of upland and meadow in the Delaware River Valley, lying between Trenton and Bordentown, Mercer County, New Jersey.

mals, as mice and shrews, and birds, like sparrows, but ordinarily these same creatures drink much oftener than once a day. But this briefly moist condition of the dawn and early morning hours was not of itself sufficient to keep the wide range of animal life in health or comfort, and the result was a migratory movement from the drier uplands to the moister meadows; a noticeable depletion of the fields and overcrowding of the marshes. This was not suddenly brought about, but rather gradual, and would not probably have been noticed except by one daily upon the scene. The parched vegetation had, of course, its effect upon seed-eating birds, but probably a more marked one upon insect life. Certainly the insect-eating birds left their old haunts to a great extent and were found in unusual abundance along the two creeks that divide the meadows into three great tracts; and it was noticeable during the evening that bats and night hawks were more abundant over the meadows than the fields. Mice and hares certainly were unusually scarce in the uplands. Here, it should be remembered, no observations were practicable that gave positive results. No census could be taken of the life in the two localities, and every statement is one of general impressions gained by almost daily visits to the more important points. One unquestionable fact was ascertained: there was an unusual abundance of life of every kind in the lowlands, and a quiet, desolate condition of the fields above, wholly different from what obtains in ordinary summers. As the weeks rolled by, the smaller meadow streams failed entirely, and hundreds of acres of land, usually more or less wet the year through, became as dry, parched, and desert-like as the sandiest field in the higher ground. Aquatic and semi-aquatic plants withered and died. The rose mallow failed to bloom, arrow-leaf wilted, and the pickerel weeds were soon as brown as sedges. This condition necessitated a second migratory movement of many forms of life, but was fatal to others. Such creatures as took refuge in pools found when too late their means of escape cut off and perished. Small minnows, young salamanders, and even aquatic insects gradually succumbed, and their dried remains were found resting upon the parched mud which became quite hard, sustaining an ordinary foot-press without retaining any mark thereof. Lifting the mummified remains from their resting place, there were found impressions of each, distinct in almost every feature. It was instructive as showing how fossils are formed, and further so, in indicating how animals not associated in life become accumulated in small areas. In one such dried-up pool I found a mouse, a star-nosed mole, and remains of many earthworms, as well as fish, batrachians, and insects. Just why the mouse and mole should have remained there and died can only be surmised. But, to return to the uplands: a more striking instance of the effects of the drought was to be seen in a small stream known as Pond Run. This is fed by scattered springs; is a stream of perhaps an average depth of six inches and a width of two or three feet. Sudden dashes of rain swell the volume of waters, but this accession is as rapidly run off. In ordinary summers the volume is reduced to considerably below the estimated average measurements, but the stream has not before been known to be absolutely dry throughout its course. For a period of five weeks the water from the springs along its valley were insufficient to give it running water, and in many cases there was no perceptible moisture at the fountain heads. As the water gradually disappeared, that portion of the stream's fauna dependent wholly upon moisture, as fish, turtles, and batrachians, collected in the pools, particularly those beneath bridges, and there by overcrowding soon poisoned the water to which no fresh supply was being added. It might be asked why these animals, except the fish, did not seek other and healthier localities, but the reason is plain. Everywhere about them was an arid region exposed to a tropical temperature into which they did not dare to venture. Again, while lingering in the pest holes into which they had gathered, they had gradually undermined their strength and were too weak to travel when, if ever, it occurred to them to do so.

And now back to the meadows. The last general migratory movement was to the tide-water flats, and here, of course, the moisture and vegetation were unaffected, and I have never seen so crowded a condition as that in which were many of the streams that were never quite dry at even the lowest stage of the tide. The carnivorous fishes waxed fat, for there was an available minnow ever in front of every pike, perch, and bass; and the grasshoppers driven to the creek banks, where alone there was green herbage, were continually leaping into the stream, and were snapped up before they could reach the opposite shore. There was here, however, not such an accession of batrachian life, frogs in particular, as might have been expected, and I failed to notice any undue number of the mud minnow (*Umbra limi*). This fact led me to make a few examinations of the parched or semi-desiccated areas. I found in two locations, that I had never before known to become dry, that frogs, of three species, and the mud minnow had buried themselves where there still remained moisture, but with a crust of dry earth above it. These frogs and fish were like hibernating animals when exhumed—i. e., soundly asleep, rather than dead, and all slowly revived when placed in clear, cool water. I estimated that they had been in their cramped quarters for at least three weeks. Two weeks later, I hunted for others but failed to find them; but the day after the first prolonged rain I found the mud minnows in their usual abundance in this same brook, which now had about one half its ordinary flow of water, and the frogs were dozing on the banks and leaping into the stream as unconcernedly as if nothing unusual had occurred.

Possibly the above simple narration of certain facts may seem to be of no special interest or importance, but there were two features of it that do not appear to have been treated of in general natural histories: the self-inhumation of the fish and frogs, and the wonderful promptness of the return of life to the temporarily depopulated areas. It does not seem unreasonable to suggest that as long as these inhumed animals could retain their moisture they could preserve their lives. Both the frogs and this one fish can withstand prolonged deprivation of food. I have tried the cruel experiment in one instance, and a mud minnow had no food for seven weeks, and had only lost two fifths of its weight when it died. As this is a period longer than the duration of any drought on record, when fish-sustaining streams were actually dry, it goes to show that this species is better prepared than any other to accommodate itself to certain geological changes when they come about. Curiously enough, the mud minnow looks more like a fossil than an ordinary brook minnow, is the sole representative of its genus, and is the only species of fresh-water fish found in both Europe and America.

While the drought destroyed much life, it more largely deported it, and I have, in many years of wandering about my home, seen nothing more positively wonderful than the promptness with which every nook and corner was repopulated when the autumn rains came. Vegetal as well as animal life responded at once. The fish were promptly in the brooks, the aquatic salamanders under the flat stones, and the frogs in their places, and on many an afternoon of sunny October days I heard their croaking, as if thankful for the return of the old-time conditions.

To a circular of the Royal Society asking for co-operation and suggestions in making a subject catalogue of scientific papers, the Academy of Natural Sciences of Philadelphia has responded that such a catalogue is desirable, and that international co-operation should be engaged in its preparation; that in order to secure uniformity in all parts of such a catalogue a central bureau appears to be necessary, rather than that separate portions should be prepared by various institutions, such central bureau to be under the direction of the Royal Society; that such a catalogue should be classified, and should be issued at least once a year, each volume to be provided with an alphabetical index; that the scope of such a classified catalogue should embrace the various yearly bibliographies of special sciences now issued; and that, whenever translations or summaries are believed to be desirable, English should be made the basis of the catalogue.

GATHERING NAVAL STORES.

By LEE J. VANCE.

THAT portion of the Southern States known as the long-leaf pine belt produces the bulk of all the naval stores used in the world. There is an immense stretch of pine forest beginning in North Carolina near the Virginia border, and it follows along the Atlantic coast to Florida, and along the Gulf coast as far as Texas. This belt of long-leaf pine varies in width from five to one hundred miles, crosses six states—namely, the two Carolinas, Georgia, Alabama, Mississippi, and Louisiana—and covers an area of about one hundred and thirty thousand square miles.

All over this great forest territory the trees are tapped, or "bled," for their sap, which furnishes what are known as naval stores. The work on a "turpentine farm," as a division of the forest is called, begins in winter with the cutting of the "boxes." A broad gash about seven inches deep and fourteen inches long is cut just above the base of the tree, making a kind of box. The cut is V-shaped, slanting from the outside, and thus forms a reservoir, which will hold about three pints of sap.

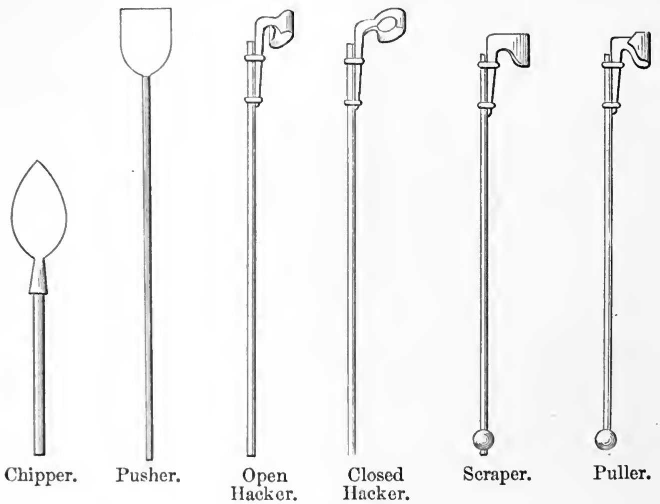
Meanwhile, the ground around the trees is raked clean, and the pine straw needles are gathered in heaps and usually burned. This is done to protect the boxes from fires, and also to give the "chipper" a firm stand when engaged in his work; but, owing to negligence, small fires are allowed to spread, and often they become disastrous conflagrations, which run over thousands of acres of valuable timber before they are finally checked.

The turpentine season does not really open till early spring, when the sap starts to flow in the trees, and "chipping" begins. The chipper first removes strips about two inches wide, beginning at the corners of the box and extending to a height of about ten inches. Then the surface between the two strips is laid bare to a depth of about one inch beneath the bark.

After a short time the "chip" ceases to "bleed," and then from time to time fresh cuts are made. This is called "hacking," and is done with a peculiar tool called the "hacker." There are two kinds of hackers—the open and the closed hacker. Both are quite similar in shape and size, except that one has an open, strong knife with curved edge, and the other a closed knife blade, fastened to a long iron handle. A heavy weight is attached at the end in order to give momentum to the blows, and it is said to make the work of the chipper easier.

Once a week from March till October the trees are either chipped or hacked. The size of the chip grows at the rate of about two inches a month; so that, by the end of the first season a surface perhaps fourteen by twenty-four inches is laid bare, and in the fourth and last year the chip has reached a height of six or eight feet.

When the crude turpentine, or resin, begins to harden, it is scraped from the chip and the boxes with a special tool, called the "scraper." The product thus obtained is "scrape," or "hard turpentine."



Tools used in the Turpentine Industry.

It is of inferior quality, containing only about one half of the volatile oil obtained from "dip," or soft turpentine. In the first year the tree yields four times as much dip as scrape, but in the fourth year the amounts are about equal.

The flow of turpentine is influenced by the state of the weather, especially the temperature. A long spell of heat or a long spell of cold decreases the yield. The flow is greatest during the hot summer months, July and August; after that it becomes less and less till October or November, when it ceases. Last year (1895) the turpentine crop was a poor one, on account of the cold spring.

The resin which accumulates in the boxes is removed by a trowel-shaped dipper. The operation is known as "dipping." In the first year from six to eight dippings are made. The dip is put in barrels and taken to the "still," where it is transformed into spirits of turpentine, resin or rosin, and pitch. Tar is made by burning the dead wood or limbs in kilns.

The crude turpentine in its natural state as it flows from the tree during the first year is distinguished by its fine white color. During the latter part of the season it shows a faint straw tint. The product dipped in the first part of the season is "virgin dip," and the other is "second virgin dip." It is from these virgin dippings that the best and highest-priced grades of resin are obtained.

In the following years the turpentine is known as "yellow dip," and it becomes darker colored, less transparent, and less liquid every year. In the fourth and last year the turpentine is very dark in color, and yields resin or rosin of the lowest grades, ranging from a deep brown to almost black and opaque.

If you look at the market reports, under the heading of Naval Stores, you will find certain technical terms and mysterious letters. The letters designate the different grades of rosin, as follows: W G, window glass; W W, water white, the lightest grade; N, extra pale; M, pale; K, low pale; I, good No. 1; H, No. 1; F, good No. 2; E, No. 2; D, good strain; C, strain; B, common strain; A, black.

Besides you will find a number of terms peculiar to the turpentine industry. Down South you hear the natives speak of the

Beginning the Work in a Virgin Forest: Boxing.

great pine forests as "turpentine farms," although some people refer to them as "turpentine orchards." The word "crop" has a special meaning. When a turpentine farmer speaks of his crop he means ten thousand boxes. This will be about five thousand trees, as from two to four boxes are cut in full-grown trees.

There will be about that number of trees on an area of two hundred acres.

Most of the turpentine farms are worked by operators on a large scale. Small landowners can not afford to work their trees, and so they rent or lease their forests for four years at the rate of fifty dollars per crop of ten thousand boxes. The total expense of working one crop is about six hundred dollars per year, or twenty-four hundred dollars for four years. Few operators work less than ten crops, which would make their expenditures twenty-four thousand dollars during the four years. To this should be added the cost of a plant (about four thousand dollars) for working ten or twenty crops, establishing a still, building houses and sheds, and buying tools, mules, and horses.

The amount of product gathered from a crop of two hundred acres in the first year is about two hundred and eighty barrels of dip and seventy barrels of scrape. This yields at the still about two thousand gallons of spirits of turpentine and two hundred and sixty barrels of rosin. In the fourth and last year the yield of the crop falls to about one thousand gallons of spirits and one hundred and ten barrels of rosin.

In speaking of the profits of the turpentine industry a veteran operator said: "There is no money in the business nowadays. Prices are too low. With the spirits at twenty-seven cents per gallon and resin at a dollar and twenty cents, it takes a right smart man to make much more than one dollar per acre."

The prices of all kinds of naval stores reached their highest point during the late war, when spirits of turpentine sold for a dollar and fifty cents and a dollar and seventy-five cents per gallon, and inferior grades of rosin sold for four dollars a barrel. This gave a "boom" to the turpentine industry of France, as production in the South was practically checked for several years.

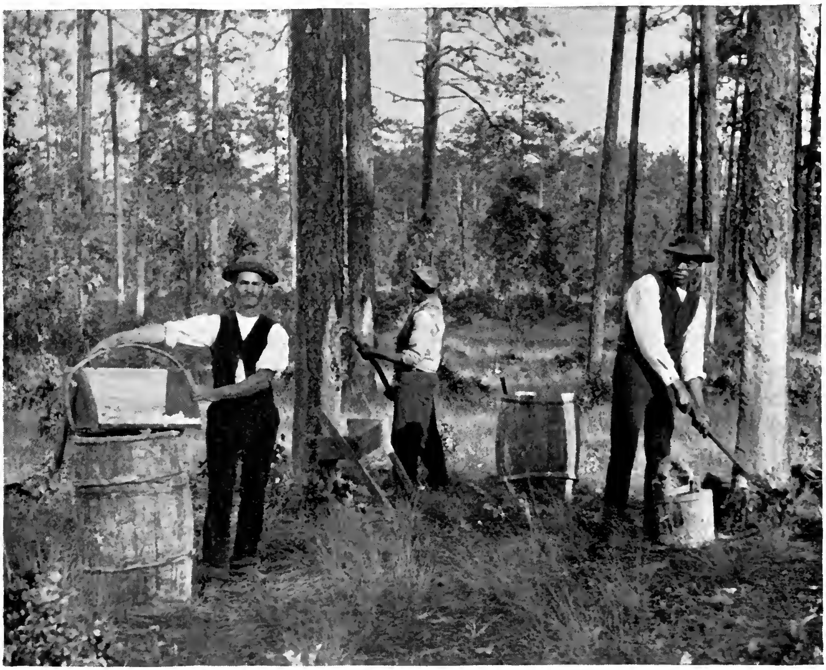
Next to the work in the pine forest, the operations at the still are interesting. Here, by the process of distillation, are obtained the different resinous products of trade, which go under the name of "naval stores." The term seems to be a misnomer just now when ships are built of iron and steel. About nine tenths of all the naval stores are used in industries other than shipbuilding.*

If you go into a turpentine still when it is in operation you will see how much care is taken to obtain the naval stores. You will inhale the health-giving properties of the pine-tree sap. Your nostrils are tickled by the pungent odor of the boiling turpentine; there is something strong and stimulating about the smell. Your lungs seem to swell to twice their normal size, and, as one person

* Oddly enough, the term "naval stores" is not defined in Webster, Worcester, or the Century dictionaries.

said to me after a visit to a still, "I feel braced up." There is no better sanitarium than the pineries of the South, and the turpentine workers are as strong and healthy a set of fellows as you can find anywhere.

The manner in which naval stores are obtained may be briefly described as follows: The dip, or crude turpentine, is emptied into a big copper still and boiled. The steam is passed through a "worm"—a coil of pipe similar to that used in a liquor distillery



Scraping and Dipping in a Turpentine Orchard.
Tree to the right shows scarified surface.

—and on reaching a certain point the condensation drops into a tank, and is the spirits of turpentine of commerce.

The residuum left after the spirit of turpentine has distilled over is the rosin of trade. This is drawn off by a tap at the bottom of the still, and strained first through a wire cloth and then through a coarse cotton cloth, and run into a trough, from which it is ladled into barrels.

In the several turpentine States, so called, there are laws regulating the inspection of turpentine, defining its grades, the size and kind of barrel, and the manner of branding. The chief points of these regulations, which are more or less the same in the several Southern States, are: turpentine must be branded "S," or "H," for soft or hard; the soft turpentine barrels to weigh two hundred and eighty pounds, the hard turpentine two hundred and forty pounds, and pitch, thirty-two gallons to the barrel. All spirits of turpentine are gauged by the inspectors of naval stores. Tar and turpentine barrels are marked and certified, and usually show the initials of the maker's name.

Very few people have any correct notion of the number of uses to which the products of turpentine have been put. Let us mention some of the different ways spirits of turpentine enters into the arts and manufactures. Many who read this article by gaslight will remember when they read their newspapers by the smoky light furnished by "camphene." This was before the introduction and use of petroleum. Camphene is prepared by mixing the rectified oil of turpentine with alcohol. Although kerosene is now so cheap, the rectified spirits of turpentine is still used for illuminating purposes in some backwood sections of the South.

Perhaps the most common uses of the spirits of turpentine are those in the arts, where it enters into the preparation of paints and varnishes, and especially in the manufacture of India-rubber goods. The paint and varnish industries take about five million gallons annually, while the rubber industry requires about three and a half million gallons a year.

But spirits of turpentine has other uses not so well known to most readers. How many would enjoy their salad oils and other vegetable oils, if they knew that they were adulterated with turpentine oil? How many invalids know that their medicines contain spirits of turpentine, or that the liniment or ointment which relieves their aches and pains is largely composed of turpentine?

Quite as varied and valuable are the products of rosin in the arts and manufactures. Do you know that the finest grades of rosin are used in the manufacture of paper? How many persons who look at the printer's ink on this paper would say that it contains rosin? How many, washing their face and hands, ever suspect that there is rosin in the scented soap? There is rosin in all these products, as there is in sealing wax, putty and sizing, and in varnishes.

Two kinds of rosin oil are obtained from rosin by the process of dry distillation. The light rosin oil is used principally in the fine varnishes. The heavy oil enters into the manufacture of axle grease, and machine and lubricating oils. It is one of the best and cheapest lubricants for metal bearings in machinery, the petroleum oils not excepted. The heavy rosin oils are largely used in the preparation of cheap paints, such as are used to cover metal, roofs, and so forth.

The product called "pitch" is the residue from the dry distillation of rosin. It is used for the calking of ships, shoemaker's pitch, and black dyes or pigments. There is a special kind of pitch used by brewers for pitching beer kegs and barrels. The process of distillation requires experience and care in order to obtain the right quantity of oil of turpentine; if too little oil, the pitch is brittle and does not adhere to the barrel; if too much, it gives a sharp, disagreeable taste to the beer.

North Carolina for years produced nearly all the tar used at home and abroad, and from this fact its people were called "tar-heels." Wilmington, N. C., is the headquarters for tar and crude turpentine, but Savannah, Ga., is the largest market in the world for naval stores. The process of making tar is simple, and may be briefly described as follows: The dead limbs and wood are put in a heap in a hole in the ground and covered with dirt and sod. A fire is started at the bottom and allowed to smolder for eight or ten days, when the tar begins to flow. It is then dipped into barrels, which contain three hundred and twenty pounds net. About forty gallons of tar are obtained from one cord of wood.

The best grades of charcoal are now made from the pine-tree wood and bark. The sawdust carries a heavy percentage of wood alcohol and creosote. The product known as oil of tar is obtained by dry distillation of the tar, and is used by farmers and fruit-growers as an insecticide, and by doctors and veterinary surgeons for external applications.

Such, then, are some of the important ways in which turpentine enters into the industries, supplying man's needs and wants. The Chinese used to say that the cocoanut palm had as many good uses as there are days in the month. The same and even more can be said of the long-leaf pine. This wonderful tree is almost like cotton in the variety and value of its products.

It is perhaps not generally known that matting and excelsior are made from the pine trees. There is a factory about fifteen miles from Wilmington that uses the pine straw as material for bagging to cover the cotton bales. When the duties on jute and jute bagging were increased, this material was in large demand.

In addition to its other uses, the long-leaf pine belt furnishes annually an immense quantity of timber to the markets. Georgia "yellow pine," as it is called, is known the world over. It is one of the most durable and ornamental of woods. It is light and easily worked, and yet it is tougher than many woods twice its specific gravity. It holds paint and varnish better than most woods, owing to its resinous qualities, and, having a finely marked grain, it shows off well when highly polished. It is thus taking the place of hard woods for use in the building of railway cars, in furnishings for offices, and for interior work in houses. It stands

Turpentine Still at Manly, N. C.

the weather, rain and sun and storm, and wears as well outdoors as inside.

Here is the place to state that, until recently, architects, builders, and engineers had a prejudice against using pine timber that had been bled of its sap for turpentine. They claimed that the bleeding process weakened the tensile strength of the timber. This was disputed, of course, in the South. In order to settle this important question, as the yellow pine lumber industry had grown to enormous proportions, the National Bureau of Forestry undertook a series of careful tests three or four years ago. It was shown by experiments that the sap comes from the sapwood, leaving the heartwood unaffected, and hence the prejudice against bled timber is not founded in fact or reason; in other words, after the pine wood has been tapped, its tensile strength, according to these tests, remains equal to that of virgin growth.

The value of the naval stores produced in the United States is about ten million dollars per annum. Nine tenths of all the naval stores used in the world come from the pineries of the Southern States. The other one tenth is furnished principally by the forests of France and Austria.

The most careful figures of the total production of naval stores in the United States are those gathered by the special agent of the Division of Forestry for the year 1890. They show the total production of these stores to be three hundred and forty thousand casks, or seventeen million gallons of spirits of turpentine, and one million four hundred and ninety thousand barrels of resin of different grades.

In order to produce this amount of naval stores it is estimated that about two million three hundred thousand acres are being worked, and that about eight hundred thousand acres of virgin forest are invaded every year to supply the turpentine stills. At this rate it will not be many years before the effects of reckless cutting, sapping of timber, and fires will be felt in the long-leaf pine belt. As a matter of fact, there has been a steady decline in the production of naval stores during the past ten years in every Southern State except Georgia, and there the increase has been due to the opening of new tracts of timber made accessible to shipping points and markets by railroads.

There is no doubt that the American process of bleeding the pine trees is crude and wasteful, and that the turpentine workers, like the lumbermen, conduct their operations on what has been bluntly termed "the robbing system." What else is it but robbing, when the turpentine operators strip the land of its forest resources, and leave only desolate wastes? It is now time that our turpentine workers introduced better methods and necessary changes in their business.

Thus, it is interesting to note the care and economy with which turpentine farming is carried on in France. There, trees are known to have been boxed and bled for a full century, whereas in the Southern States trees are seldom worked for more than five or six years. The differences between French and American practices may be briefly stated, as follows:

The French turpentine workman does not cut a big, deep, broad box into the tree. Instead, he makes a small chip about three inches wide, an inch and a half high, and only two fifths of an inch deep, near the foot of the tree. This chip is enlarged from time to time, and at the end of the first season it reaches a height of about six feet. During the next four seasons the chipping increases at the rate of about two feet and a half each season, so that at the end of the fifth year the chip reaches a height of twelve or thirteen feet. Only one chip is made on a tree at a time. A tree that has been worked for five seasons is given a rest of several years, and then a new chip is started some six or eight inches from the old one. And so, by alternating periods of bleeding and of rest, trees fifty years old and more will be completely encircled by long scars or chips, and when the trees cease to yield a profitable supply of turpentine they are bled "to death" and cut into lumber.*

The French method of collecting the sap is better and more economical than ours. Instead of having the resin or crude turpentine run into a deep box at the base of the tree, as in this country, the French gather the crude turpentine in a pot or pail, which is nailed just above the old chip. As the sap flows only a short distance, there is not much loss from evaporation, and, besides, the product is cleaner. The chip is covered with a board, and this simple device assures a good yield and a clean product. It is claimed that by the French or Hugues system the yield of turpentine is one fourth larger than by the American method, and the trouble of securing comparatively pure sap is more than repaid by the increased price.

In brief, the French methods of collecting turpentine should be an "object lesson" to our Southern orchardists, who carry on their business in a most wasteful and extravagant manner. The result is, if the same care and economy which are observed in the pineries of France were taken of the pine forests of the Southern States, they would yield an annual revenue second only to that of the cotton crop. If to the naval stores be added the amount

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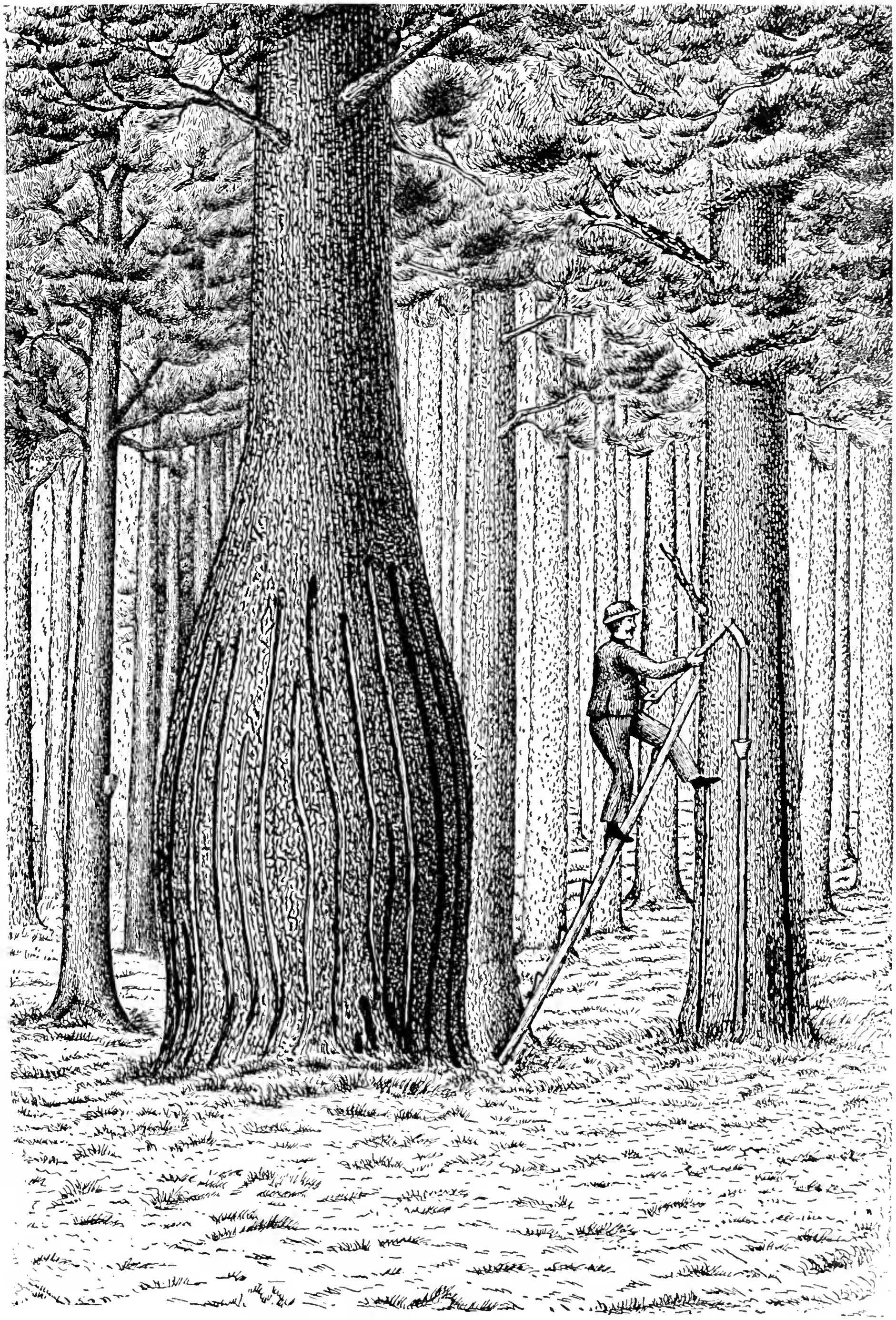
* The method of boxing trees during their productive period is known as *gemmage à vie*—i. e., "bleeding alive"; the "bleeding to death," *gemmage à morte*, is commenced when the turpentine orchard needs regenerating. By this method of forest management the trees are kept uniform, strong, and in good shape or condition.



The French Method of Bleeding the Trees.

of lumber that can be taken from the pine belt, we have a revenue even larger than that of the cotton crop. All this could be done without reducing the forests of the South to any serious extent. It simply requires good husbandry and common sense in forest management.*

Perhaps the greatest loss and damage are caused by fires, which sweep through the forests and destroy millions of feet of valuable timber every year. It is estimated that the total loss from this source alone is not less than a million dollars annually.

The greater part of this loss of valuable timber is wholly unnecessary. Our people take extra precautions against allowing fires to burn their houses and buildings, but they view with comparative indifference the destruction of millions of feet of timber. The districts invaded by the turpentine workers are left desolate wastes, and few people who have not been in the long-leaf pine belt can realize the great injury that has been done to the prosperity of the South by an industry which is rapidly changing the face of Nature and even the climate of the country.

THE STUDY OF INHERITANCE.

A Review of the Writings of Francis Galton.

By W. K. BROOKS, LL. D.

FIRST PAPER.

IT is much more easy to talk about inheritance than to study it. Of the books and essays which meet us at every turn, few have much basis in research, but those of Francis Galton are among the most notable exceptions. These books, which have appeared at intervals during the last twenty-five years, are not speculations but studies. They describe long exhaustive investigations, carried out by rigorous methods, along lines laid down on a plan which has been matured with great care and forethought.

The simplicity of their language is as notable as their subject. Dealing with conceptions which are both new and abstruse, the author finds our mother tongue rich enough for his purpose, and, while the reasoning often taxes all our powers, there is never any doubt as to the meaning of the words.

When in rare cases a technical term is inevitable, some famil-

* Three years ago the Geological Survey of North Carolina investigated the methods of the turpentine industry and suggested a number of radical changes or improvements. The recommendations have been adopted by many turpentine workers, who have modified their old, destructive methods. Prof. J. A. Holmes, of the Survey, informs me that as a result of these improvements the production of naval stores in North Carolina has been increased by one hundred and fifty thousand dollars within the past two years.

iar word is chosen with so much aptness that it does its duty and presents the new conception better than a compound from two or three dead languages. The terms "mid-parent" or "mid," "fraternity," "nurture," and "Q" can not mislead or convey any idea except the right one.

The reviewer's debt to Galton is very great, and it is acknowledged with gratitude. Such acquaintance with the statistical method as he possesses he owes to the study of these books; especially the ones on Hereditary Genius (1869), on Natural Inheritance (1889), and on Finger Prints (1892).

The attempt to question Galton's generalizations may therefore seem ungracious and presumptuous, but the uncertainties of vital statistics are proverbial; and it is not impossible that Galton's data may fail to cover all the ground needed to prove his general conclusions.

One of these generalizations is so far-reaching that, if it is well founded, it must lead to profound and fundamental changes in our view of the origin of species.

According to Darwin and Wallace, specific identity in living things is the outcome of the extermination, in the struggle for existence, of the individuals which depart too widely from that "type" which is on the whole best adapted to existing conditions. As these conditions change, the "type" is also slowly modified through a change in the character of this process of extermination. According to this view, the "type" is the outcome of the statistical "law of error," or the deviation from the mean, which holds good in the environment; and while the "events" are properties of the organism, the type is fixed by the external world, and not by anything in the organism itself.

Galton holds that specific identity is not due to the process of extermination, but to "organic stability." As I understand him, he holds that this fills up the gaps made by extermination, and thus keeps the type intact.

This "principle of stability," which is held to result in the permanency of types, is said to be quite independent of selection. "Genera and species may be formed without the slightest aid from either natural or sexual selection." "Organic stability is the primary factor by which the distinctions between genera are maintained."

Galton holds, furthermore, not only that specific stability is independent of selection, but that selection is "scarcely competent" to effect a change of type "by favoring mere varieties"—that is, by the extermination of the ordinary slight differences between individuals; and that it is only when a "sport" has made its appearance, only when the type has actually changed, that selection can exert any influence. According to this view, the agencies which cause "sports" are the real causes of the mutability of species, and natural selection can do nothing more than to exterminate disadvantageous sports, and thus favor advantageous ones.

The "organic stability" to which so much is attributed is held to be due to the fact that the child inherits in part from its parents, in part from more remote ancestors; and since the sum of its ancestry, or its "mid-parentage," is on the average nearer than any exceptional parents to the mean of the race, the children of selected parents are on the average more mediocre than their parents.

It is quite possible that Galton's data may be valuable and trustworthy, and that they may yet fail to prove this generalization; and I shall try to show that this is the case, although I am not sure that I fully grasp his point of view.

I assume that he regards a zoölogical type or species as something; something which is due to a "principle of stability," which is not the result of selection. This is assuredly the current interpretation of his statements, and it is from this standpoint that I shall examine his writings.

If this is not his opinion; if he really believes that this "principle" owes its existence to past selection; if he only deduces from his data the generalization that the results of past selection may persist after it has ceased to act; I see no ground for criticism, for his data assuredly prove this much, although I can not reconcile his statement that "the principle of stability is independent of selection" with the belief that it is the result of past selection.

Before entering upon the discussion of the subject it may be well to ask what evidence there is that the child does inherit from any ancestor except its parents, for descent from a long line of ancestors is not necessarily equivalent to inheritance from them, and it is quite possible that the conception of a "mid-parent" may be nothing but a logical abstraction.

Most of its support is derived from the phenomena of reversion or atavism; from the appearance in children of ancestral features which were not exhibited by the parents. While these phenomena are familiar and real, we may well doubt whether any of them are reversions in Galton's sense.

In some cases we can prove that a so-called reversion is simply the manifestation of a feature which is latent in the structure of all the normal individuals of the species. The occurrence of a distinct premaxillary bone in man is an example of this sort of reversion. It is the outcome of the arrest of normal development, and this arrest might have happened to any member of the species. We do not know what causes the arrest, but the view that it is due to some adverse circumstance which has kept the individual from completing its development is much more simple and probable than the view that the child inherits its distinct premaxilla from any ancestor except its parents.

When the son of a beardless boy grows up and acquires a beard, we may be permitted to say that he has inherited his grandfather's beard; but this is only a figure of speech, and he actually inherits the beard which his father might have acquired had he lived; nor would the case of a child descended from a series of ten or a hundred beardless boys and beardless women be any different. If we were to propagate a plant by cuttings, for ten or a hundred generations, under conditions which did not permit it to flower, and were finally to put the last of the series where it did flower, we should not be justified in saying that it did not inherit its flower from the preceding cutting; nor would the case be any different if, for some reason, this preceding cutting could not be made to bloom.

The phenomena of polymorphism in insects and in hydroids present illustrations of the normal inheritance of latent characters, but we find in them no ground for the assertion that the ancestral characteristics of the medusa are not inherited from the hydroid which produces it.

The sum of the visible features of the parent, plus the sum of its latent potencies, may be called a "mid-parent" for statistical purposes, if we see fit, but there is no evidence that this mid-parent is anything else than the actual parent.

With this introductory note, we may now enter upon the study of Galton's works, the central point of which is as follows:

If we select any one characteristic of a natural group of animals—such a characteristic as the weight of the individuals, or the ratio between the lengths of their arms and legs, or anything else which admits of exact numerical statement—it will be found that while no two members of the group are exactly alike, they nevertheless conform to a type, and show the existence of a standard, the mean or average, to which the majority adhere pretty closely, while other members of the group are more abnormal, and show marked deviation from the mean.

If the cases tabulated are numerous enough, the individuals will conform, so far as this quality is concerned, to what is known in statistical science as the law of frequency of error. This agreement will be so close, when great numbers of instances are examined, that the number of individuals which depart from the mean to any specified degree may be computed mathematically.

For example, the chest measurements of 5,738 soldiers gave the following results:

Inches.	Measured.	Computed.
33	5	7
34	31	29
35	141	110
36	322	323
37	732	732
38	1,305	1,333
39	1,867	1,838
40	1,882	1,987
41	1,628	1,675
42	1,148	1,096
43	645	560
44	160	221
45	87	69
46	38	16
47	7	3
48	2	1

If the number of events had been five hundred thousand or five million instead of five thousand, the agreement between the computed and observed frequency of each degree of departure from the mean would have been very much closer. When the number of cases is unlimited, the agreement is perfect.

Galton gives the following illustration of the significance of a type:

Suppose a large island inhabited by a single race, who intermarry freely, and who have lived for many generations under constant conditions, then the average *height* of the adult male of that population will undoubtedly be the same year after year. Also—still arguing from the experience of modern statistics, which are found to give constant results in far less carefully guarded examples—we should undoubtedly find year after year the same proportion maintained between the number of men of different heights. I mean if the average stature was found to be sixty-six inches, and if it was also found in any one year that one hundred per million exceeded seventy-eight inches, the same proportion of one hundred per million would be closely maintained in all other years.

An equal constancy of proportion would be maintained between any other limits of height we please to specify, as between seventy-one and seventy-two inches, between seventy-two and seventy-three, and so on. Now, at this point the law of deviation from an average steps in. It shows that the number per million, whose heights range between seventy-one and seventy-two inches, or between any other limits we please to name, could be *predicted* from the previous datum of the average, and of any other one fact, such as that of one hundred per million exceeding seventy-eight inches.

Suppose a million of the men to stand in turns with their backs against a vertical board of sufficient height, and their heights to be dotted off upon it. The line of average height is that which divides the dots into two equal parts, and stands, in the case we have assumed, at the height of sixty-six inches. The dots will be found to be ranged so symmetrically on either side of the line of average that the lower half of the board will be almost a precise reflection of the upper. Next, let a hundred dots be counted from above downward, and let a line be drawn below them. According to the conditions, this line will stand at the height of seventy-eight inches. Using the data afforded by these two lines, it is possible by the help of the law of deviation from an average to reproduce with extraordinary closeness the entire system of dots on the board.

This law of deviation from an average is not restricted to vital phenomena, but holds true of all events which are the resultants of variable conditions, which remain the same through all the events recorded. If the marks on the board had been made by bullets fired at a horizontal line stretched in front of a target, they would have been distributed according to the same law, their average value would be constant, and the deviations of the several events from the average would be governed by the same law, which is identical with that which governs runs of luck at a gaming table.

Galton has described an apparatus which mimics in a very pretty way the conditions on which deviations from a mean depend. It is a long, shallow box set on end and glazed in front, leaving a depth of about a quarter of an inch behind the glass. Strips are placed in the upper part to act as a funnel. Below the outlet of the funnel stand a succession of rows of pins stuck squarely into the backboard, and below these again are a series of vertical compartments. A charge of small shot is inclosed. When the frame is held topsy-turvy, all the shot runs to the upper end; then when it is turned back into its working position the desired action commences.

The shot passes through the funnel and, issuing from its narrow end, scampers deviously down through the pins in a curious and interesting way: each one of them darting a step to the right or left, as the case may be, every time it strikes a pin. The pins are so placed that every descending shot strikes a pin in each successive row. The cascade issuing from the funnel broadens as it descends, and at length every shot finds itself caught in a compartment immediately after freeing itself from the last row of pins. The outline of the columns of shot that accumulate in the successive compartments approximates to the mathematical law of frequency, and is closely of the same shape, however often the experiment is repeated.

The outlines of the columns would become more nearly identical with the normal law of frequency if the rows of pins were much more numerous, the shot smaller, and the compartments narrower; also, if a larger quantity of shot were used.

The principle on which the action of the apparatus depends is that a number of small and independent accidents befall each shot in its career. In rare cases a long run of luck continues to favor the course of a particular shot toward either outside place, but in the large majority of instances the number of accidents that cause deviation to the right balance in a greater or less degree those that cause deviation to the left. Therefore most of the shot finds its way into the compartments that are situated near to a perpendicular line drawn from the outlet of the funnel, and the frequency with which shots stray to different distances to the right and left of that line diminishes in a much faster ratio than these distances increase.

Types which are based upon vital statistics have peculiar interest, since they persist from generation to generation, according to what is known as the law of specific stability, while they also undergo slow changes according to the principle of the mutability of species.

Individuals come and go, but the type persists, and its slow changes may be pictured as quite independent of and more substantial than the procession of individuals which files past only to vanish from the world.

The statistical comparison of vital types affords a means for studying the phenomena of inheritance by the exact methods of mathematics, and it is capable of yielding definite and valuable results, so far as the vital phenomena which are studied can be treated as if they stood alone, but the attempt to generalize from vital statistics and to deduce general laws of inheritance from them is attended by peculiar difficulties, due in great part to the fact that the data which are studied are not separable from the organism which exhibits them. Stature or size or weight may be treated abstractly for statistical purposes, but the stature of an organism is not an abstraction, for the organism is not only a bundle of properties, but a unit as well, and its stature is only one among many features which are all beautifully co-ordinated with each other in such a way as to promote the welfare of the species. A generalization which ignores this fact and treats stature as an abstraction may, while proved by statistics, be untrustworthy as a contribution to our knowledge of inheritance.

In popular language, specific stability may be said to be due to inheritance, and specific mutability to variation; but in this connection these words have only a loose meaning. In so far as they convey the impression that the stability of species and the mutability of species are antagonistic to each other, or are due to two distinct and opposing influences, these terms are unfortunate, for we have good ground for holding that they are due to the same influence—the extermination of certain individual peculiarities, and the preservation of others by natural selection.

The older naturalists held that adherence to type is due to some innate principle of specific stability which is an essential and immutable attribute of each species of living things; but the accumulation of conclusive evidence of the mutability of species has driven this conception out of the field. Most naturalists now regard the type as nothing but that normal which is most perfectly fitted to the environment, and they hold that it is kept true through the extinction of aberrant individuals by selection.

According to this view, which seems to be supported by ample evidence, the stability of species is due to survival—to the same mechanism which brings about the mutability of species.

Galton is led by his statistical studies of vital characters to a view which bears an odd resemblance to that of the older naturalists; for, according to him, the principle of stability which results in the permanency of types is quite independent of selection.

He shows, for example, by the statistical study of stature, that the type of human stature is very constant from generation to generation, although the statistics of marriage show that there is no controlling tendency for persons of like stature to marry. He also shows that the children of parents who are both tall or both short do not on the average have the stature of their parents, but are nearer than they to the mean for the race. These facts, and others like them, are held to prove the existence of a principle of stability independent of selection.

In his more recent work on the patterns at the tips of human fingers, he says that—since it has been shown (chapter xii) that the character of the finger prints is practically identical in Englishmen, Welshmen, Jews, negroes, and Basques, the same familiar patterns appearing in all of them with much the same degree of frequency, and that persons belonging to different classes, such as students in science and students in art, farm laborers, men of culture, and the lowest idiots in the London district, show no decided difference in their finger prints, it seems to be proved that no sensible amount of correlation exists between any of the patterns on the one hand and any of the bodily faculties or characteristics on the other. It seems absurd, therefore, to hold that, in the struggle for existence, a person with, say, a loop on his right middle finger has a better chance of survival or a better chance of early marriage than one with an arch. Consequently, genera and species are here seen to be formed without the slightest aid from either natural or sexual selection, and these finger patterns are apparently the only peculiarity in which panmyxia, or the effect of promiscuous marriage, admits of being studied on a large scale.

He says that results of panmyxia in finger-markings corroborate his arguments in Natural Inheritance and elsewhere to show that "organic stability" is the primary factor by which the distinctions between genera are maintained. Consequently, the progress of evolution is not a smooth and uniform progression, but one that proceeds by jerks, through successive "sports" (as they are called), some of them implying considerable organic changes, and each in its turn being favored by natural selection.

Galton's explanation of this specific stability is as follows: The child inherits in part from the parents, in part from more remote ancestors; and since the sum of its ancestry, or, as Galton terms it, the mid-parentage, is on the average nearer than the exceptional parents to the mean of the race, the children of selected parents are on the average more mediocre than their parents.

I have tried to show that, while the child is descended from a long line of ancestors, it inherits from none but the two parents, and that it can only be said in a figurative sense to inherit from more remote ancestors. I shall soon refer to proofs that the persistency of inherited types is due to natural selection, and not to any principle of organic stability independent of selection.

If this is true, if the stability of specific types is due to the survival of the fittest, why do we have a type and not a fixed standard? If speed and strength and courage are good things, why is not every individual as swift as the swiftest, as brave as the bravest, and as strong as the strongest? Why does not every individual have every useful quality developed to the highest excellence to which it may attain in any individual of the species? Why should we find that diversity among individuals which usually passes under the name of "variation"?

We can measure strength and can treat it abstractly, and we can artificially select and breed from the strongest members of a stock, neglecting all other features; but this is not what takes place in Nature.

Here the most favored individuals are not the strongest, but the ones in which all the qualities of the species are most perfectly co-ordinated with each other in relation to the external world. Excessive strength may involve deficiency in some other essential, and the mean or average strength of the species is that degree of strength which is most in harmony with the mean degree of development of all the other characteristics of the species; and the individuals who depart too widely from this mean, either through excess of strength or deficient strength, are the ones which are exterminated.

Galton has himself given such a clear statement of the way a type is established by selection that it can not be improved upon, and I quote it in his own words:

"Suppose," he says, "that we are considering the stature of some animal that is liable to be hunted by certain beasts of prey in a particular country. So far as he is big of his kind, he would be better able than the mediocres to crush through the thick grass and foliage whenever he was scampering for his life, to jump over obstacles, and possibly to run somewhat faster than they. So far as he is small of his kind, he would be better able to run through narrow openings, to make quick turns, and to hide himself. Under the general circumstances it would be found that animals of some particular stature had on the whole a better chance of escape than any other; and if their race is closely adapted to these circumstances in respect to stature, the most favored stature would be identical with the mean of the race. Though the impediments to flight are less unfavorable to this (stature) than to any other, they will differ in different experiences. The course of an animal might chance to pass through denser foliage than usual, or the obstacles in his way may be higher. In that case an animal whose stature exceeded the mean would have an advantage over mediocrities. Conversely the circumstances might be more favorable to a small animal. Each particular line of escape might be most favorable to some particular stature, and, whatever this might be, it might in some cases be more favored than any other. But the accidents of foliage and soil in a country are characteristic and persistent, and may fairly be considered as approximating to a typical kind. Therefore those which most favor the animals of the mean stature will be more frequently met with than those which favor any other stature, and the frequency of the latter occurrence will diminish rapidly as the stature departs from the mean.

"It might well be that natural selection would favor the indefinite increase of numerous separate faculties if their improvement could be effected without detriment to the rest: then mediocrity in that faculty would not be the safest condition. Thus an increase of fleetness would be a clear gain to an animal liable to be hunted by beasts of prey, if no other useful faculty was thereby diminished.

"But a too free use of this 'if' would show a jaunty disregard of a real difficulty. Organisms are so knit together that change in one direction involves change in many others; these may not attract attention, but they are none the less existent. Organisms are like ships of war, constructed for a particular purpose in warfare as cruisers, line-of-battle-ships, etc., on the principle of obtaining the utmost efficiency for their special purpose. The result is a compromise between a variety of conflicting desiderata, such as cost, speed, accommodation, stability, weight of guns, thickness of armor, quick steering power, and so on. It is hardly possible in a ship of any established type to make an improvement in any one of these respects without a sacrifice in other directions. If the fleetness is increased, the engines must be larger, and more space must be given up to coal, and this diminishes the remaining accommodation.

"Evolution may produce an altogether new type of vessel that shall be more efficient than the old one, but when a particular type has become adapted to its functions, through long experience, it is not possible to produce a mere variety of its type that shall have increased efficiency in some one particular without detriment to the rest. So it is with animals."

This quotation from Galton shows how a type may be established by selection, and it also shows why it is not possible to make any great and permanent change in the type of one characteristic of an organism unless changes at the same time occur in the type of other characters of the same organism. It also follows that a breeder of domesticated animals or cultivated plants who devotes his attention to one characteristic exclusively must soon reach a point where no further improvement in this quality is practicable unless the spceies is at the same time modified in other respects. This fact does not prove that specific stability is due to anything else than selection. It only proves that no great change is possible without the co-ordinated modification of correlated features, and this is just what we should expect as the effect of long ages of selection.

The passage I have quoted from Galton seems to indicate that, after all, he may believe that the specific types of zoölogy and botany are nothing more than the persistent effects of past selection, and that his statement that "organic stability is independent of selection" may refer to present selection only.

These statements are clear and explicit, however, and they have been interpreted by most readers as a flat contradiction of the view that the mechanism which leads to the formation of new types is identical, on its vital side, with that which preserves established types; the view that the differences between the two are differences in the external world.

He says (Nature, September 4, 1885): "It is some years since I made an extensive series of experiments in the produce of seeds of different sizes, but of the same species. . . . It appears from these experiments that the offspring did *not* tend to resemble their parent seeds in size, but to be always more mediocre than they; to be smaller than they if the parents were large; to be larger than the parents if the parents were very small," and that the analysis of the family records of heights of 205 human parents and 930 children fully confirms and goes far beyond the conclusions obtained from seeds, as it gives with great precision and unexpected coherence the numerical value of the regression toward mediocrity. He says that this regression is a necessary result of the fact that "the child inherits partly from his parents, partly from his ancestors. Speaking generally, the further his genealogy goes back, the more numerous and varied will his ancestors become, until they cease to differ from any equally numerous sample taken at haphazard from the race at large. Their mean stature will then be the same as that of the race; in other words, it will be mediocre." He illustrates this by comparing the result of the combination in the child of the mean stature of the race with the peculiarities of its parents to the result of pouring a uniform proportion of pure water into a vessel of wine. It dilutes the wine to a certain fraction of its original strength, whatever that strength may have been.

He then goes on to the deduction that the law of regression to the type of the race "tells heavily against the full hereditary transmission of any rare and valuable gift, as only a few of the many children would resemble the parents. The more exceptional the gift the more exceptional will be the good fortune of a parent who has a son who equals, and still more if he has a son who surpasses, him. The law is even-handed; it levies the same heavy succession tax on the transmission of badness as well as goodness. If it discourages the extravagant expectations of gifted parents that their children will inherit all their powers, it no less discountenances extravagant fears that they will inherit all their weaknesses and diseases. . . . Let it not for a moment be supposed that the figures invalidate the general doctrine that the children of a gifted pair are much more likely to be gifted than the children of a mediocre pair; what it asserts is that the ablest of the children of one gifted pair is not likely to be as gifted as the ablest of all the children of many mediocre pairs."

In his recent work on Finger Prints he says: "It is impossible not to recognize the fact so clearly illustrated by these patterns in the thumbs that natural selection has no monopoly of influence in the construction of genera, but that it could be wholly dispensed with, the internal conditions acting by themselves being sufficient. Not only is it impossible to substantiate a claim for natural selection that it is the sole agent in forming genera, but it seems, from the experience of artificial selection, that it is scarcely competent to do so by favoring mere varieties in the sense in which I understand the term. Mere varieties from a common typical center blend freely in the offspring, and the offspring of every race where statistical characters are constant necessarily tend, as I have shown, to regress toward their common typical center. A mere variety can never establish a sticking point in the forward course of evolution." He therefore holds that, while specific stability is due to inheritance from a long series of ancestors, the transmutation of species is due to the sudden appearance of "sports," which, if useful, are seized upon and perpetuated by selection.

He says that a sport is a substantial change of type effected by a number of small changes of typical center, each more or less stable, and each being in its turn favored and established by natural selection to the exclusion of its competitors.

"The distinction between a mere variety and a sport is real and fundamental."

This generalization, based upon definite numerical data, is so fundamental and far-reaching that a critical discussion of the evidence is most important.

IMITATION AMONG ATOMS AND ORGANISMS.

By EDMUND NOBLE.

DURING the past dozen years scientific writers, American as well as European, have given a certain amount of attention to the part played in human life by imitation, with especial reference to the conditions under which children acquire from parents and associates the salient characters of individual and social habit. But the examples drawn upon for illustration have been narrow in their range, while the analogous process of assimilation among the lower animals and in the realm of the inorganic has received but scant recognition. It is proposed in the present article to connect the three classes of phenomena by formulating a general law which may serve, provisionally at any rate, to cover them all, and then to group the phenomena in their various natural divisions.

Without taking note of its unimportant and obvious qualifications, the statement may be made that all things free to move, capable of becoming closely associated, and impelled to movement by the system to which they belong, tend to come together when they are likes, and to be separated when they are unlikes. If we regard this tendency from the point of view of the movement, we shall say that likeness of things involves association of them in the degree of their likeness, and that unlikeness of them involves dissociation of them in the degree of their unlikeness; while, if we regard the tendency from the point of view of the things themselves, we shall say that association of things involves likeness of them in the degree of the association, while dissociation of things involves or implies unlikeness of them in the degree of the dissociation. These truths may be expressed in a more general way by saying that in systems the association of likes involves the least degree of resistance among them, while the association of unlikes involves the utmost degree of resistance. It follows that where unlikes are associated, the resistance offered to their union will tend (1), where they are forcibly held in association, to make them likes; and (2) where they are free to move, to dissociate them. This law of assimilation, as we may briefly call it, finds illustration over so vast a field that it may fairly be described as a universal character.

If we begin, then, with the most complex of all the phenomena known to us, our first illustrations will be drawn from the realm of mind. The fact that cognition is a process of the association of like and the dissociation of unlike impressions, and the further fact that all the activities of thought, from reasoning of the lowest to reasoning of the highest kind, involve the association of like and dissociation of unlike elements—these are psychological truths of the utmost certainty. At the outset of all knowing is the indispensable condition that unless we can connect the thing perceived with some other things already known, and thus recognize our object as a like of those things, we can not know it at all, and it can not become a part of our store of mental experiences; while the very act by which we know it involves dissociation of it as an impression from all the impressions which it does not resemble. From this, the simplest form of knowing, to the most elaborate process of the reasoning faculty; from the recognition of single objects as like others to the recognition of classes of objects as like other classes; from the discovery of a causal relation between one set of objects or changes that is like the causal relation between another set of objects or changes to the discovery of the causal likeness connecting great groups of objects and activities, and finally all objects and changes whatsoever, there is throughout the same process at work—the process of the association of likes and the dissociation of unlikes—that conditions the mode of all our mental operations. So-called thought or reflection, for example, is simply the recovery into consciousness, for the purposes of knowledge, of cognitions more or less simple, more or less complex; cognitions recoverable as images, symbols, or terms from the classes in which they have been first associated by the mind; and the sense of pleasure felt by a thinker in discovering analogies can spring only from satisfaction of the demand, even in mental processes, that likes shall be brought together and unlikes separated. Classification in all its forms, whether in the ordinary business of life, as a means to scientific investigation, or for the ends of philosophic thought, illustrates the same necessity: at first unlikes and likes are mingled indiscriminately, and at first the mind regards them, if roughly, as being alike; but a sense of unrest leads to further examination of the aggregated elements until, by a more conscious and complete knowledge of them, they are found to be likes and unlikes, and are associated and dissociated accordingly.

The elements of coherent systems, whether of thought or language, always have their relations facilitated by likeness and impeded by unlikeness; hence we find in such systems that it is resemblance which is the bond of their union. Just as views in science or philosophy, schools in literature or art, are related to each other by varying degrees of likeness, the whole forming a group through which each of the parts thereof is rendered intelligible, so concepts and the words representing them are interrelated by degrees of resemblance, and so every term we can use is really intelligible to us only through its connection—a connection of likeness more or less proximate, more or less remote—with all other terms whatsoever. This is true, moreover, not only of all words as they exist at a particular moment, and are in use for particular concepts, but also for all the forms through which particular words have passed in their structural development. We bring new words into existence by connecting them, through likeness either of sound or of form, with words already familiar to us; and such new words, when we meet with them, become intelligible to us largely because of the likeness which connects them with known and intelligible elements of speech. When, moreover, a word is unfamiliar, the mental system rejects it as long as it remains a stranger and an unlike; but as soon as the mind, insisting on assimilation, obtains the satisfaction it seeks by change of form, the modified term, no longer meeting with resistance, becomes one of the system of likes. It is the same kind of assimilation as that seen in the use of *Shotover* for *Château Vert* which leads races to spell any foreign word they adopt in accordance with the analogy of their own tongue, and children to construct such grotesque plural forms as "foots," "mouses," "goodest," and "bringed." That in nearly all languages the vowels within a word tend to be assimilated to one another is a phenomenon encountered very early in the study of linguistics. The use of metaphor, again, which is largely the mental assimilation of a thing more or less unknown to something much better known, is universal.

Passing from the allied realms of cognition and speech to the sphere of human relationships, we shall find that here also likes tend to be associated and unlikes dissociated; that the resistance is greatest where the association is of unlikes, and least where the association is of likes. At the outset we must understand that likeness or unlikeness between human beings is a likeness or unlikeness not merely in structure but also in manner of acting; not only in structure and acting, as these are popularly understood, but also in thinking, in belief—not only, that is to say, in body, but also in mind—not only in permanent and fundamental characters, but also in temporary and superficial characters. If men were exactly alike in every respect, we should find the greatest ease of association between men and men generally, as distinguished from association of beings human and beings not human. Yet upon the fundamental characters in which all men are alike there are superposed by advancing social and industrial complexity those superficial characters in which, for such characters, the members of particular groups come to be, on the one hand, more alike one another than, for the same characters, they can be alike men in general; and on the other, more unlike each other than, for the same characters, they can be alike men in general. Hence, even among human beings fundamentally alike we shall find abundant scope for movements both of association and dissociation.

First note the superior ease, even pleasure, which characterizes the relations of likes temporarily or permanently associated, and observe how, in the very facility of such relations, we are entitled to see a satisfaction of the demand that likes shall be brought together. The illustrations naturally take a wide range. Men of the same vocation, for example, find intercourse with each other, for the scope and ends of such vocations, much easier than with those engaged in other vocations. It is from likeness within industrial groups that the *camaraderie* of the trades and professions draws its spirit. The pleasure, again, with which artists, musicians, scientific and literary men come together manifestly has its origin in likeness of common pursuits, tastes, and aspirations. That facility of association is at its highest between men of like politics, men of like faith, men of like aims in any field of activity, has long been proverbial. Societies and clubs of every kind constitute so many classes of likes within which the elements of resistance are at a minimum, and this not because each individual is always or even often wholly like his fellow-member, but because there is a resemblance between them on some one or more sides which, being permanent, at least for the time, and valid for the ends of the association, facilitates the intercourse of all who during that time and for those ends come into contact with each other. Even when men gather for only temporary and general purposes—such as for those of social enjoyment—we often hear of religion or politics being tabooed, and this is done obviously as a means of avoiding the resistances of unlikeness—of bringing forward only those sides of human nature on which the associated individuals are for the time being alike. Intercourse is also much easier within than without the limits of class; the poor find among the poor the greatest facility of relation with their fellow-beings; so the possessors of wealth are usually most at their ease in intercourse with the well-to-do. Who has not witnessed how quickly two abnormally stout men enter into confiding relations with one another; or how easily, between persons afflicted with a like disease or deformity, friendship is set up? Caste, group, and race prejudices of every kind, together with such distinctions as those implied in the names of aristocrat, commoner, bourgeois, official, proletariat, all imply and involve the coming together of likes and the separation of unlikes. In most countries there is still a strong though diminishing prejudice against alliances with foreigners; even among natives, marrying "below one's station" or "out of one's religion" meets with a certain amount of social as well as with much family resistance. Most people usually fall in love with those about their own age. Deaf-mutes almost invariably marry deaf-mutes.

Highly temporary likenesses are equally potent in promoting association. Their influence is seen in the pleasure we feel at the discovery in others of some character like to our own, even if that character be no more than a gleam of intelligence in the lower animals. We note it constantly in the unifying effect which the wearing of a common badge or uniform has upon large bodies of men brought together for special ends. So in moments of exaltation or depression, as in the excitement of conflict or intoxication; under the influence of music or during religious worship; the ordinary differences belonging to more permanent states lose their separative power, and men come into unwonted facility, even pleasure of relation with each other. It is supposed that even between deadly enemies chancing to meet at the dinner table there passes a flash of momentary reconciliation. It is certain that shipwrecked men do not quarrel over politics; that the starving are usually free from religious bigotry; and that in the presence of a general bereavement, the clamors of faction and the prejudices of class are silent. The power of a war and of the comradeship of battle to annihilate distinctions usually recognized in time of peace is notorious. In all these cases, and in all the cases which they represent, we see great importance suddenly given to one side of men's natures—to some all-absorbing feeling or experience in the presence of which the ease of association with likes becomes extended for the moment to each of the human beings by whom the same experience is shared, whether they be few or many; in other words, the unlikenesses which normally separate men into more or less narrow classes lose their importance in proportion as some suddenly developed feeling gives prominence to resemblances either wider in character or more strongly felt.

Observe next how unlikes tend to be separated from the human systems in which they appear, and to be associated, in the act of separation, according as they are likes to each other. From whatever causes the unlikenesses which differentiate men from each other take their rise, it is manifest that even in the most minute of them the law of likes and unlikes finds illustration. Perhaps the most common and familiar example of this simultaneous association and dissociation is afforded by the breaking up of a social gathering into minor groups of likes that do not easily coalesce. In all such cases the individuals who so naturally fall into pairs or groups move from associations that involve the greatest resistance into associations that involve the least resistance, while the movement itself (given the need of association) is manifestly the product of the stress of the greater resistance.

In what multifarious ways this stress is exerted may be easily shown. As a small group of men surrounded in battle by a larger force naturally come together and are compacted for defense by the stress of those who attack, so the individual members of classes or races despised, hated, or feared, when persecuted by the community in which they live, are in like manner thrust and welded together by the stress which they encounter. Individuals, again, who differ from their fellows to the extent of being unable or unwilling to work—to take part in those co-operative activities that are necessary for individual as well as social maintenance—meet with the resistances which failure in self-maintenance involves, and are by them, though nominally by society, thrust into hospitals or poor-houses; while men whose actions are unlike those of others beyond the amount of difference permitted by law are dissociated, either by exile or imprisonment, from the communities which they injure. When expulsion of the unlikes is not practicable, there is association of them as prisoners within the system. Savages, again, often abandon or destroy individuals deformed at birth or incapacitated from social duties by age; even a comparatively advanced people like the Spartans exposed their weaklings to death by starvation. That there is still a tendency to offer undue resistance to the unlikenesses of physical and mental deformity is shown by the treatment of lunatics and criminals even in the most civilized countries; not many years ago positively cruel, it is still in many cases culpably careless and inadequate. The treatment ordinarily given by human beings to the lower animals; offenses against the helplessness of children and women; the oppression of individuals by autocrats, by governments, by official tyrants abusing power intrusted to them by the people, and by capitalists taking unfair advantage of the economic condition of those whom they employ—these are all cases of stress directed against unlikes. So shortcomings of men of every kind—veritable unlikenesses—are in numberless ways made the goal of individual or social stress; even ridicule and slander are forms of aggression, based on the real or fancied discovery of fault, and therefore unlikeness in the person assailed. But the action here illustrated, so far as human beings are concerned, is not necessarily moral and not necessarily immoral. Men may be in advance of as well as behind their age—may be larger as well as smaller than their fellows; yet the social system offers the same resistance to the individual too greatly contemplating the good of his kind as to him who wantonly plots its harm.

We thus come to note how the social group or system tends constantly to the production of conditions of least resistance within itself—how, that is to say, its resistance to unlikeness acts as a stress compelling likeness among its units. The fact that profound differences between individuals are not to be eradicated by the social stress after their appearance is quite consistent with the power of that stress to assimilate human beings to each other in their more superficial and temporary characters. The tendency to do as others do is universally felt, no matter to what extent, in individual cases, it may or can be resisted. It appears both as imitation of the particular acts of particular persons and of the acts in which a number of persons are generically alike; as imitation not only by the one of the many, but also by the many of the one. It usually begins—for wholly voluntary actions, at any rate—in that interesting process by which people are assimilated to each other in their views and beliefs.

Submission of opinion, whether accompanied by imitative action or not, is clearly a path of least resistance—a way in which men avoid the difficulties of differing from the community in which they live. And when action is involved, as it usually is, the process shows us the enormous assimilative influence which it brings to bear upon human development. It may be said, indeed, that civilized human beings acquire their normal activities as such largely through the molding influence which the social community exerts upon them from their earliest years.

This stress impelling individuals to imitate society is well seen in industrial organization, and is thus obvious in the lowest as well as the highest stages of human development. The civilized human being who enters a savage community will be compelled to go half naked through very lack of any means of producing clothes to which he has been accustomed; he will be forced to hunt or fish for a living for the reason that there is yet no system of co-operative supply in existence; in the absence of those functionaries, he must become his own farmer, his own soldier, his own tailor and shoemaker, his own doctor, even his own priest. So a savage entering civilized society will be forced to wear clothes, partly by social intolerance for human nudity in public, and partly because of the facilities for obtaining clothes, with all which that implies; there will now be no game to pursue and no need to pursue it, since the man's food supplies will come from the agents of the industrial system; he will soon lose his primitive, many-sided industrial capacity, for he will have an army of stock-raisers, farmers, tailors, shoemakers, house-builders, and doctors at his service; while in time society will impose, in place of the powers which it abstracts, new functions and activities, assimilating him industrially to the units of which it is already composed. In both these cases, moreover, likeness will be enforced by the resistance offered to unlikeness, and not by any inherent superiority of one system or any inherent inferiority of another; for savages who have not yet learned to coöperate are as much held to their rude industrial methods by the stresses that impel to likeness as civilized men are held by such stresses to the vastly more complex and highly organized activities of the modern society.

The same is true of nonindustrial forms of social organization. As a community imposes its industrial methods upon its own and upon intruding members, whether it represent a high or a low stage of human society, so does a community, quite irrespective of the degree of its development, insist upon a certain likeness of habits and customs in the units of which it is composed. A civilized man forced to live among savages will find it impossible to avoid barbarous methods of living, just as a savage compelled to sojourn in a civilized community will inevitably adopt the manners of the race among whom his lot is cast. In all communities whatsoever, and under ordinary circumstances valid for the majority of men, it is vastly easier to imitate others in general characters than to differ from them in those characters, while the difficulty of differing becomes almost insuperable when the stresses tending to assimilate the individual to the sum of individuals are exerted directly by the group or community as a whole. All acts of race assimilation in history—many of them already accomplished, some of them still going on—all so-called civilizing processes, whether carried out by individuals or by peoples, and all proselytizing movements, by whomsoever conducted, are but so many illustrations of the general process. Such modifications, moreover, as have been wrought in the native races of India, and in the negro of the United States, by dominant populations in those countries, are going on within each nation, each city, and every social group, however large or small its dimensions may be. For if the traveler, when living in strange countries, finds it expedient, if only temporarily, to conform to the customs of the people he meets—such customs being imposed upon him by the very resistances which divergence from them entails—he none the less, on his return home, finds his actions in social intercourse determined by the same need of conforming to some larger or smaller group of which he may happen for the time to be a member. It is because of this "doing at Rome as Rome does" that social gatherings are said to succeed best and to be most enjoyable when the guests are all alike each other on certain social sides of human nature, or are willing to appear to be thus alike during the period of their association. The fact that the social code, as it is sometimes called, frowns upon the guest who would take more than his share of the attention or time of the company, and encourages the host to an equal distribution of his favors to all of them alike—this shows how thoroughly, even in the social circle, imitation of the group is the direction of greatest ease, and how it is the stress of the resistances offered to unlikeness by the group as a whole which impels the members of it to those acts of imitation by which they are more or less temporarily assimilated.

The very description, again, of costumes as *de rigueur* for certain special occasions contains a suggestion of the resistance which the social group opposes to unlikenesses in dress. The attacks sometimes made upon strangely attired persons in so highly conservative a country as China have had their parallels even in the highly progressive countries of Europe and America. A similar antagonism is manifested to nonconformity in social manners; and all formulæ of such manners—the etiquette at baptisms, weddings, and funerals; established methods of paying and receiving visits; prescriptions of what to do and what not to do at the dinner table—are simply means, among those who attach importance to these minutiæ, of avoiding the resistances that would inevitably be encountered were there many ways, instead of a generically common manner, of behaving on social occasions.

The resistance offered to unlikenesses among associated individuals is also announced in that universal human character, the passion for equality among men—the tendency, however vaguely or vividly it may be felt, to insist upon it that those with whom we come into contact shall, in as many respects as possible, be likes of ourselves. Jealousy of special privilege, with its spirit embodied in such phrases as "fair play," "start equal," "share and share alike," "a fair field and no favor," begins to manifest itself very early in the life of the individual: mere children, when associated, insist in multifarious ways on likeness of treatment; anything like favoritism in the distribution of gifts or the bestowal of attention, as well as all unfair advantage in games, they resent with surprising promptness and vigor, often also with indignation. In adults this jealousy of unequalness finds expression over a much wider field, and finally gives character to the whole social system. All rules governing the activities of large or small bodies of men, such as regulations in factories, hospitals and prisons, by-laws in cities, and general laws framed for communities and nations, are manifestly means of providing against unequal acting of individuals—of securing, that is to say, the like acting, under particular and specified circumstances, of all the individuals associated. The sense, early developed, in the individuals of a community that they ought to be equal before the law, with the restiveness which they manifest under all inequalities of its operation; the claim that men shall be politically as well as legally equal; and the demand always made, if not always satisfied, for universal suffrage, first for men, and then for women—at first with limitations of race, property, or sex, and finally without such limitations—all these explain the progress which the world has been making during the last fifty years toward an ideal democracy—toward a condition of ideal political equality between the units that make up a human society as the very condition and means of least resistance between those units.

But men do not remain satisfied with likenesses set up by statute law, with resemblances imposed by a governing body. They aim, more or less consciously, more or less outspokenly, at a common degree of social well-being for all the individuals of a community, and, rightly or wrongly, regard inequalities of wealth, even inequalities of industrial power, as imperfect stages of human development that are to be outgrown. Hence it is that men denounce monopolies, and declare abnormally large accumulations of wealth in private hands to be iniquitous, because inequitous; hence, too, it is that, in the common jealousy of privilege, there is to be found every form of hostility to exceptional social power and rank, from the dislike in which it is merely envied to the anger by which it is openly attacked. Socialistic schemes of reform are really schemes for diminishing those inequalities which still offer resistance to the association of men—schemes, that is to say, for making men in social, political, and legal relations, in powers, privileges, and responsibilities—more than ever before likes to each other. Even religions illustrate the progress from a belief and acquiescence in special privileges held out to a favored few to an expectation and demand for the salvation of all; for if the pagan had to content himself with the satisfaction of knowing death as the universal leveler, asking with Cicero (Tusculan Disputations) "Can what is necessary for all be a source of misery to one?" the Christian, who claims the equality of all men before God, looks forward to a life hereafter in which all earthly unlikenesses are to be removed.

We shall next note that when unlikes are forced to remain associated, such unlikes being kept together for longer or shorter periods, the resistances which arise operate as a power tending to assimilate them. This process of assimilation is manifested in all degrees of our intercourse with others. Men rarely come into contact with each other, even for special and temporary ends, without feeling the molding influence of more or less unlike habits, manners, opinions, and speech. Unless our ways of thinking, acting, and speaking are so firmly established as to be unchangeable, we can not long remain in the society of others without feeling that the differences which separate us from them are gradually being worn down, if not disappearing altogether: strenuous as our determination may be, Nature herself seeks to lessen resistance, and thus guides us insensibly into the path which offers the least. Thus it is (in indifferent things, at any rate) that we gain our opinions and beliefs from those about us, that we unconsciously acquire the gestures and mannerisms of relatives and friends—that, in a word, we come at last to be profoundly modified by the more permanent characters of our human surrounding. In speech alone the change wrought is often considerable. Few succeed in avoiding the use of colloquialisms constantly heard, and fewer still escape the insidious influence of phrases and idioms peculiar to districts and countries: newcomers may at first regard them as strange, even barbarous, yet in the end they employ the novel forms as frequently and as unconsciously as the native. The very features of human beings living in close association with each other are known to undergo assimilation. The fact, again, that jockeys, hostlers, and cowherds sometimes betray more or less distant resemblances to the animals with which they habitually associate is well known; and although animals do not in feature grow to be like human beings by contact with them, it is certain that in the character of intelligence, as in the case of the dog and the cat, as well as in tameness generally, as in the case of cattle and poultry, a real and profound assimilation of them to men has undoubtedly taken place.

Fashion in all its forms illustrates the same assimilative process. The first fashions are seen under the domestic roof: there, children imitate their parents not only in speech, gesture, and action, but also sometimes in opinion and bent of mind, and (for the sons, at any rate) occasionally also in vocation. Men imitate individuals as well as communities; they borrow from each other mannerisms of dress, of conduct, of opinion, and even of literary style, whenever attention is strongly called to any of these; even maladies have been known to become fashionable. A remarkable exploit in athletics usually sends a fever of emulation through the sympathetic members of a social group, just as a fashion set in literature, science, art, or philosophy inspires a thousand imitators. All composition, whether of prose or poetry, is in the ground of it imitative — a fact sufficiently suggested by the grotesquely moral turn ordinarily given to college and school essays, by the accession of literary power which always follows much reading, and by the imitation of any particular author or style to which great liking for one or the other inevitably leads. What has been called the contagiousness of example is really the power of a strong impression, and therefore practically of stress, to produce likeness. This may be noticed at public meetings, where people applaud or cheer gregariously, and do other acts, such as those of sitting or standing, with obvious reference to what others are doing. The ease with which a stammerer communicates his defect to another is a matter of common observation. Movements or actions of persons sitting together, such as yawning, coughing, and the like, tend to be propagated more or less through the whole of them by unconscious imitation. To the same process is due the spread of more or less hysterical ailments among a company of persons, such as the often-recorded mania for mewing among nuns, or the propagation of convulsions among girls in factories. Simple movements, like the shifting of a chair, the rustling of a paper, audible change in the position of the body, often follow involuntarily in others after they have occurred in one of the persons associated. If in a thoroughfare a man be encountered staring intently and conspicuously at some portion of the sky, most of those who see him will at once direct their gaze in the same direction. A man watching an athletic feat, or a stroke at billiards, in which he is deeply interested, will often at a critical moment imitate the attitudes or action of the performer.

The law is further abundantly illustrated by facts relating to the lower animals. These find the greatest ease of association as likes, and come together everywhere in Nature on the ground of likeness. The general evidence of this is familiar, and mention need be made here only of a representative example. In the Falkland Islands, for instance, where the cattle have run wild, and where they are of several different colors, each color keeps in a separate herd, often restricted to one part of the island; among the wild horses of Paraguay, those of the same color and size associate with each other; in Circassia three races of horses exist which, when living in freedom, always refuse to mingle and cross; on the Färöe Islands the half-wild, native black sheep resist attempts to breed them with imported white sheep; in the Forest of Dean and the New Forest the dark and pale colored herds of fallow deer have never been known to mingle; the merino and heath sheep of Scotland, if the two flocks are mixed together, will each breed with its own variety; Ancon sheep have been observed to keep together, separating themselves from the rest of the flock when put into inclosures with other sheep; "the female of the dog" (according to Prof. Low, an authority on domesticated animals), "when not under restraint, makes selection of her mate, the mastiff selecting the mastiff, the terrier the terrier, and so on"; pigeons pair, when choice is free, with their own kind; flocks of white and Chinese geese, even when associated by the breeder, keep themselves distinct. The fact that organisms prefer to associate and breed with their likes is also widely shown by the habits of birds. Describing a molluscan fauna in the Sandwich Islands, Mr. Gulick says: "We frequently find a genus represented in several successive valleys by allied species, sometimes feeding on the same, sometimes on different plants. In every such case the valleys that are nearest to each other furnish the most nearly allied forms; and a full set of the varieties of each species presents a minute gradation of forms between the more divergent types found in the more widely separated localities."

The recognition marks of insects, birds, and other animals imply and involve the association of likes and the separation of unlikes. The mimicry of one set of organisms by another, whether the imitation be of color, shape, or both, is manifestly a means of acquiring the superior ease of living which assimilation offers to the imitating kind: the mimickers always occupy the same region as the species mimicked, and the resemblance wrought is sometimes (Darwinism, page 256) advantageous to both. All association of organisms involves likeness between them, and when, by unequal conditions, unlikeness is set up in sufficient degree, that unlikeness involves dissociation of the unlike members of the group, accompanied by the resistance which sterility offers to the intercrossing of those members. The like individuals, moreover, are only held together by the constant operation of assimilative processes: one of these is the free intercrossing of all the associated members, whereby the individual is maintained true to the average; the other is the resultant tendency of the organism to transmit and perpetuate only those characters due to influences and conditions that are the common experiences of all the members of a kind, as opposed to characters arising out of special individual experiences.

The group of animals, like the group of men, expels unlikes that appear in its midst. Thus ants eject intruding members of alien kinds; geese and hens drive away strange birds of their own species; crows and rooks expel wrongdoers from their midst; domestic pigeons attack and badly wound sick, young, or fallen birds; beavers dissociate idle members from their colony; a wounded herbivorous animal returning to its companions is usually attacked and gored to death; elephants not only expel a "rogue" from the herd, but have been known to refuse refuge to one of their number who had escaped into the jungles with the bandages of the capturer still on its legs.

It should be added that the organism itself, and the organic structure, everywhere illustrates the principle of the association of likes and the dissociation of unlikes. All tissue systems in the organism are systems whose units are likes to each other, and the likeness which those units exhibit is a likeness maintained by the assimilative force of the organism acting a whole. So all food material taken into the organic system—which is really a community of cells—must undergo assimilation as the very condition of its admission to association, while all material that can not be associated is expelled, either by dissociation without or by dissociation within the system.

In the inorganic world the same law holds good. Its most general evidence is afforded by the fact that matter is always associated with matter, and that where free to move it always constitutes a system of which the parts of like density are associated and the parts of unlike density dissociated. In a general way the bodies which constitute the solar system occupy positions in that system according to the degree of their density, the denser planets lying nearer to, those less dense farther away from, the sun. The ring system of Saturn shows a like collocation, due to differences and likenesses of density. In the earth itself (omitting complications of gravitation produced by internal heat) the denser solids always tend to move nearer to the earth's center than the liquids; the liquids thus displaced take precedence in position over the atmosphere; while even the air shows a gradually diminishing density in a direction away from the earth. That which, moreover, is observable in our own solar system may reasonably be predicated of stellar aggregations generally: most of the planetary nebulæ and star clusters display a gradually increasing density from circumference to center; comets, densest at their nucleus, visibly diminish in mass as their fanlike streamers recede from the sun; in meteor orbits the densest bodies travel first, the remainder, roughly speaking, following in the order of their density. In the star system itself, there are signs of the same kind of segregation, one region of the Milky Way being as remarkable for the multiplicity of its suns and its almost complete absence of nebulæ as are the other regions of the heavens for the fewness of their stars and the large number of incipient systems which they contain.

What is true of matter in the varying degrees of its density is also true of the different types of matter; for whether the atom constitutes the molecule, as in the case of a few of the elements, or the molecule be made up of two or more atoms, as in the case of most of the elements, it is undisputed, not only that the uniting parts are likes to each other, but that the molecules which they form are also likes to each other. That which, moreover, is especially obvious in the case of the elements, where the molecule is always made up of the same kind of atoms, is none the less true of compounds; for, however superficially unlike the atoms or molecules may be that enter into combination to form such compounds, and whether the matter formed be what we know as inorganic or what we know as organic—whether it be extremely simple, as in the case of water, or highly complex, as in the case of albumin—the resultant system is in every instance a system whose unit parts all possess the same general character.

The power of material systems to dissociate unlikes is best seen when the dissociating stress is exerted by matter in the liquid or gaseous state—in a form, that is to say, in which the power to dissociate is at its maximum and the resistance to dissociation at a minimum. If we thrust a ball of wood into a volume of water, the entering mass is immediately expelled to the surface, and it is thus expelled for the reason that it possesses less density than water, and is therefore an unlike: the act of dissociation, moreover, is manifestly an act of the water system; for, if we remove the water, our wooden ball will descend freely through the space previously occupied by the fluid. So a balloon ascends through air because, being less dense than air, it appears in the air system as an unlike, and is by that system expelled to those regions of the atmosphere which resemble it in density: in this case, as well, the act of dissociation is an act of the air system, for, if the air could be removed, the balloon would not rise at all.

Unlikes, sufficiently free to move, often repel one another when forced into association. Zinc and lead, or zinc and bismuth, may be melted together, but they separate more or less completely during the process. Chloroform and water may be mechanically mixed, but when they are no longer shaken the two fluids part into distinct layers. If, upon oil placed in a receptacle, water be poured, the water will displace the oil; while, if mercury be added, it will displace both oil and water; the final result of the experiment—three layers occupying positions in the order of their density—being reached by acts involving both association and dissociation—association of the like parts of each layer, and dissociation of the unlike layers.

How likes are associated and unlikes dissociated may also be shown in most of the phenomena of cohesion, and especially in those wherein particles of matter assume the spherical or globular form. Where the medium is not apparent, as in the case of the sun, moon, and planets, the association of likes is alone displayed;

where the medium is more accessible to us, there is more or less suggestion of an act of dissociation by the system in which the parts become associated. Thus an atmosphere overcharged with moisture literally expels water from itself, first into fine vesicles, and later, by cumulative aggregation of these, into the drops which constitute rain; so when the vapor of water issues from the spout of a kettle, the air which it traverses condenses it into the droplets visible as steam. Water thrown upon a dusty surface; molten lead let fall from a tower in the process of shot-making; melted glass dropped into water—all these assume a more or less spherical shape under circumstances which suggest, not only cohesion of the parts, but also repulsion by the medium. The spherical shape assumed by oil dropped on water is not wholly due to cohesion of the parts of oil, but is also due in very large measure to the repulsive action of the water system itself. A still more striking illustration of these acts of simultaneous association and dissociation is yielded by mixing small quantities of water with large quantities of oil: here the water, in descending, breaks up into spherelike globules, each of which exemplifies at once cohesion of the intruding parts and repulsion by the receiving system. There is also to be added the evidence of smoke and vapor rings, the forms of which are largely determined by the action of the atmospheric system in which they are produced.

That assimilative action takes place within material systems is also to be noted. Such action is of several kinds, and includes (1) assimilation of movement, (2) assimilation of substance by diffusion, and (3) assimilation of mass or structure, the latter being divisible into (*a*) assimilation by change of form in the case of gross aggregates rudely associated, and (*b*) assimilation by changes of arrangement in the case of minute parts closely associated. The simplest form of assimilation is seen when volumes of two different gases are brought together within a closed receptacle; for, though the molecules of the two gases may originally possess different "kinetic" energy, they undergo in association a change by which the molecules of both gases come to have a like degree of the energy of movement. What is true of gases is true also of matter in each of its states: heat communicated to an aggregate is more or less rapidly distributed through it until all the parts possess, roughly speaking, like degrees or amounts of movement; a mass of metal heated in a furnace becomes gradually assimilated to the character of its surroundings; by a precisely similar process, the overheated earth radiates energy into the atmosphere. There is also the assimilative distribution of heat through liquids by means of convection currents: as the surface of the sea becomes cooled in winter, the cooler layers, grown heavier, sink, and are constantly being replaced by warmer water from below. Vertical exchanges of temperature also take place between higher and lower layers of the atmosphere, while the difference of temperature between the polar regions and the equatorial zone results in the assimilative movements of the general atmospheric circulation. As ocean currents, like the Gulf Stream of the Atlantic and the Kuro Siwo of the Pacific, carry heat from the warmer to the colder regions of the earth, so air currents arise out of those differences of heat and of barometrical pressure which it is obviously their function, as far as possible, to remove. All atmospheric movements, in fact, however local or general their character may be, are either movements of direct assimilation by which the atmosphere is seeking, so to speak, to bring all its areas into like temperature and pressure with each other, or are disturbances involved and arising indirectly out of such acts of assimilation. It is only because the work done by these movements is being constantly undone through the agency of influences, permanent and temporary, that differentiate areas of the atmosphere in every part of the globe—setting up, for example, unlikenesses of temperature and pressure between the equatorial and polar regions, between continents or islands and the surrounding oceans, or between any area of the earth's surface abnormally heated or cooled and the surrounding parts of that surface, as well as between seasonal variations in such inequalities—that we have cyclones and anticyclones, tornadoes, blizzards, land and sea breezes, mountain and valley winds, sand spouts and dust whirlwinds, as well as various periodical and more or less local disturbances all over the world. It should be added that meteorological phenomena do but illustrate the wider interchanges that take place in the ether system, since the constant distribution, as electro-magnetic disturbances, of movement differentially accumulated in material aggregates—whether such disturbances take place within purely local limits, as in circuits artificially set up, or on a universal scale, as by diffusion from solar bodies—are all cases of the distribution of movement, and therefore cases of assimilation.

The diffusion of molecules through each other is also a common form of assimilation. Gases, if brought together, permeate each other until a tolerably like constitution for every larger or smaller area of the total volume has been reached; gas distributes itself equably through liquids, as in the case of effervescing drinks; solutions of salts brought into contact gradually intermingle. A soluble solid, when introduced into a liquid, usually assumes the liquid state to the extent of the capacity of the fluid for taking it up, as in the familiar case of sugar in tea or alum in water, while the liquid itself undergoes modification by the equable distribution of the particles absorbed. The uniform hardness of "hard" water, due to the presence of bicarbonate of lime, and the uniform tenacity of solutions of soap in water, as shown in experiments with soap bubbles, both illustrate how equably substances held in solution are diffused. The evaporation of fluids into air, like the dissolution of solids in water, is in its results, at any rate, a case of assimilation to the character of the surrounding or adjacent medium; so that, the more we heat a bar of iron, the more progress does it make toward that vaporous condition in which it can easily be diffused through its environment. The mixing of metals also illustrates diffusion; for, whether it results in amalgams or alloys, whether the mixture be a merely mechanical association of the parts brought together or a chemical combination of those parts, the fact remains that for given areas, which may be large or small, the average degree of diffusion is the same. This is shown with especial clearness in those compounds of carbon and manganese with iron needed for a variety of industrial purposes, since such compounds would have none of their present commercial value were it not for the uniform diffusion through the iron of the substance employed to modify it.

Here, then, our treatment of the subject must draw to a close. While necessarily brief, it has been complete enough to reveal a process far reaching in its scope and of cosmical significance. We have seen how like units everywhere tend to be associated and unlikes dissociated; how unlikes, held in forcible association, tend to be more or less profoundly assimilated to one another; and how disturbances of prevailing uniformity tend to be equably distributed through the several media in which they occur. But we have also noted that the power impelling to these multifarious acts of assimilation, to these movements of association and dissociation, is not the power of the units themselves, but the power of the system to which they immediately belong; and we are thus warned of the important bearing which our law has upon two problems of the utmost generality in physics—namely, the problems of chemical affinity and gravitation. It is true that we have as yet no formula for explaining these manifestations of power by a single principle; that we do not yet know the real structure of ether; and that there is still needed a definite account of gravitation as an intelligible mechanical process. Nevertheless, the causal connection of both gravitative and chemical actions with the ether system is already obvious to physicists. That the power which accomplishes these actions does not reside in matter alone, but resides also in the ether system—is, in fact, a function of that system regarded as including both ether and matter—seems to be increasingly pointed to by the trend of recent physical research. Basing our final conjecture, therefore, on generalization from a wide array of facts, it may not be premature to look to the ether system, not only for an illustration on the widest scale of the law of assimilation, but also for the ultimate source of all the phenomena in which the operation of that law can be traced. For whether the ether be continuous or granular, it clearly satisfies, by its very nature and uniformity, the demand that likes shall be associated, the while that, by the actions known as chemical and gravitative, it also fulfills the requirement that there shall be dissociation of unlikes. Lacking, as we do, all explanation of the actual mechanism of gravitation, we may none the less find its form suggested to us when we describe it as an act of dissociation by the ether system. And if this view be tenable, we should be justified in regarding the ether as primarily embodying the power manifested in the multifarious changes which we call evolution.

NATURAL FEATURES OF VENEZUELA.

By FREDERIK A. FERNALD.

THE first part of the American mainland seen by Columbus was Venezuela. On his third voyage, in 1498, he bore farther to the south than before, and had become convinced that he should not meet with any land on that course when his lookout descried three hilltops in the southwest. The island from which these peaks arose Columbus appropriately named Trinidad (the Trinity). Sailing on, he entered the chief mouth of the Orinoco and then skirted the island-fringed coast on his way to Haiti. The country is said to owe its name to Ojedo, who, on entering Lake Maracaibo the following year, noticed one of the Indian villages of pile dwellings on its shore. "Why, here," he said, "is a little Venice" (Venezuela), and this name became the designation of the whole region round about.

The great curve of the Orinoco divides the area of Venezuela into two unequal parts, the larger of which, lying to the north and west of the river, contains the more populous districts. Seven of the eight States of the republic lie wholly in this part, while most of the region south of the river and along its upper course is divided into Territories. The surface of the country is much diversified. In the extreme northwest, around the gulf and lake of Maracaibo, it is level and well watered. East of this tract a branch of the Andes crosses the country diagonally. Five of its peaks extend above the snow line, the highest, Concha, rising to fifteen thousand four hundred feet above the sea—between the height of Mount Whitney, in California, and that of Mont Blanc. From this peak descends a small glacier which

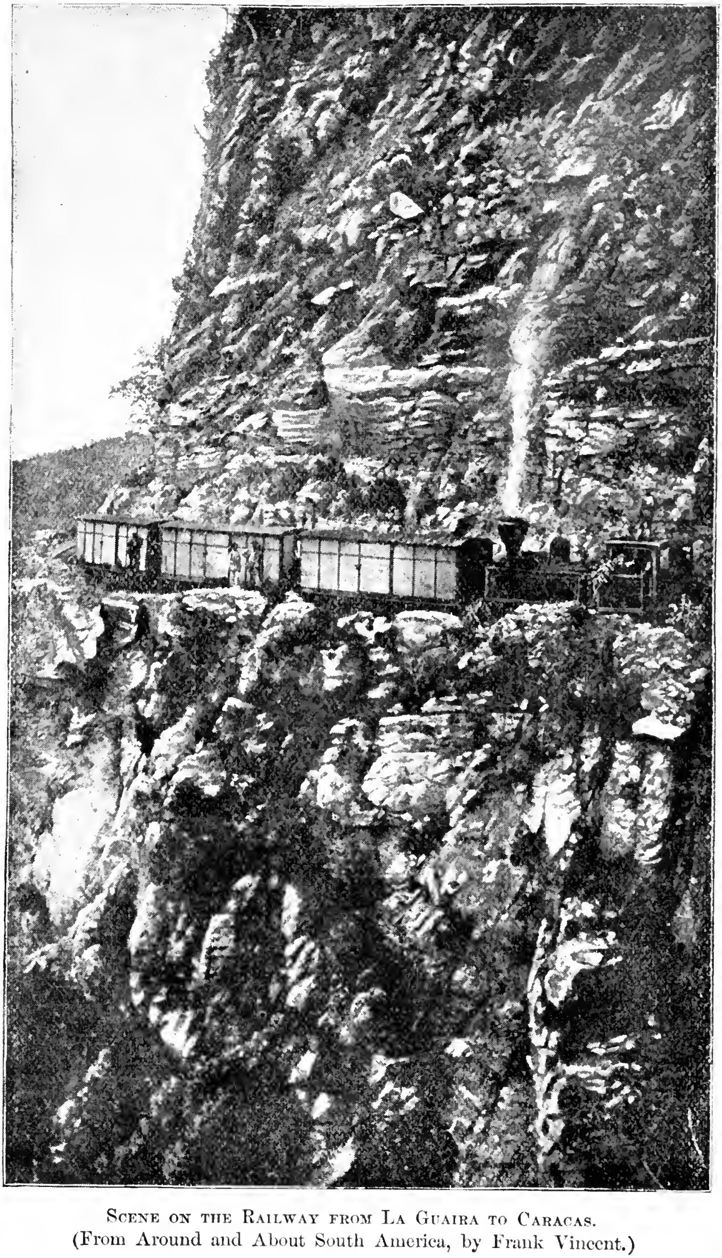
LAKE DWELLINGS OF SANTA ROSA, NEAR MARACAIBO.

supplies the neighboring city of Merida with ice. Low chains also stretch along the coast as far as the delta of the Orinoco. These mountains for the most part run in parallel ranges, between which lie elevated valleys. In these valleys are most of the cultivated lands of the country. Here also are the chief cities, although many of the seaports are of considerable size. Carácas, the capital, is nine miles back from the coast, at an elevation of three thousand feet, but the railroad which runs to it from La Guaira is obliged to take a tortuous way of twenty-three miles, passing through many cuts and tunnels. There are no stations along the route, and the country is not cultivated except near the termini. In many places the track winds around a mountain on the verge of a sheer descent of hundreds of feet. Carácas lies in one of the mountain valleys, which slopes toward the south and is traversed by the Guaire River. Its temperature is equable; the mean of its coldest month, January, being 68° F., and of its hottest month, May, being 93°. Rain falls abundantly in April, May, and June, though not so constantly as in other tropical regions. The rest of the year is rather dry.

Between the mountains and the Orinoco stretch the broad llanos or grassy and partly tree-covered plains which form the basin of the great river on the northwestern side. The extensive, thinly populated territory south and east of the Orinoco is made up of alternating hills and valleys, and is heavily wooded. This region has some mountains of moderate elevation, among which is Roraima, of much interest to explorers, standing on (or near) the boundary of British Guiana. Its tablelike upper portion, a mass of pink sandstone rising sheer sixteen hundred feet, was first ascended in 1884 by Im Thurn and Perkins after many unsuccessful attempts had been made. "Obviously Roraima was formerly," says Reclus, "part of an elevated table land, which has been gradually isolated by a process of cleavage and erosive action. It survives to present times as a superb witness to former geological conditions. Streams have their rise on the upper platform, over the edge of which they fall in cascades, draping the pink escarpments as with lace veils of their silvery spray. 'O Roraima, red mountain, wrapped in clouds, fruitful mother of streams!' sing the Arecuna Indians encamped in the surrounding valleys."

Venezuela has no volcanoes, but traces of ancient eruptions are to be found among the highlands. Certain flames often seen hovering over the ground were formerly thought to be connected with subterranean fires, but this idea has been dispelled by advancing knowledge. "This curious phenomenon," says Reclus in his description of it, "has been noticed on the slopes of Duida, on Mount Cuchivano, in the province of Cumaná, and in the marshy valley of the Catatumbo and of other streams flowing to Lake

Maracaibo, where it is known as the 'lighthouse' or 'lantern,' because it indicates to mariners the position of the land. Flames



SCENE ON THE RAILWAY FROM LA GUAIRA TO CARACAS.
(From Around and About South America, by Frank Vincent.)

are also frequently seen flitting about amid the grasses of the llanos without burning them. These are 'the fire of the tyrant

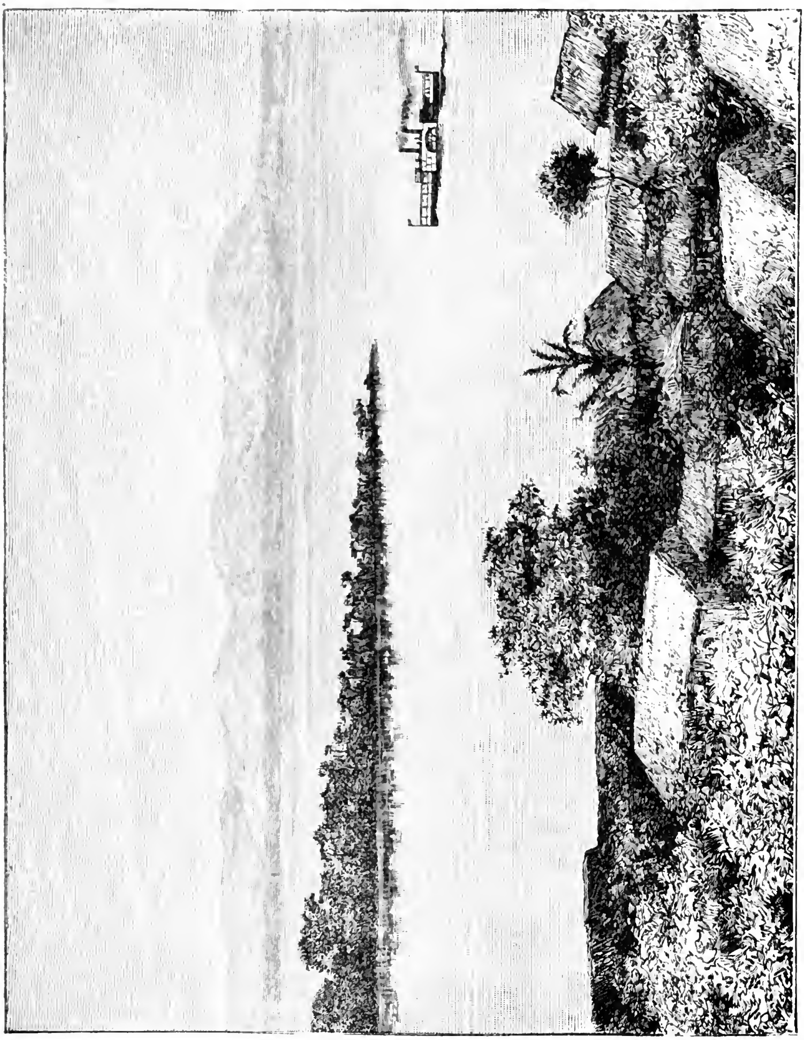
Aguirre,' say the natives, who, after more than three hundred years, are still haunted by the legends associated with this sixteenth-century corsair. The vapors rising from certain asphalt lakes similar to that of Trinidad are also said at times to be subject to spontaneous combustion." It might have been well if there had been a few active volcanoes in the country during recent times. Venezuela has suffered some terrible earthquakes, and on the theory that these disturbances are due to pent-up underground forces, the existence of natural vents would have prevented them. In 1550 an earthquake occurred, accompanied by a tidal wave, which swept away the settlement of Cumaná, and the same place suffered severely in 1766, after which the ground continued to tremble for fifteen months. One of the most destructive shocks, by which Carácas was laid in ruins with a loss of twelve thousand lives, occurred in 1812, during the war for independence. "The indirect consequences of this disaster," says Reclus, "were even more deplorable than the catastrophe itself. It certainly prolonged the ruinous war probably for years, and greatly intensified its horrors. The event having taken place on Holy Thursday, the anniversary of the declaration of independence, the priests, nearly all of whom belonged to the Spanish party, declared that the hand of God had wrought the ruin in order to crush the revolution." Thousands of superstitious revolutionists, including Miranda, the general in chief, laid down their arms, and the Spaniards secured fortified places and other advantages that were recovered only at great cost.

In a country so much upheaved a variety of minerals will naturally be found accessible. There are rich deposits of gold in the region east of the Orinoco bordering on British Guiana, which accounts for the ownership of part of that territory having been in dispute for half a century. The famous mine El Callao has yielded over three million dollars a year. Its upper levels have been pretty well worked out, so that its present output is secured by deep mining operations. As an export, gold ranks next after coffee and cacao. Considerable copper ore is exported, mainly the product of the Aroa mines in the Maritime Alps, near the northern coast. Lead and tin are also found. If Venezuela owned all the islands that lie off its coast it would have an important source of mineral wealth in the famous asphalt lake, La Brea, on Trinidad. But Trinidad and Tobago had been taken from Spain by Great Britain, while Curaçoa, Buen Aire, and Oruba had been appropriated by the Dutch, before Venezuela secured its independence. The mainland, however, is by no means devoid of bituminous deposits—asphalt, petroleum, jet, and bituminous coal being obtained in various localities. Other useful minerals found are sulphur, kaolin, and phosphate rock. Margarita, the largest of the islands belonging to Venezuela, is the seat of a pearl industry that was once important but has seriously declined. Its fisheries are flourishing, but these, together with the scant agricultural resources of the island, do not suffice to support the native population, which increases rapidly. Consequently, large numbers of the men emigrate to the mainland. The climate of the island is salubrious and attracts consumptive patients from great distances. An excellent quality of salt is produced on all these islands and along the coast of the mainland. From a lichen growing on the rocks of Orchilla is extracted the violet dye of that name.

While in the United States the Indians are an almost unregarded remnant, the aborigines of Venezuela form a large element of the less than two and a half million population. The pure whites, mainly of Spanish origin, but including immigrants from the chief trading countries, are less than two per cent of the whole. The pure aborigines are estimated at about one seventh, and there are some negroes, as African slavery existed here up to 1854. Parts of these races have intermingled in various ways, producing mestizoes, mulattoes, zambos, and mixtures of other degrees. Four fifths of the full-blooded Indians are classed as civilized, and are engaged in agriculture, or as laborers in the other occupations carried on by the whites.

The climate of different parts of Venezuela varies greatly with elevation, aspect, and soil. The highlands are in the main temperate and salubrious, while the low parts of the coast, the lands about Lake Maracaibo, the delta of the Orinoco, and parts of the plains are among the hottest regions in South America. During the rainy season, from April to October, many of these low lands are flooded, giving rise to swamp fevers and dysentery. The country does not suffer so much from yellow fever as might be expected.

The downpour of the rainy season is drained away by over a thousand rivers, many of which become dry or dwindle to chains of lagoons in the dry months. The Orinoco is the great artery of the country and is destined to become of vast importance as a channel of traffic when the region through which it flows is more thickly settled. Steamers enter it from the sea by seven of its fifty mouths, and run to Bolivar, three hundred and sixty miles up the river. Smaller steamboats can ascend as far as the Atures rapids, nearly a thousand miles. Its chief branch, the Apure, gives access to a region far west of the main stream, and, as some four hundred of its other affluents are said to be navigable, it will be seen that a vast extent of country is reached by the Orinoco system. In this respect, which is the true measure of a river's importance, the Orinoco ranks fifth on the American continent, or fourth, if we disregard the artificial helps with which the St. Lawrence has been provided. Just below the great bend of the river, two hundred and fifty miles above Bolivar, is the smaller town of Caicara, which is also an important trading station. Here manufactured goods are exchanged for the products of the forests and plains. Mr. Frank Vincent thus picturesquely describes the voyage up the great river:



THE ORINOCO AT CAICARA.

"On leaving Port-of-Spain we headed at once toward the southwest and the Serpent's Mouth, out of which we safely passed and entered that branch, or rather that one of the many great mouths of the Orinoco styled the Macareo River, which was at first about half a mile in width, its shores densely covered with aquatic plants and forests. Running nearly parallel to this river is another called the Casquina. Both are navigable for steamers drawing less than ten feet; those requiring deeper water than this must use the southern and main branch of the Orinoco. This one is naturally always preferred by ships. The water of the river is a thick yellow, and the current is as swift as four or five miles an hour. As we went on all day, the Macareo narrowed to about one hundred feet, but was very deep. The banks appeared quite uninhabited until we reached the Orinoco proper. First we passed two very small Indian villages. The houses consisted merely of grass roofs and wooden pillars, being quite open on all sides, and disclosing numbers of hammocks each containing a nearly nude Indian. Near by were fields of mandioc and bananas. On the beach small pirogues were drawn up. At one place some of the boys paddled out to us, and in wanton sport threw on board many sticks of sugar cane. These Indians had stout, strong bodies and broad and good-natured physiognomies, with their hair 'banged' across the forehead and left long at the sides.

"In its vast size, and large and numerous islands, the Orinoco is not unlike the Amazon, but the banks differ from the Amazon's chiefly in their greater profusion of lianas, the forests being not only decked but half covered with them. After the Indian villages, we passed, upon the Macareo, long lines of widely separated mud huts, belonging to negroes and low-class creoles. All these people wore clothes, had a variety of cooking utensils, and better dwellings than the pure Indians. Near where the Macareo enters the main branch of the Orinoco is a small town called Barrancas—simply two short streets of dilapidated mud huts. We stopped only ten minutes to send our boat ashore with the mail, and to bring on board two or three passengers. Some very large islands invite the view hereabout, and the distant ranges of the Imataca Mountains, ridge behind ridge, look blue and picturesque. The current of the Orinoco does not carry down the great number of grassy islands and tree trunks that one sees always on the Amazon. . . . A fine spectacle at night were the many great prairie fires, the whole sky being aglow with them. A certain fire would suddenly appear, tearing along at a terrific rate, with a blinding glare and long trail of smoke, recalling a night express train a thousand times magnified. The Venezuelans are accustomed to burn their savannas once a year. We had already left the regions of the pristine wilderness, and were now among the great savannas, or natural meadows of the central plains of Venezuela. The delta is the only thickly wooded part of the Orinoco, the upper portion of the river being bounded by the llanos, or great grassy and almost treeless plains."

Near the head waters of the Orinoco is its junction with the Cassiquiare, by which it has a navigable connection with a branch of the Amazon. The stream forming this curious bond between two great river systems lies in a valley which is prolonged south-

Vegetable Products of Venezuela.
(From Around and About South America, by Frank Vincent.)

ward by that of another river. About one third of the water that it sends down to the Amazon is obtained from the Orinoco.

The chief wealth of Venezuela consists in products of the soil, natural and cultivated. There are many coffee and cacao plantations in the mountain valleys near the coast, and coffee to the value of fourteen million dollars is exported yearly, which is double the value of all other exports. Among the other cultivated articles are manioc, sugar, cocoanuts, maize (Indian corn), tobacco, wheat, cotton, indigo, sweet potatoes, and melons. Canoes which ascend the upper Orinoco and its branches to the forested region of the southeast bring down rubber, vanilla and tonka beans, fruits, gums, and drugs. The forests are also rich in cabinet and dye woods, useful fibers, from which cordage and hammocks are made, and a variety of other products. The deadly arrow poison called *urari* by the natives is made in the district south of the Orinoco.

The central plains of the republic form a vast grazing range which supports millions of horned cattle, horses, and asses. These herds are subject to great vicissitudes; they were reduced to a small fraction of their normal size by the war for independence, and again by the civil wars ending in 1863, while vast numbers of horses and asses were destroyed by a murrain which broke out in 1843. Their numbers have, however, been restored, and the stock has been improved recently. Sheep and goats are bred in the mountainous district of the northwest, whence goatskins (known as Curaçoa kid) are largely exported.

The animal life of the forest is varied and abundant. The howling ape makes his presence known morning and evening to all within earshot, and fifteen other simians are met with. The representatives of the cat tribe include the jaguar, puma, and ocelot. There are also harmless bears living on fish and honey, the ant-eater, the cavy, the cuchi-cuchi, the tapir, various species of deer, and the slothful sloth, which, as Reclus says, "after devouring the foliage of a cecropia, utters long, plaintive cries at having to climb another." Myriads of birds of brilliant plumage vie with the tropical flowers to enliven the somberness of the forest. The waterfowl are no less numerous; it is said that a regiment, encamped near the confluence of the Apure River with the Orinoco, lived for a week on wild duck without appreciably reducing their numbers. One of the curiosities of Venezuelan bird life is the *guacharo*, a night-flying fruit-eater which inhabits caves in certain of the coast districts. Its fat yields a much-prized table oil.

Both the salt and fresh waters of the country abound in fish. Sixty-pound turtles are abundant in the large rivers, but will not long continue so unless the taking of their eggs is limited. Three species of alligators are found in the rivers and lakes, while the manatee and porpoise enter the Orinoco from the ocean. The electric eel also inhabits Venezuelan waters. Certain streams of the Apure district are carefully avoided by bathers, less through fear of the alligators than of these eels and other electric creatures, and of the ferocious fishes called caribs, after the once-dreaded tribe of cannibals. The last so abound that some creeks are said to contain "more caribs than water."

Noxious creatures are not wanting on land. Many snakes glide through the herbage, especially on the plains, among them being the anaconda, the boa constrictor, and the striped rattlesnake. The swampy islands of the Orinoco delta swarm with mosquitoes, and at the Maipures rapids, where "the wind never blows," the air sometimes seems to be full of them. Locusts are often a great plague to the peasants.

Venezuela is a country of great resources, with some obstacles in the way of utilizing them. Not all of its known useful minerals have been mentioned here, and a thorough geological survey, which the country has never had, would doubtless largely extend the list. Nor are its forest products by any means completely known. The future prosperity of the land requires self-control and energy on the part of its citizens, with regulations to induce the foreigners who go there to become Venezuelans instead of withdrawing a portion of its wealth to be enjoyed after returning whence they came.

SUGGESTIBILITY, AUTOMATISM, AND KINDRED PHENOMENA.

By Prof. WILLIAM ROMAINE NEWBOLD.

III. DISORDINATION AND INCOORDINATION.

IN my two former papers I have sketched the conception of any state of consciousness as a coordination of mental elements which might conceivably exist independently, and have endeavored to bring it into relation with our conception of the physical basis of consciousness as a similarly coordinated system of forces to certain elements of which the various discernible elements of consciousness in some sense correspond; and I have drawn from this fundamental conception two inferences; (1) That we must think and reason about the mental thing as we would about its physical basis; we must therefore ascribe to it dynamic properties which will in the long run be found correspondent to the laws of brain-functioning. (2) It is conceivable that a cortical process might exist without coalescing with any such system as underlies a personal consciousness, and that a mental state might exist in connection with the process outside any consciousness whatever. We can not, however, logically stop at this point. If a single cortical process and its concomitant mental state may be dissociated from others, there appears no *a priori* reason why many may not be simultaneously dissociated, nor yet why the entire system may not be dissolved and reduced to a chaotic mass of physical processes and concomitant mental states. For such a supposititious condition I would propose the term *disordination*, the etymological opposite of coordination. We may well believe that if a disordinated state occurred it would not be remembered. Memory depends, from the psychological point of view, upon the law of association, and from the physiological upon the fact that between the cortical processes underlying the present state of consciousness and the traces left in the cortex by those accompanying the state remembered, there is a continuous system of traces, representing actual processes that discharged successively into one another. In a disordinated state there is no such continuous system and consequently no memory. But it is also conceivable that, from a present state succeeding a state of disordination, a single devious thread of traces, so to speak, might lead us back a little way into the maze of confusion which lies behind. As I shall later show, our memory of a dream depends upon such a line of continuous discharge.

In a disordinated state the dissociated elements would not of course be what they would be in a well coordinated state. In the latter the characteristics of each element are largely determined by the relation which it bears to other elements of the system with which it is interwoven. Freed from the restrictions and incitements of the others, each process would tend to work out its own proper results in a very different way from that which it would otherwise have been compelled to follow.

Furthermore, it is conceivable that co-ordination might be defective without being absolutely lacking. I would term this *incoördination*. It might occur in either of two forms, or in both at once. The coordinated system underlying the upper consciousness might consist of relatively few elements as compared with those of other persons, there being a larger subconscious field. The upper consciousness would then habitually be narrow; the individual would be unable to grasp many considerations at once and would be easily abstracted. Or, the elements actually coordinated might be defectively coordinated. The consciousness would tend to be confused, the individual would see dimly things which would persistently refuse to get clear, and would be in general what we call "muddle-headed." And, as I have suggested, many are both muddle-headed and narrow-minded.

It is evident that the distinction between disordination and incoordination, is merely a question of degree, and it will frequently be difficult to assign any given concrete case to either the one class or the other.

So much for the logical analysis of the hypothesis we are considering and its implications. If we turn now to the facts and try to apply these principles to them we shall find, I think, that many phenomena for which our current psychology can not give any explanation, become, if not entirely intelligible, at least more comprehensible than they were.

A familiar form of disordination is found in states of which sleep may be regarded as the type. Perfect sleep is not a disordinated state. In perfect sleep we must suppose that all mental life is absolutely quenched; not even isolated states remain. But most sleep is not perfect, and it is probable that some cortical activity persists throughout. When we would go to sleep we withdraw ourselves as much as possible from the storm of stimuli that is always assailing our sense-organs, thus cutting off all vivid sensations with their complex and far-reaching associations. Little by little the activities that remain—i. e., those that lie at the foundation of our ideational life—become quiescent. Then the laggards among them, freed from their usual restraints, assume distorted forms. Isolated scenes, dislocated scraps of sentences, vague thoughts, flit through the mind's rapidly emptying chambers, coalescing and combining with one another in fashions grotesque and unpredictable; from moment to moment they become fewer, and then—oblivion. Sometimes on awaking we remember strange experiences had in sleep—what we term dreams. What are they but dislocated systems of mental elements, sometimes springing out of elements which have persisted through the period of disruption, as when we dream of things with which our thoughts have been busied through the day, sometimes springing out of sensations occasioned by stimuli falling upon our sense-organs. Yet in every case dreams are developed under associative laws analogous to those of waking life, although very different in the details of their operation. Take the case M. Maury reports. He got a friend to tickle his face with a feather while he was asleep, and dreamed that he was being tortured by having a mask of pitch applied to his face and then torn forcibly away, taking with it the skin and flesh. Had he been awake, the stimulus would have caused a sensation of tickling; by associative reasoning he would have instantly divined its cause, and would have thought of the movements suitable to stop it. In sleep the sensation developed far more than it would have done in waking life, and was therefore magnified into an intense tearing sensation, and for this magnified state by similar associative reasoning a suitable cause was found. Had he been awake, even if the sensation had succeeded in developing, the least suggestion of torture as an explanation would have been quenched by a mass of inconsistent ideas. In sleep the grotesque notion finds no obstacle to its acceptance. Who has not dreamed of himself as being in some public place and then suddenly become aware that he is naked and exposed to the gaze of the crowd? What is this but the coalescence of the sensations arising from his actual state as he lies in bed with the thought systems representing his imaginary experiences?

If one puts a man asleep and all the while keeps talking to him, touching him and otherwise keeping him aware of one's presence, one gets in many cases a peculiar type of sleep known as a hypnotic state. We may suppose that all the elements composing the man's normal consciousness are disordinated and for the most part extinguished, but the one group which he calls the consciousness of the presence of his friend Smith who is hypnotizing him still remains. That has no chance to go to sleep, as it were, and consequently in his disordinated brain all processes originated by that one still active group tend to work out their normal results with a precision and certainty unknown in waking life. He is either totally dead to all other stimuli, or can be made aware of them only with difficulty. Frequently the attempt to force such a stimulus upon him is followed by great nervous excitement, somewhat like that which usually follows a great shock or surprise. This is, I think, the true character of the suggestibility found in hypnotic states and of the so-called phenomenon of *rapport*.

Another common form of disordination is that which accompanies a "nerve storm." We know that if a mass of heated and moisture-laden air begins to escape into the upper and colder regions of the atmosphere at any point, the upgoing current, no matter how slender at the outset, may increase in volume and velocity until it develops into a vast storm center hundreds of miles in extent. So also does it appear that a relatively small and localized nerve explosion is capable, under conditions which we do not at all understand, of propagating itself irregularly through the nervous system, ignoring the usual association paths, until the entire nervous mechanism is exhausted. Such a progressive, periodic disturbance is said to be epileptiform. The causes of the various forms of epilepsy are often unknown. Some, however, are due to mechanical irritation of the cortex, as by a depression of the skull, an extravasation of blood, disease of the membranes, or the growth of a tumor on the cortex. Others are produced by some continuous and intense peripheral irritation, as that springing from an unhealed wound, an ingrown nail, etc. Others still are due to the memory of some great shock or fright, and we may suppose that the subconscious memory of that experience is capable of becoming from time to time strong enough to disturb the coordination of the upper consciousness. Indeed, most of these causes may produce chronic incoordination without going so far as to destroy coordination altogether. Now, all these cases may be generalized under one conception. In my first article I compared the system of activities underlying consciousness to the system of forces upon which the existence of the soap bubble depends. We all know that the introduction of any new and intense factor into that system, as when one pricks the bubble with a dry pin, instantly destroys it. It would appear that much the same is true of the system of cortical activities.

The precise effect of the nerve storm upon consciousness, however, varies with the region upon which its force is chiefly spent. In the so-called masked epilepsies or periodic insanities consciousness is directly affected, and with greater or less severity, but the complex disturbances so produced can not be reduced to definite classes. New elements are introduced, old elements are destroyed, or weakened or intensified, as the case may be, and the character temporarily modified. Whenever the disturbance is very great, however, memory is more or less impaired, as our theory would lead us to expect. In the true epilepsies the violence of the storm is expended upon the motor region, producing movements, sometimes of a purposive character and sometimes not. Whenever the storm is at all severe, consciousness is disordinated and no memory remains. After the storm is over the patient sinks into a state of true unconsciousness, and often he recovers from it but slowly, passing through stages of automatism as the elements of consciousness slowly find one another and are built up into a system. If you question him after his recovery, he says he was unconscious the whole time. But we have reason for believing that during the period of convulsion mental states—such as muscular sensations, sensations of pain, and probably horrible dreams and nightmares—really existed, while in the comatose state there was nothing of the kind. The first was a state of disordination; the second, of true unconsciousness.

The symptoms of incoordination are, as one would expect, of infinite variety and incapable of classification. It is known in medicine as hysteria, and I can say but little of it here.

In its simpler forms there seems to be a general inability to think of much at once. Consequently, what is in consciousness is very much there, to use a colloquial phrase, and tends to work out its own results. The patient is easily abstracted, fails to notice things, is narrow and prejudiced. In practical matters he has bad judgment, for good judgment implies the ability to weigh many considerations at once. It is difficult to convince him of a new point, but, once convinced, there is no length to which he will not go in its application. At any given time he is a man of one idea, given to a fad, and very apt to be zealous in reform movements of all kinds. He can rarely discriminate the probable from the possible, and consequently can never think of a disaster without fearing it will come to pass. This is especially true of his own health. If he reads a medical book or a patent-medicine advertisement, he discovers in himself the symptoms of most of the diseases of which he has been reading. In a person of this temperament any great shock is apt to bring on a state of disordination with concomitant derangement of the motor coordination—what we vulgarly call a "fit of hysterics."

In more serious cases the indisposition to notice things goes further and often culminates in absolute inability to perceive what a normal person would. Entire systems of sensations may be wholly or partly lost. Touch is the sensation most frequently lost in this way, although sight and hearing sometimes go too. Very frequently sensation is lost on one side of the body only. The control exerted by the idea trains over the movements of the body is also partially or wholly lost and the patient is paralyzed. Hysterical losses of this kind are often cured by suggestion, or by any means in which the patient has faith. In the most extreme cases the patient passes hours, days, months, or even years in a state of apparent lethargy, which is probably a chronic disordination.

With the retrenchment of the field of consciousness goes hand in hand a corresponding increase in the subconscious field, and the elements dissociated from the upper consciousness frequently appear to become coordinated with one another, forming subconscious systems analogous to the upper system. They are then sometimes manifested to the patient himself by being obtruded upon the upper consciousness in the form of inner voices, hallucinations of sight or hearing, etc., or to other persons by means of movements. Occasionally they go so far as to produce writing in which the upper consciousness of the patient has no part. Hence arises for outsiders the appearance of two minds existing in one body, while to the patient his body seems to be running like a machine, without his cooperation. All such phenomena may be termed automatic, and upon them the popular belief in "spirit control" and "demoniacal possession" undoubtedly largely depends. When automatic phenomena are numerous and complex, the upper consciousness of the patient is usually profoundly affected. He sinks into a dreamy state, and often loses "consciousness"—i. e., memory—altogether. "Mediumistic trance" may then be regarded as a form of disordination analogous to that of the hysterical crisis.

In some of these unfortunates the upper consciousness is not only of very narrow range and liable to frequent disordination, but is of such unstable composition that, after being disordinated, it is reconstructed out of a quite different set of elements. Mr. F. W. H. Myers has proposed to call this phenomenon an "allotropic crystallization" of the elements of mind, which seems to me a highly appropriate simile. The patient can then scarcely be said to have any permanent self at all. He is, as it were, broken to pieces and rebuilt out of different memories, desires, and aptitudes at every hysterical crisis. It seems as if his body were successively possessed by totally different persons. But we have no reason for believing that the different persons all coexist. Probably the emergence of one is only made possible by the destruction of another. In some of the extreme forms of hysteria it is possible to take advantage of this principle to reconstruct the lost normal individual. Pierre Janet has taken a hysterical woman who had lost many of her memories and sensations, and to some degree her power of movement; disordinating the upper consciousness by hypnotizing her, he has grasped, as it were, by suggestion the lost mental elements, restored them to the upper consciousness, and made her for the time being quite normal. But, unfortunately, the enlarged upper consciousness seems of very unstable composition, and the patient soon sinks into trance and awakens in her former state.

I have briefly outlined this conception of consciousness as a system of elements capable of disintegration and of various novel recombinations. And let me repeat what I have already said, that although I have preferred, for the sake of brevity, to develop it deductively from certain fundamental hypotheses, it has been attained by the opposite process from a study of facts. Confessedly it is as yet only a theory, and will doubtless be essentially modified before being accepted as the foundation of the science of psychology. In its present form I can not myself regard it as more than a good working hypothesis. But it is something to have even a good working hypothesis in a field in which the constructive conceptions of current psychology prove absolutely useless.

A GREAT nebula has been discovered by Prof. Barnard in the constellation Scorpio, including Antares and a region extending two or three degrees southward. It is described as vast and magnificent, intricate in shape, and gathered in cloudlike forms. Prof. Barnard pronounces it one of the finest nebulæ in the sky, and says that, as it involves so many of the bright stars of the region, it would imply that they are essentially at the same distance from us.

THE STAMPING OUT OF CRIME.

By Dr. NATHAN OPPENHEIM.

IT is only a short time since civilized nations abolished slavery, and already we look back with wonder at our own and other countries, and are barely able to realize that the world could have borne such an unspeakable institution—that it could have steadily progressed while weighted with the breaking load of such a burden. Nevertheless, for thousands of years, and even at times of exquisite culture, men thought that slavery was inevitable, or even necessary, or at any rate that it could never be done away with. Now there is an equal steadfastness of opinion in the opposite direction. We regard with horror the social condition which justified bondage; we are astounded that we could have lived in such an atmosphere.

There are other similar examples in the history of civilization. Until the present century drunkenness was almost universal, and the gentleman who did not drink himself under the table was thought at best to be a poor sort of man. Our present attitude in the matter is just as great a revolution as our change in regard to slavery. Likewise is there an equally great difference so far as the interests of society are concerned. Again, until the middle of this century there was a constant succession of wars among the principal nations; but within a few years conditions have so changed that the man who dared to precipitate a war would be utterly overwhelmed with universal abhorrence.

If we look into the future, we may see as great a change, which is beginning to assert itself in regard to the necessity of crime. Indeed, the above analogies are well carried out, from the fact that so many people at present think crime is inevitable—that because society has always sweated under this burden it follows that the burden must ever be carried. On the contrary, because society has always been oppressed with crime there is good reason to suppose that changed conditions must alter the present facts, and that we may look for a season when crime as a constant and unvarying social element will have ceased to exist; when it will show itself in minor and individual cases, as drunkenness is beginning to do, as plagues and epidemics are beginning to do.

One of the best indications for hope is the growing effort to study crime accurately; not merely to regard it as an excuse for confining lawbreakers in self-infecting herds, where they may undisturbed pollute one another, but, on the other hand, to seek for the causes of crime, to ascertain all its concomitant conditions, to recognize and classify the criminal in sociological, psychological ways—in the ways of anatomy and physiology. The recent congresses for this object in Paris, Rome, and Brussels have opened a new world of information, have shown how misty have been our ideas on the subject, how primitive our methods have been and are, and what little hope for the future lies in a continuance of them.

This much, at least, we have learned: that the criminal forms a class by himself, no matter whether he is born so or grows into vice; that not only in his acts but likewise in mind and body does he vary from the healthy normal. For his tendency, as that of all organic life, is to reproduce his kind. This fact should be regarded as a rule that is as widely applicable and as unvarying as any law of biology. It can not be otherwise, for every child is a summing up and a manifestation of the traits of his ancestors. And so, in spite of our present efforts, each confirmed lawbreaker becomes an ever-fruitful fountain for wrong—a moral plague spot—the limits to whose contagion are bounded only by the amount of material that can be contaminated. The most superficial glance will show how true this is, for if it were otherwise one would rightly suppose that the vast efforts for social amelioration throughout society must surely result in an increase of the better and a decrease of the worse elements. But as a matter of fact this is not the case. We spend tremendous amounts of time and money and effort in the attempt to eliminate the need of crime; we strive to the last extent to do away with destitution, unsanitary conditions, ignorance, and depressing moral influences, and undoubtedly these efforts have accomplished much good. But in spite of all this, in spite of aid societies for discharged convicts, in spite of educational possibilities that are as free as air, in spite of college settlements, protecting associations for children, reformatories, and lavish charities of all kinds—in a word, in spite of vastly improved social surroundings—the criminal remains as he has always been. Crime does not lessen, but on the contrary increases with the growth of our cities, or even increases beyond the proportion which we should naturally ascribe to it.

The strange thing about all this is that the development in crime does not necessarily depend for its beginning and growth upon the elements which are popularly held responsible. Many people believe that with the wider diffusion of knowledge wrongdoing must necessarily shrink away—that mental enlightenment and moral darkness are incompatible. But this is merely a supposition, for the most part based on our admiration for education. And, as a matter of fact, concrete examples constantly remind us that the educated person, if wrongly minded, does not as the result of his mental training become a law-abiding citizen, but rather becomes a dangerous and capable criminal. Moreover, this is true not only of individuals, but also of masses as well. We have to prove it the statistics of Dr. Ogle, in regard to the English population at a time of a steady increase of crime: "Eighty-five per cent of the population were able to read and write in the years 1881–'84, and as this represents an increase of ten per cent. since the passing of the Elementary Education Act, it is probably not far from the mark to say that at the present time almost ninety per cent of the English population can read and write. In other words, only ten per cent of the population is wholly ignorant." In spite of this general diffusion of knowledge, in spite of compulsory education in the most critical and formative years of childhood, there was no decrease, but on the contrary an increase of crime.

Again, it has been conclusively proved that destitution, that specter which frightens the hearts of men, which covers and obscures with its sodden wings every wrongdoing in human life, is not in any way the real cause of crime; it is true that often it is the excuse. But it is only the excuse, and even in that capacity it serves for the want of something better. However, relying upon this excuse, one would naturally think that men with the greatest burdens would be the most liable to lawbreaking, and that times of profound destitution would be those most deeply marked with crime. As a matter of fact, both of these suppositions are false, so that we find criminals, as a rule, to be those persons having almost no responsible burdens, and, strangest of all, the times of prosperity show the greatest flourishing of crime. Therefore, Morrison, a reliable writer, says: "It is a melancholy fact that the moment wages begin to rise, the statistics of crime almost immediately follow suit, and at no period are there more offenses of all kinds against the person than when prosperity is at its height." Again: "It is found that the stress of economic conditions has very little to do with making these unhappy beings what they are; on the contrary, it is in periods of prosperity that they sink to the lowest depths."

In like manner it can be fully and plainly proved that the other fortuitous and external conditions which are usually blamed for the wrongdoing in the world are either quite innocent or merely accidental. Thus, climate is said by some to be a guilty factor; but we all know how easy it is to show that there is no part of the world untainted. Seasons are responsible, say others. Here, again, a strange fact confronts us: for it is in the pleasantest seasons of the year, when people have least in Nature to contend with, when they are most abroad and mingling together, that crime is commonest. Some well-intentioned men say that certain foods, especially "strong" and animal foods, so inflame the tendency to viciousness that evil instincts flare up, and as a result we have the criminal. It is quite unnecessary to spend time in exposing this fallacy in physiology; we need only refer to the Italians, whose food is very largely vegetable, and whose percentage of crime is among the greatest. The native inhabitants in India are another case in point; for their diet is likewise almost entirely a vegetable one, and yet, if it were not for the interference of the carnivorous English, they would even now be addicted to the almost universal practice of infanticide. So also is it that social rank, while setting metes and bounds in every other direction, fades away in the domain of evil. The criminal may be high or low, he still is the criminal; and, reasoned about broadly, there are as many offenses among the socially exalted as the socially debased.

Thus from every side we are driven away from the fortuitous, the occasional, the accidental as the controlling cause. We are forced, as a necessary resort, to something more reasonable, more stable, something which we can work on and understand. And as soon as we look on the matter with such eyes, it becomes plainer, more tangible, holding out hopes for amelioration if not entire cure.

In a problem like this, which has so many ramifications, we should seek for constant factors of divergence from the normal; or, better still, let us decide what is the healthiest development, so that we may be better able to understand the abnormal, the deficient in human character. "The perfection of man," says M. de Laveleye, "consists in the full development of all his forces, physical as well as intellectual, and of all his sentiments; in the feeling of affection for the family and humanity; in a feeling for the beautiful in Nature and art." Now we have something really definite. We have a clear idea of what is essential to the highest growth of human worth, and immediately we recognize that in the criminal we have a being more or less utterly removed from this standard, and thus representing what is abnormal, twisted, or diseased. What is more, this divergence is a constant one, which reproduces itself over and over again in successive generations of wrongdoers. It is rarely necessary for a man to commit crime at the present time, even though he be laboring under adverse circumstances; and it is never necessary for him to continue such a career. Therefore, when he does, it is a matter of choice or of temperament. Very often the amount of ingenuity and talent exhibited would be sufficient, if rightly applied, to bring him comfort if not greater rewards in the regular lines of effort.

The majority of us exhibit a strange lack of logic in thinking about hereditary transmissions. We recognize the necessity of breeding and the duty of selection in regard to animals; we are perfectly willing to follow well-known ideas on the need of weeding out undesirable traits in cattle; moreover, the world has for a time shown its belief in the existence of hereditary genius, otherwise Galton's painstaking work on the subject could never have reached its present popularity, nor should we now possess our admiration for "good blood." But when we speak of the more unfavorable traits and the deadly certainty of their reproduction in descendants, our lips falter, we quickly hide the unpleasant sight with a capacious covering of charitable forbearance. We constantly meet with startling examples of transmitted crime, such as the famous or infamous Cook gang and Jukes family; every day in the more unfortunate phases of metropolitan life we see children following in the wake of parents and grandparents in the wide sea of vice; even do we see the same manner of crime reproduced in straight family lines, and yet we dare not look the plain truth full in the face; under the mask of a specious system of correction we hide our fear of facts and our incapacity to act for the criminal individual as well as the noncriminal public.

It is time for us to see that punishment will not abolish crime, any more than a whipping will change a lunatic into a sane man. Until the citizens of a community are really healthy in mind, body, and soul, crime will and must continue in its concomitant ratio. For crime is merely the expression of the action of ordinary social conditions upon distorted and diseased organisms. The symptoms of this pathological state when occurring singly may, as in the common sicknesses, mean but little. But when they come together in recognized groups they point to definite degrees of degeneration. For this reason anthropologists have been trying to classify criminals, to put in their proper places symptoms of weakened will and industry, overweening egoism, a failing respect for consequences, deficient domesticity, insensibility to the higher impulses, as well as the merely physical traits of facial and cranial asymmetry, misshapen heads, epilepsy, idiocy, and the tendency to disfigurement, as in tattooing. It is on the permanency of such traits that Bertillon's system of measurement is founded, as well as Galton's theory of finger markings. The main idea which these facts should impress upon us is the absolute stability of these peculiarities and the inevitable surety of the results which flow from them. The criminal is not necessarily without good impulses; on the contrary, he may have them more or less constantly, but he is unable to act them out. Where the will is thinned out almost to the vanishing point, or where the faculty of concentration has been progressively weakened, it is practically impossible to make up for them, and the unhappy offender is quite at the mercy of circumstances which bring him time and again before the criminal courts. In this connection it is interesting to read from Sir John Strachey's quotation of an official report from India: "When a man tells you that he is a Bodhak, or a Kanjar, or a Sonoria, he tells you what few Europeans ever thoroughly realize—that he, an offender against the law, has been so from the beginning and will be so to the end; that reform is impossible, for it is his trade, his caste—I may almost say his religion—to commit crime."

The belief in the inevitable steadfastness of these personal and family traits will finally clear our moral atmosphere, for we shall and must see that the safety of society lies in right methods of development based upon normal marriages and normal breeding. As population increases and the complexities of life increase, the burdens put upon us become heavier in proportion. We need more mental and moral backbone than we have; we are becoming progressively unable to stand the strain, it has become absolutely necessary to raise men to a higher level. For our present standard in character even more than in brains is a pitiably low one. Just as it is practicable to improve a breed of animals, so is it possible to increase our own worth. It is in this belief that Francis Galton said: "I argue that, as a new race can be obtained in animals and plants, and can be raised to so great a degree of purity that it will maintain itself, with moderate care in preventing the more faulty members from breeding, so a race of gifted men might be obtained, under exactly similar circumstances."

Here we have the gist of the matter. There is a consensus of opinion in the competent that crime is not fortuitous; likewise that there is one sure method for betterment: "*in preventing the more faulty members from breeding.*"

Scientists have known this for a long time; but the mere fact that the opinion was a scientific one kept it from the active appreciation of the many people who go to make up the intelligent class. Now it is time for us to understand the full bearing of the matter, as we certainly must do if we follow to their logical conclusion the teachings of great minds like Darwin and Wallace, like Wilson, Prof. Oscar Schmidt, Dr. Maudsley, and Jonathan Hutchinson; if we would rightly follow the meaning of the brilliant Weismann when he says that heredity is "that property of an organism by which its peculiar nature is transmitted to its descendants. And not only are the characteristics of the species transmitted to the following generation, but even the individual peculiarities." Besides all this, we have the evidence of men of authority, specialists in criminal anthropology, whose conclusions point in exactly the same direction, men like Cesare Lombroso, Ottolenghi, Rossi, Zucarelli, Virgilio Morselli, Marro; to these let us add the names of the eminent Lacassagne, of Kocher, Raux, Bournet. And even then we shall have only a part. The teaching of science all over the world echoes again and again the words of Galton, that the way to better a race lies "in preventing the more faulty members from breeding."

The proper method has been used often enough, but crudely, by such rulers as Ezzelin da Romano, Henry I, and many others.

We need this reform more than any other that has been proposed in our present time. We should look forward to it as we do to the noblest and best aspirations which crown our lives with light, yea, as we look with uplifted eyes for the hope of our best salvation in this world. The earth is reeking with the sweat of evil, injustice, and moral sickness; the means for relief are easily within our reach; they will bring injustice to no one, they will put a stop to millions of wrongs, they will guarantee to our posterity the possibility of a higher career in every way, without the burdensome disadvantages which crowd us to low planes of life. There is no room with us for the confirmed criminal; there is less room for his offspring, for they pollute the place whereon they stand.

THE YOUNG DRAUGHTSMAN.*

By JAMES SULLY, M. A., LL. D.,
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A CHILD'S first attempts at drawing are pre-artistic and a kind of play, an outcome of the instinctive love of finding and producing semblances of things. Sitting at the table and covering a sheet of paper with line-scribble, he is wholly self-centered, "amusing himself," as we say, and caring nothing about the production of "objective values."

Yet even in the early stages of infantile drawing the social element of art is suggested in the impulse of the small draughtsman to make his lines indicative of something to others' eyes, as when he bids his mother look at the "man," "gee-gee," or what else he fancies that he has delineated.† And this, though crude enough and apt to shock the æsthetic sense of the matured artist by its unsightliness, is closely related to art, forming, indeed, in a manner a preliminary stage of pictorial design.

We shall therefore study children's drawings as a kind of rude

* From advance sheets of Studies of Childhood, by James Sully, M. A., LL. D., in press of D. Appleton & Co.

† This indicative or communicative function of drawing has, we know, played a great part in the early stages of human history. Modern savages employ drawings in sand as a means of imparting information to others—e. g., of the presence of fish in a lake. See den Steinen, Unter den Naturvölkern Braziliens, Kap. x, S. 243 f.

embryonic art. In doing this our special aim will be to describe and explain childish characteristics. This, again, will compel us to go to some extent into the early forms of observation and imagination. It will be found, I think, that the first crude drawings are valuable as throwing light on the workings of children's minds Perhaps, indeed, it may turn out that these spontaneous efforts of the childish hand to figure objects are for the psychologist a medium of expression of the whole of child-nature hardly less instructive than that of early speech.

In carrying out our investigation of children's drawings we shall need to make a somewhat full reference to the related phenomena, the drawings of modern savages and those of early art. While important points of difference will disclose themselves, the resemblances are important enough to make a comparison not only profitable but almost indispensable.

I have thought it best to narrow the range of the inquiry by keeping to delineations of the human figure and of animals, especially the horse. These are the favorite topics of the child's pencil, and examples of them are easily obtainable.

As far as possible I have sought spontaneous drawings of quite young children—viz., from between two and three to about six.* In a strict sense, of course, no child's drawing is absolutely spontaneous and independent of external stimulus and guidance. The first attempts to manage the pencil are commonly aided by the mother, who, moreover, is wont to present a model drawing, and, what is even more important at this early stage, to supply model movements of the arm and hand. In most cases, too, there is some slight amount of critical inspection, as when she asks, "Where is papa's nose?" "Where is doggie's tail?" Yet perfect spontaniety, even if obtainable, is not necessary here. The drawings of men and quadrupeds of a child of five and later disclose plainly enough the childish fashion, even though there has been some slight amount of elementary instruction. Hence I have not hesitated to make use of drawings sent me by kindergarten teachers. I may add that I have used by preference the drawings executed by children in elementary schools, as these appear to illustrate the childish manner with less of parental interference than is wont to be present in a cultured home.

A child's drawing begins with a free, aimless swing of the pencil to and fro, which movements produce a chaos of slightly curved lines. These movements are purely spontaneous, or, if imitative, are so only in the sense that they follow at a consider-

* Only a few drawings of older children above seven have been included.

able distance the movements of the mother's pencil.* They may be made expressive or significant in two ways. In the first place, a child may by varying the swinging movements accidentally produce an effect which suggests an idea through a remote resemblance. A little boy, when two years and two months, was one day playing in this wise with the pencil, and happening to make a sort of curling line, shouted with excited glee, "Puff, puff!"—i. e., smoke. He then drew more curls with a rudimentary intention to show what he meant. In like manner, when a child happens to bend his line into something like a closed circle or ellipse, he will catch the faint resemblance to the rounded human head and exclaim, "Mamma!" or "Dada!"

But intentional drawing or designing does not always arise in this way. A child may set himself to draw, and make believe that he is drawing something when he is scribbling. This is largely an imitative play-action following the directions of the movements of another's hand. Preyer speaks of a little boy who in his second year was asked when scribbling with a pencil what he was doing and answered, "Writing houses." He was apparently making believe that his jumble of lines represented houses.†

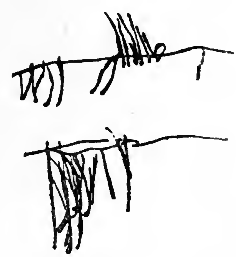

FIG. 1.

The same play of imagination is noticeable in the child's first endeavors to draw an object from memory when he is asked to do so. Thus a little girl in her fourth year, referred to by Mr. E. Cooke, when asked to draw a cat, produced a longish, irregularly curved line crossed by a number of shorter lines, which strange production she proceeded quite complacently to dignify by the name of "cat," naming the whiskers, legs, and tail (Fig. 1, *a*); compare the slightly fuller design in Fig. 1, *b*.

Here it is evident we have a phase of childish drawing which is closely analogous to the symbolism of language. The representation is arbitrarily chosen as a symbol and not as a likeness. This element of a nonimitative or symbolic mode of representation will be found to run through the whole of childish drawing.

Even this chaotic scribble shows almost from the beginning germs of formative elements, not merely in the fundamental line elements, but also in the loops, and in the more abrupt changes of direction or angles. A tendency to draw a looplike rudimen-

* E. Cooke gives illustrations of these in his thoughtful and interesting articles on Art-teaching and Child-nature, published in the Journal of Education, December, 1885, and January, 1886.

† Preyer, *op. cit.*, p. 47.

tary contour soon emerges, and thus we get the transition to a possible outlining of objects. With practice the child acquires by the second or third year the usual stock in trade of the juvenile draughtsman, and can draw a sort of straight line, curved lines, a roughish kind of circle or oval, as well as dots, and even fit lines together at angles.* When this stage is reached we begin to see attempts at real though rude likenesses of men, horses, and so forth. These early essays are among the most curious products of the child-mind. They follow standards and methods of their own; they are apt to get hardened into a fixed conventional manner which may reappear even in mature years. They exhibit with a certain range of individual difference a curious uniformity, and they have their parallels in what we know of the first crude designs of the untutored savage.

It has been wittily observed by an Italian writer on children's art that they reverse the order of natural creation in beginning instead of ending with man. It may be added that they start with the most dignified part of this crown of creation, viz., the human head. A child's first attempt to represent a man proceeds, so far as I have observed, by drawing the front view of his head. This he effects by means of a clumsy sort of circle with a dot or two thrown in by way of indicating features in general. A couple of lines may be inserted as a kind of support, which do duty for both trunk and legs. The circular or ovoid form is, I think, by far the most common. The square head in my collection appears only very occasionally and in children *at school*, who presumably have had some training in drawing horizontal and vertical lines. The accompanying example (Fig. 2) is the work of a Jamaica girl of five, kindly sent me by her teacher.

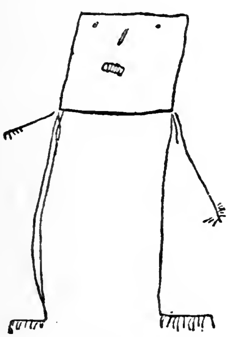

Fig. 2.

This first attempt to outline the human form is, no doubt, characterized by a high degree of arbitrary symbolism. The use of a rude form of circle to set forth the human head reminds one of the employment by living savage tribes of the same form as the symbol of a house (hut?), a wreath, and so forth. Yet there is a measure of resemblance

* I am much indebted to Mr. Cooke for the sight of a series of early scribbles of his little girl. *Cf.* Baldwin, Mental Development, chapter v, where some good examples of early line-tracing are given. According to Baldwin, angles or zigzag come early, and are probably due to the cramped, jerky mode of movement at this early stage. Preyer seems to me wrong in saying that children can not manage a circular line before the end of the third year (*op. cit.*, p. 47). Most children who draw at all manage a loop or closed curved line before this date.

even in this abstract symbolism: the circle does roughly resemble the contour of the head: as, indeed, the square or rectangle may be said less obviously to do when hair and whiskers and the horizontal line of the hat break the curved line.

But it is not the mere contour which represents the face: it is a circle picked out with features. These, however vaguely indicated, are an integral part of the facial scheme. This is illustrated in the fact that among the drawings by savages and others collected by General Pitt-Rivers, one, executed by an adult negro of Uganda, actually omits the contour, the human head being represented merely by an arrangement of dark patches and circles for eyes, ears, etc. (Fig. 3).*

FIG. 3.

Coming now to the mode of representing the features, we find at an early stage of this schematic delineation an attempt to differentiate and individualize features, not only by giving definite position but by a rough imitation of form. Thus we get the vertical line as indicating the direction of the nose, the horizontal line that of the mouth, and either a rounded dot or a circular line as representative of the curved outline of the eye—whether that of the iris, of the visible part of the eyeball, or of the orbital cavity. A precisely similar scheme appears in the drawings of savages.†

At first the child is grandly indifferent to completeness in the enumeration of features. Even "the two eyes, a nose, and a mouth" are often imperfectly represented. Thus, when dots are used, we may have one or more specks, ranging, according to M. Perez, up to five.‡ The use of a single dot for facial feature in general has its parallel in the art of savage tribes.# It is, however, I think. most common to introduce three dots in a triangular arrangement, presumably for eyes and mouth—a device, again, which reappears in the art of uncivilized races.‖ Even when the young draughtsman has reached the stage of distinguishing the features he may be quite careless about number and completeness. Thus a feature may be omitted altogether. This funnily enough happens most frequently in the case of that

* These drawings, of the highest interest to the student of child-art as well as to the anthropologist, are to be seen in the general's museum at Farnham (Dorset) (seventh room).

† Schoolcraft has a good example of this facial scheme in the drawing of a man shooting (The Indian Tribes of the United States, vol. i, plate 48).

‡ L'Art et la Poésie chez l'Enfant, p. 186.

For an illustration see Andree, Eth. Parallelen und Vergleiche, plate 3, Fig. 19.

‖ See, for an example, Schoolcraft, vol. iv, plate 28.

one which seems to us "grown-ups" most self-assertive and most resentful of indignity, viz., the nose. These moon-faces with two eyes and a mouth are very common among the first drawings of children. The mouth, on the other hand, is much less frequently omitted. The same thing seems to hold good of the drawings of savages.* The eyes are rarely omitted. The single dot may perhaps be said to stand for "eye." Some drawings of savages have the two eyes and no other feature, as in the accompanying example from Andree (Fig. 4, *a*). On the other hand, a child

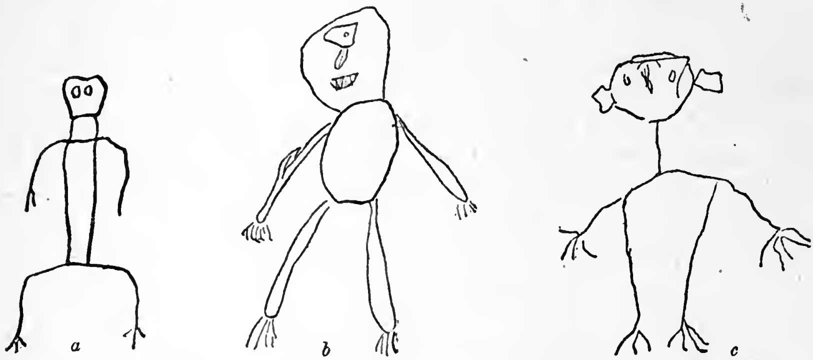

FIG. 4.—*c*, Mustache = horizontal line above curve of cap.

will, as we have seen, sometimes content himself with one eye. This holds good not only where the dot is used but after something like an eye-circle is introduced, as in the accompanying drawing by a Jamaica girl of seven (Fig. 4, *b*).

In these first attempts to sketch out a face we miss a sense of relative position and of proportion. It is astonishing what a child on first attempting to draw a human or animal form can do in the way of dislocation or putting things into the wrong place. The little girl mentioned by E. Cooke on trying, about the same age, to draw a cat from a model; actually put the circle representing the eye outside that of the head. With this may be compared the drawings of den Steinen and other Europeans made by his Brazil Indian companions, in which what was distinctly said by the draughtsman to be the mustache was in more than one instance set above the eyes (Fig. 4, *c*). When dots are inserted in the linear scheme they are apt at first to be thrown in anyhow. The two eyes, I find, when these only are

* According to Stanley Hall, the nose comes after the mouth. This may be an approximate generalization, but there are evidently exceptions to it. On the practice of savage draughtsmen see the illustrations of Australian cave drawings in Andree, *op. cit.*, p. 159. *Cf.* the drawings of Brazilian tribes, plate iii, 15. In some cases there seems a preference for the nose, certain of the Brazilian drawings representing facial features merely by a vertical stroke.

given, may be put one above the other as well as one by the side of the other, and both arrangements occur in the drawings of the same child. And much later, when greater attention to position is observable, there is a general tendency to put the group of features too high up—i. e., to make the forehead or brain region too small in proportion to the chin region (see Fig. 2).*

The want of proportion is still more plainly seen in the treatment of the several features. The eye, as already remarked, is apt to be absurdly large. In the drawing of Mr. Cooke's little girl, mentioned above, it is actually larger than the head outside which it lies. This enlargement continues to appear frequently in later drawings, more particularly when one eye only is introduced, as in the accompanying drawing by a boy in his seventh year (Fig. 5 *a*, and Fig. 4, *b*). The mouth is apt to be even more disproportionate, the child appearing to delight in making this appalling feature supreme, as in the following examples, both by

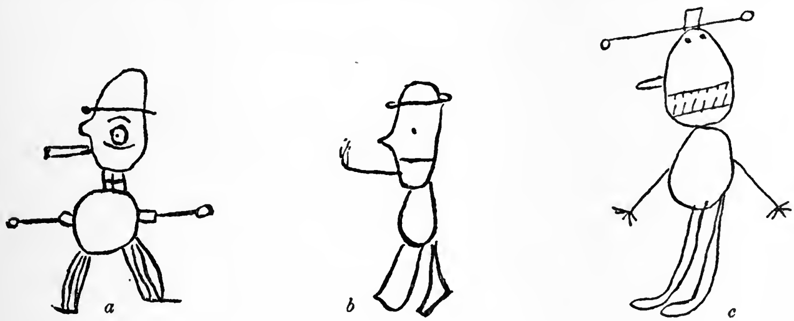

FIG. 5.

boys of five (Fig. 5, *b* and *c*). The ear, when it is added, is apt to be enormous, and generally the introduction of new details, as ears, hair, hands, is wont to be emphasized by an exaggeration of their magnitude.

Very interesting is the gradual artistic evolution of the features. Here, as in organic evolution, there is a process of specialization, the primordial indefinite form taking on more of characteristic complexity. In the case of the eye, for example, we may often trace a gradual development, the dot being displaced by a small circle or ovoid, this last supplemented by a second circle outside the first,† or by one or by two arches, the former placed above, the latter above and below the circle.

* M. Passy calls attention to this in his interesting note on children's drawings, Revue Philosophique, 1891, pp. 614 ff. I find, however, that though the error is a common one, it is not constant.

† In one case I find the curious device of two dots or small circles, one above the other within a larger circle, and this form repeated in the eye of animals.

The evolution of the mouth is particularly interesting. It is wont to begin with a horizontal line (or what seems intended for such) which is frequently drawn right across the facial circle. But a transition soon takes place to a more distinctive representation. This is naturally enough carried out by the introduction of the characteristic and interesting detail, the teeth. This may be done, according to M. Perez, by keeping to the linear representation, the teeth being indicated by dots placed upon the horizontal line. In all the cases observed by me the teeth are introduced in a more realistic fashion in connection with a contour to suggest the parted lips. The contour—especially the circular or ovoid—occasionally appears by itself without teeth, but the teeth seem to be soon added. The commonest forms of tooth cavity I have met with are a narrow rectangular and a curved spindle-shaped slit with teeth appearing as vertical lines (see the two drawings by

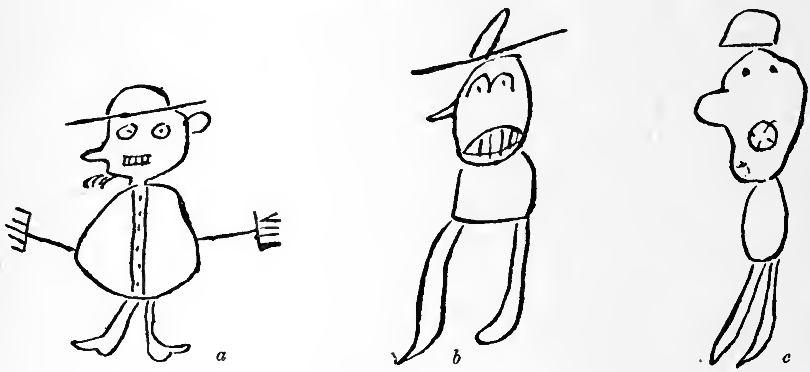

Fig. 6.

boys of six and five (Figs. 6, *a* and *b*). These two forms are improved upon and more likeness is introduced by making the dental lines shorter, as in Fig. 5, *c*. With this may be compared a drawing by a boy of five (Fig. 6, *c*), where, however, we see a movement from realism in the direction of a freer decorative treatment.

A somewhat similar process of evolution is noticeable in the case of the nose, though here the movement is soon brought to a standstill. Thus the vertical line gives place to an angle, which may point to the side, as in the drawing of a country boy between three and four (Fig. 7, *a*), but more frequently, I think, points upward, as in the drawing of a boy of six (Fig. 7, *b*). This in its turn leads to an isosceles triangle with an acute angle at the apex, as in the drawing of a boy of six (Fig. 7, *c*). In a few cases a long spindle-shaped or rectangular form similar to that of the mouth is employed, as in a drawing of a nervous child of six (Fig. 7, *d*). Refinements are introduced now and again by an attempt at the nostrils, as in the accompanying curious drawing by a seven-year-old Jamaica girl (Fig. 7, *e*).*

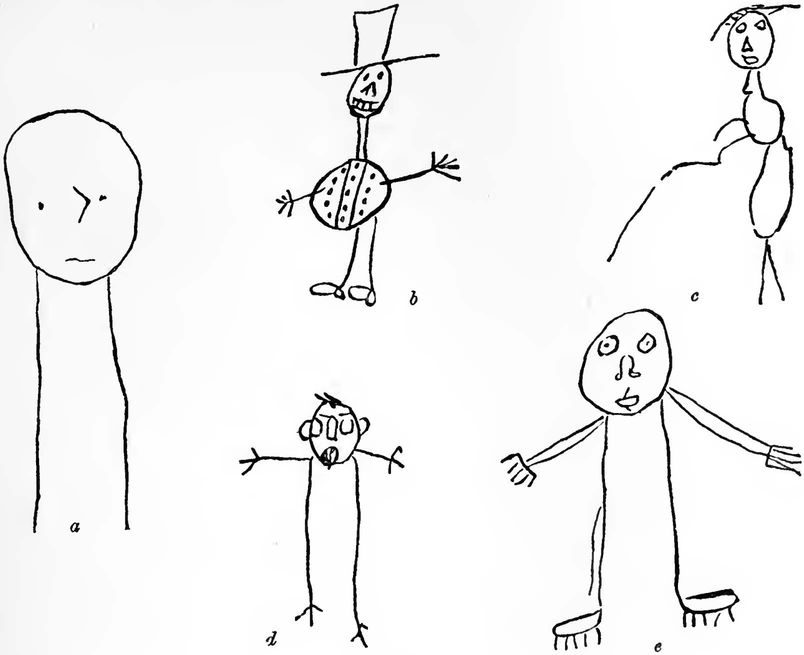

Fig. 7.

The introduction of other features, more especially ears and hair, must, according to my observations, be looked on as occasional only, and as a mark of an advance to a more naturalistic treatment. Differences of treatment occur here too. Thus the ears, which are apt to be absurdly large, are now inserted inside the head circle, now outside it. The hair appears now as a dark cap of horizontal strokes, now as a kind of stunted fringe, now as a bundle or wisp on one side, which may either fall or stand on end (see Fig. 7, *d*, and the accompanying drawing by a girl of nearly four, Fig. 8, *a*). These methods of representation are occasionally varied by a more elaborate line device, as a curly looped line similar to

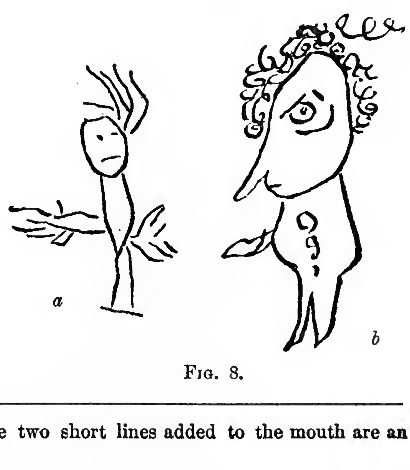

Fig. 8.

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* It is possible that in this drawing the two short lines added to the mouth are an original attempt to give the teeth.

that employed for smoke, as in the annexed drawing by a girl of seven (Fig. 8, *b*).

As implied in this account of the facial features, a good deal of conventionlike agreement of method is enlivened by a measure of diversity of treatment. Perhaps one of the most striking instances of daring originality is seen in the attempt by a girl of four—who was subjected to a great deal of instruction—to give separate form to the chin (Fig. 9). This may be compared with the attempt of the Uganda negro to indicate symbolically the cheeks (see Fig. 3).

Fig. 9.

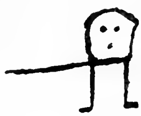

Fig. 10.

As I have remarked, to the child bent on representing "man" the head or face is at first the principal thing, some early drawings contenting themselves with this. But in general the head receives some support. The simplest device here is the abstract mode of representation by two supporting lines, which do duty for legs and body. These are for the most part parallel (Fig. 2), though occasionally they are united at the top, making a kind of target figure. This same arrangement, fixing the head on two upright lines, meets us also in the rude designs of savages, as may be seen in the accompanying rock inscription from Schoolcraft (Fig. 10).

The comparative indifference of the child to the body or trunk is seen in the obstinate persistence of this simple scheme of head and legs, to which two arms attached to the sides of the head are often added. A child will complete the drawing of the head by

Fig. 11.

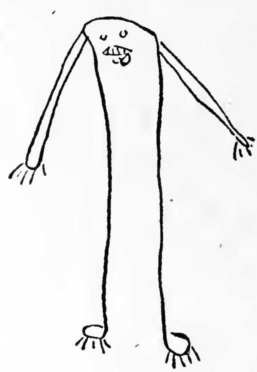

Fig. 12.

inserting hair or a cap, and will even add feet and hands, before he troubles to bring in the trunk (see Fig. 2 and Fig. 7, *d*, also the accompanying drawing by a boy of six, Fig. 11, *a*). With this neglect of the trunk by children may be compared the omission of it—as if it were a forbidden thing—in one of General Pitt-Rivers's drawings, executed by a Zulu woman (Fig. 11, *b*).

From this common way of spiking the head on two forked or upright legs there is one important deviation. The contour of the head may be left incomplete, and the upper occipital part of the curve be run on into the leg lines, as in the accompanying example by a Jamaica girl of seven (Fig. 12). I have met with no example of this among English children.

The drawing of the trunk may commence in one of two ways. With English children it appears often to emerge as an expansion or prolongation of the head contour, as in the accompanying drawings of the front and side view (Figs. 13, *a* and *b*).* Or, in the second place, the leg scheme may be modified, either by drawing a horizontal line across them and so making a rectangle, as in the accompanying drawing by a boy of six, or by shading in the upper part of the space, as in the other figure by a girl of five (Fig. 13, *c* and *d*). A curious and interesting variant of this second mode of introducing the trunk is to be found in the drawings of den Steinen's Brazilians, where the leg lines are either kept parallel for a while and then made to diverge, or are pinched in below what may be called the pelvis, though not completely joined (Fig. 13, *e* and *f*).

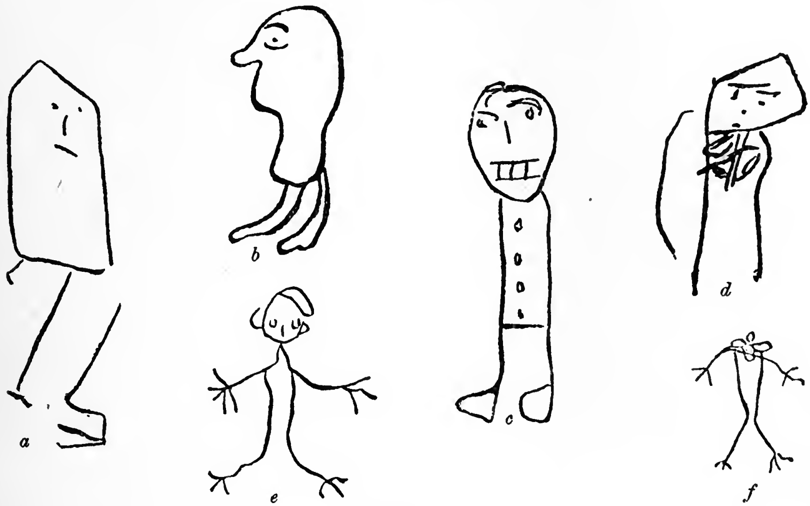

Fig. 13.

When the trunk is distinctly marked off, it is apt to remain small in proportion to the head, as in the following two drawings

* A drawing given by Andree, *op. cit.*, plate ii, 11, seems to me to illustrate a somewhat similar attempt to develop the trunk out of the head.

by boys of about five (Fig. 14, *a* and *b*). As to its shape, it is most commonly circular or ovoid like the head. But the square or rectangular form is also found, and in the case of certain chil-

Fig. 14.

dren it is expressly stated that this came later. A triangular capelike form also appears now and again, as in the accompanying drawing by a boy of six (Fig. 14, *c*).* The treatment of the form of trunk often varies in the drawings of the same child.

At this stage there is no attempt to show the joining on of the head to the trunk by means of the neck. The oval of the head is either laid on the top of that of the trunk, or more commonly cuts off the upper end of the latter. The neck, when first added, is apt to take the exaggerated look of caricature. It may be represented by a single line, by a couple of parallel lines, or by a small oval or circle, as in the accompanying drawings by a girl of six and a boy of five respectively (Fig. 15, *a* and *b*; also Fig. 7, *b*).

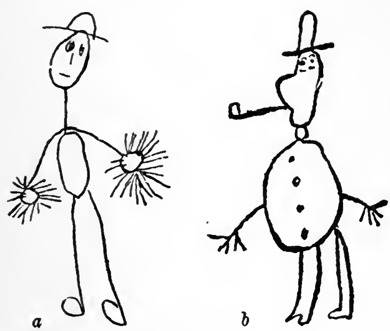

Fig. 15.

It is noticeable that there is sometimes a double body, two oval contours being laid one upon the other. In certain cases this looks very like an expansion of the neck, as in the following drawing by the same boy that drew the round neck above (Fig. 16, *a*). In other cases the arrangement plainly does not aim at differentiating the neck, since this part is separately dealt with (Fig. 16, *b*). Here it may possibly mean a crude attempt to indicate the division of the trunk at the waist, as brought out espe-

* The opposite arrangement of a triangle on its apex occurs among savage drawings.

cially by female attire, as may be seen in the accompanying drawing, where the dots for buttons on each oval seem to show that the body is signified (Fig. 16, *c*; *cf.* Fig. 7, *c*).* This, along with the triangular cape-shape of the trunk, is one of the few illustrations of the effect of dress on the first childish treatment of the figure. As a rule, this primitive art is a study of Nature in so far as the artificial adjuncts of dress are ignored, and the rounded forms of the body are, though crudely enough, no doubt, hinted at.

Coming now to the arms, we find that their introduction is very uncertain. To the child, as also to the savage, the arms are what the Germans call a *Nebensache*—side matter (i. e., figuratively as well as literally)—and are omitted in rather more than

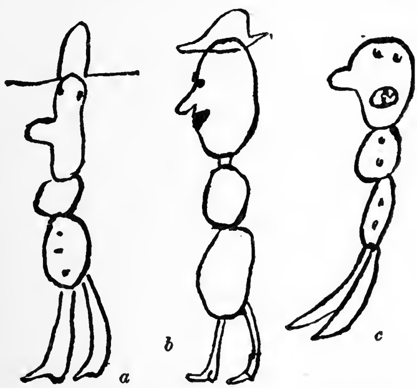

FIG. 16.

FIG. 17.

one case out of two. After all, the divine portion, the head, can be supported very well without their help.

The arms, as well as the legs, being the thin, lanky members, are commonly represented by lines. The same thing is noticeable in the drawings of savages.† The arms appear in the front view of the figure as stretched out horizontally, or at least reaching out from the sides; and their appearance always gives a certain liveliness to the figure, an air of joyous self-proclamation, as if they said in their gesture language, "Here I am!" (see Fig. 5, *a*, and the accompanying drawing of a boy of six, Fig. 17).

In respect of shape and structure a process of evolution may be observed. In certain cases the abstract linear representation gives place to contour, the arm being drawn of a certain thickness. But I find that the linear represenation of the arm often

* On the other hand, I find the button dots sometimes omitted in the lower oval.

† For examples, see Andree, *op. cit.*, plate 3. *Cf.* the drawings of den Steinen's Brazilians.

persists after the legs have received contour, this being probably another illustration of the comparative neglect of the arm; as in the accompanying drawing by a boy of five (Fig. 18, *a*). The primal rigid straightness yields later on to the freedom of an

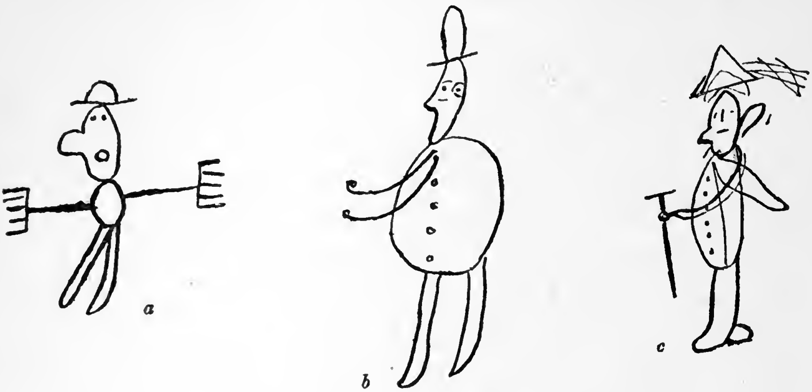

FIG. 18.—*c*, A miner.

organ. Thus an attempt is made to represent by means of a curve the look of the bent arm, as in the accompanying drawings by boys of five (Fig. 18, *b* and *c*). In other cases the angle of the elbow is indicated. This last comes comparatively late in children's drawings, which here, too, lag behind the crudest outline sketches of savages.

SKETCH OF ANDREW DICKSON WHITE.

BY PROF. GEORGE L. BURR.

ALMOST in the exact geographical center of the State of New York there suns itself in the upper valley of a tributary of the Susquehanna a tidy village on which the impoverished fancy of an official map-maker has set the ancient name of Homer. Ancient, indeed, for its region is the village itself. The settlers from Massachusetts and from Connecticut who pushed westward along the valleys of the Mohawk and the Susquehanna, reaching these uplands in the last decade of the eighteenth century, settled here more thickly than elsewhere, and for half a century—till its neighbor settlement of Cortland, once its suburb but soon its rival, crowded it from the pre-eminence—it was, not only in the number of its citizens, but in their thrift, their piety, and their public spirit, the recognized metropolis of the district.

It was here, in the midst of all that is conservative in American life, that on the 7th of November, 1832, was born a man destined in much to be a leader of the fresher thought—ANDREW

Dickson White. His grandfather, Asa White, a migrant from southern Massachusetts in 1798, was long the well-to-do miller of the little community, but in 1815 a conflagration brought him in a day to poverty; and his eldest son Horace, the father of Andrew, was forced, though but a lad of thirteen, to turn from the education of the schools to that of business. So well he learned its lessons that before the age of thirty he had not only won a reputation for unusual mercantile sagacity and enterprise, but had already amassed a moderate fortune when in 1831 he married Clara Dickson, only daughter of a village magnate. Her father, the Hon. Andrew Dickson, like the Whites of Massachusetts birth, had come a young man to Homer and was, in the year of his grandson's advent, the representative of his county in the Legislature of the State.

The fortunes of Horace White still prospered, and in 1839 he took advantage of the new banking law of the State to establish himself as one of the earliest bankers at Syracuse, the rising metropolis of central New York, then a town of some five thousand people. There his energy found a worthier field; identified with all the interests of his city, he rapidly amassed wealth, and all the advantages his own youth had missed he could well afford his son.

The earliest tastes of the boy were, however, not bookish; all his love was for machinery and for the wonders of out of doors; and, though he early picked up the power to read, it was not until after the removal to Syracuse that he was first put into school. Of his education he has himself told the story:

"After much time lost in various poor schools, I was sent to the preparatory department of the Syracuse Academy, and there, by good luck, found Joseph A. Allen, the best teacher of English branches I have ever known. . . . He seemed to divine the character and enter into the purpose of every boy." There young White perfected himself in spelling, in arithmetic, in geometry, the only mathematical study he ever loved, in grammar, of which he thinks there was too much; there he gained the rudiments of natural science and even of music, becoming "proficient enough to play the organ occasionally in church." There, too, literature was first opened to him. "Great attention was given to reading aloud from a book made up of selections from the best authors, and to recitals from these. Thus I stored up not only some of the best things in the older English writers, but inspiring poems of Whittier, Longfellow, and other moderns," and the treasures thus gained were never lost. "As to the moral side, Mr. Allen influenced many of us strongly by liberalizing and broadening our horizon. He was a disciple at that time of Channing, and an abolitionist; but he . . . never made the slightest attempt to proselyte any of his students. Yet the very atmosphere of the school made sectarian bigotry and narrowness impossible."

But the boy was destined for college, and was now sent to a classical school, where Stoddard, the story writer, was among his fellow-pupils, and where, though the methods in classical teaching were imperfect, "the want in grammatical drill was more than made up by the love of manliness and the dislike of meanness which was in those days our very atmosphere."

Outside the school his imagination had been stimulated by desultory reading and by pictures of travel, and he had stumbled upon the novels of Scott, to which above all was due the birth of his interest in historical studies. The public meetings of the time, especially those of the antislavery party, took also a deep hold upon his mind.

He had dreamed of entering one of the great New England universities; but the zealous young churchman into whose hands he was put for his final training persuaded his father to send him instead to the young and struggling Episcopal college at the neighboring town of Geneva. There he matriculated in the fall of 1849. With all his loyalty to his father's church and to his father's wish, the college could not content him. Dependent on the wealthy patrons whose sons it sought to educate, its discipline was lax and its means too feeble for the work it undertook. "Only about half a dozen of our number studied at all; the rest, by translations, promptings, and evasions of various sorts, escaped without labor."

A year of this was all that he could stand, and when, at the opening of another, his protest was still unheeded, he took French leave of his reluctant *alma mater* and went into hiding at the home of an old instructor until his father at last gave consent to his transfer to Yale College. There he was admitted in January, 1851, to what has since become "the famous class of '53." But, even among such classmates as Billings and Davies and Gibson and Lewis and MacVeagh and Robinson and Shiras and Smalley and Stedman, he soon won for himself a high place—not so much by his work in the classroom, though that was good, as by the breadth of his information and of his sympathies, and by his facility with pen and voice. He became an editor of the college magazine, The Lit., and before his graduation won the first Clark, the Yale Literary, and the De Forest prizes, the last for an essay on The History of Modern Diplomacy. Nor were physical and social claims neglected. He belonged to the earliest Yale crew, and he became a member of Psi Upsilon and of the mystic Skull and Bones, as well as of the more literary Linonia. His roommate and bosom friend was his classmate Davies, to-day Bishop of Michigan. Of his college work, perhaps that which left the deepest impression upon him was his study of Guizot's Civilization in Europe, under Dr. Woolsey.

In December, 1853, he went abroad for further study, having as fellow-traveler his college mate (now the well-known President of Johns Hopkins, and at this moment his colleague on the Venezuelan Commission). After a few weeks in England and several months in France, spent in studying French, reading the French historians (Thierry, Mignet, Thiers, Chateaubriand), listening to lecturers like Laboulaye at the Sorbonne and the College of France, chatting with the old soldiers of the Revolution at the Invalides, making historical pilgrimages throughout the northern and central provinces, everywhere reveling in architecture and music and haunting the old book shops, he was invited by the American minister to Russia, ex-Governor Seymour, of Connecticut, to join that legation as an *attaché*.

Accordingly, in October of 1854 he made his way, *via* Brussels, Cologne, and Berlin, to St. Petersburg. It was the stirring time of the Crimean War, and the young diplomat found his attachéship no sinecure. His knowledge of French made him valuable as an interpreter; he became the companion of the minister in his interviews at court and at the foreign office, and took a most interested part in the ceremonial attending the death of the Czar Nicholas and the accession of Alexander II. Yet he found much time for study. Huge scrap-books were filled with clippings on the progress of the war; the book-stalls afforded rich store for his rapidly growing collection on Russia and Poland; and the archives of the legation even gave him material for research in American history. He there, under the inspiration of Mr. Seymour, became interested in the character and policy of Jefferson, and drew up the nucleus of the study later published in the Atlantic Monthly on Jefferson and Slavery.

But he tired of the restraints of official life, and in June, 1855, resumed the career of a student, first wandering in Germany and Switzerland, then matriculating at the University of Berlin. There he heard Boeckh, Lepsius, Friedrich von Raumer, Karl Ritter, and tried in vain to follow the lectures of Ranke. With the Easter vacation he was off for Austria and Italy, and lingered till late spring beyond the Alps, in the company of his fellow-student and close friend Frieze, the Latinist. Crossing then the Alps, and lingering but a little among the Roman ruins of southern France, he turned his footsteps homeward, reaching America in time to share the commencement festivities of his *alma mater* and to receive at her hands his Mastership of Arts.

It was then, with his future profession all undecided, that he chanced to stray within sound of the voice of President Francis Wayland, who was delivering at Yale one of the addresses of the commencement season; and the orator's plea for the new and growing West as the field for the young scholar sank deep into his mind. The next year he spent in graduate study at Yale, and before its end, declining all other offers, he had accepted the chair of History and English Literature at the University of Michigan.

He was but five and twenty, and looked a boy, but the vigor of his thought and the finish of his style soon dispelled all doubt as to his maturity. "He came to Ann Arbor," says one who then listened to him, "fresh from European studies, and he entered upon his labor with that peculiar enthusiasm which is instantly caught by students, and is perhaps the most successful element of all good teaching. His instruction in history was a genuine revelation to those who had been accustomed to perfunctory text-book work and the hearing of dry and colorless lectures. The exceptional excellence of his instruction consisted largely of the spirit which he infused into his students. He had in a remarkable degree the rare gift of seizing upon the most important principles and causes and presenting them in such a manner as to illuminate the whole course of events with which they were connected. He not only instructed, but, what was even more important, he inspired. While he remained in his chair perhaps no study in the university was pursued with so much enthusiasm by the mass of students as was that of history."

In the general development of the university he was like his old friend Frieze, whom, to his joy, he found a fellow-member of the Michigan faculty, a loyal supporter and adviser of President Tappan. And there was work to do outside the institution. The university, in order to keep its hold on the State, from which it drew its support, loved to send out its faculty as lecturers into the towns and villages of Michigan, and into this task, too, the young Professor of History went with zest and success.

On the eve of his going to Michigan he had married, at Syracuse, Mary Outwater, a neighbor's daughter, whom he had known and admired since her childhood. He was fond of entertaining his colleagues and students; and Mrs. White united in her character a sweetness and a dignity which made her the most charming of hostesses. Their home soon became at Ann Arbor, as afterward at Cornell, the very heart of the university's social life. There, in his growing library, amid the influences of art and music so dear to him, Prof. White ministered a hospitality which could have meant hardly less to the culture of those who shared it than did the work of his classroom.

The death of his father, in 1860, brought upon him the cares of fortune; his health, never strong, flagged under the accumulated burden. In 1862 he found it wise to ask a leave of absence, and sailed with his family, now numbering a daughter and a son besides his wife, for Europe. The civil war then raging in America had stirred him deeply, and his had been no slight share in sending to the field the young manhood of the North. Now, arrived in Europe, a new task confronted him. In answer to the pro-Southern correspondents of the London press, who were misleading the English public as to the resources and the character of the North, and bade fair to win for the Confederacy the recognition, if not the intervention, of Great Britain, he dashed off his A Word from the Northwest, perhaps the most telling defense of the Unionist cause; and this he followed up with effective letters in the journals of England and the Continent. Returning in 1863 to the financial cares which demanded his presence in Syracuse, he found in domestic politics a fresh field for his powers as a writer and orator, and in the autumn of that year was sent by his native county of Onondaga to the Senate of New York.

Of this body, in which he sat till 1867, he was, though its youngest member, from the first a man of influence. Against the peace sympathies of Governor Seymour he was an eloquent and effective advocate of the aggressive prosecution of the war. Though a director of the New York Central Railroad and a resident of the city most dependent on the Erie Canal, he did loyal service as an opponent of the dictation both of railway and of canal ring. His intelligent interest in civic affairs earned him a place on the legislative Committee on Municipal Reform, where he was especially concerned in the organization on its present basis of the Health Department of New York city. But it was as chairman of the educational committee, or Committee on Literature, as it was called, that there opened to him the largest opportunities. He was able to carry through a great extension of the normal school system for the training of teachers. What was more, the beneficence of the national Government seemed to put within reach what had long been the dearest dream of his public life.

Even while a boy at the Geneva College, as he paced rebelliously the shore of Seneca Lake, he had begun to frame in his thought the great university, worthy of the greatest State of the Union, by which New York should some day make needless all petty sectarian institutions. When Gerrit Smith had later talked of endowing a university in central New York, he had offered the half of his own fortune for such an object. The dream ripened during his years at Michigan. "It is now just about ten years ago," said George William Curtis in 1868, "since I was in the city of Ann Arbor, the seat of the University of Michigan, . . . and I sat at night talking with my friend, a New York scholar, Professor of History in that institution. . . . There, in the warmth and confidence of his friendship, he unfolded to me his idea of the great work that should be done in the great State of New York. Surely, he said, in the greatest State there should be the greatest of universities; in central New York there should arise a university which, by the amplitude of its endowment and by the whole scope of its intended sphere, by the character of the studies in the whole scope of the curriculum, should satisfy the wants of the hour. More than that, said he, it should begin at the beginning. It should take hold of the chief interest of this country, which is agriculture; then it should rise—step by step, grade by grade—until it fulfilled the highest ideal of what a university could be. . . . Until the hour was late this young scholar dreamed aloud to me these dreams."

Now, in the year 1862 an act had passed Congress for the endowment of the higher education throughout the country, from the great landed domain of the nation. Every State was to receive for each of its representatives in Congress thirty thousand acres of the public land with which each should endow "at least one college," where, "without excluding other scientific and classical studies," such branches as are related to agriculture and the mechanic arts should forever be taught. To New York, as the most populous State, came thus nearly a million of acres. This superb fund, provisionally bestowed by the State on a small existing institution, seemed likely in 1864 to fall back into its hands through a failure to comply with the conditions of the gift. Mr. White strenuously opposed all suggestions for the division of the fund, urging as the only worthy policy for the higher education the concentration of resources. It was in the struggle over this question that he was brought into close relations with his colleague from Tompkins County, Ezra Cornell—a stern, shrewd old man, of Quaker birth and breeding, who had migrated in his youth, a roving mechanic, into western New York, where, after making one fortune in milling and losing it in farming, he had built up a vaster one through his connection with the spread of the electric telegraph, and now, in his declining years, was casting about for a worthy public use for his wealth. The two men were strangely unlike, and as to the division of the land grant they had been sharply opposed; but each had learned to prize the other, and it was to his young fellow-Senator that the old Quaker now turned for advice. The result was the offer, by Ezra Cornell to the State of New York, of five hundred thousand dollars for the further endowment of a great university, if the State would transfer to it the public lands and would locate it in his own town of Ithaca.

It is needless here to recount further the tangled story of the establishment of Cornell University, or to describe the happy policy by which the nation's gift, frittered away for a song by most of the States, became in time for the New York university the source of millions. Large as was Mr. White's share in securing for it the charter and the land grant, what was peculiarly his own was the educational shaping of the new institution. He was its spiritual founder not less than Mr. Cornell its material—a fact too much obscured, perhaps, by the name which he, against Mr. Cornell's protest, gave to the university. It was he who wrote all but the financial clauses of its charter; he who drew its plan of organization; he who took all steps looking to the selection of its equipment and the choice of its faculty. It is not strange that when, in 1866, a head was to be found for it, Mr. Cornell insisted that Mr. White must accept its presidency.

It was to turn his back on political ambitions to which he had earned a right. It was to sever his connections with Michigan, where, in the hope that he might yet return, the chair of History was still his. Just now, too, there had come from Yale an invitation to take up his home in the "City of Elms" as director of its School of Fine Arts; and this, if he must leave his political career, was the life most tempting to a man of his tastes and means, and was especially attractive to his family. But his choice was soon made, and was made once for all. Entering at once upon his executive duties, he remained President of Cornell for nearly twenty years, until ill health compelled his retirement in 1885.

The features in which the new university, as planned by him, differed most notably from others of its sort were: (1) Its democracy of organization, uniting the humanities, the sciences, and the technical arts in a single faculty and in common classrooms under precisely like conditions, and this so effectively that their parity at Cornell has never been questioned; (2) its freedom from all sectarian control—"at no time shall a majority of [its trustees] be of one religious sect, or of no religious sect," and "persons of every religious denomination, or of no religious denomination, shall be equally eligible to all offices and appointments"; (3) its parallel courses and its large individual freedom of choice among studies—in this, too, it was a pioneer in American education; (4) its vital connection with the public schools of its State through the establishment of free scholarships, to be awarded by competition in each Assembly district; (5) its large recognition of the worth of the modern languages and literatures, both as practical and as disciplinary studies; (6) its system of nonresident professorships, by which it sought to bring both its students and its faculty in touch with eminent scholars whose permanent services it could not hope to win; (7) its assumption that its students are not children, but grown and earnest men, and its attitude toward them as such.

Much that was planned at the outset could not, for lack of means, be then or for long afterward carried out. In fact, throughout nearly the whole administration of Mr. White the institution was "land poor"—its vast estates an expense instead of an income.

Throughout his presidency Mr. White filled also the professorship of History, and with the same inspiring influence upon historical studies as at the University of Michigan. Though his other duties compelled his restriction to a single course throughout the year, no element of the university's work left a deeper mark upon the whole student body.

And his benefactions took often a more tangible form. From his own means he built and furnished upon the university's grounds the home which he gave to be used, when he should be through with it, by his successors in the presidency. Of his lesser gifts it would be idle to attempt enumeration. No department but felt again and again the help of his ready pocket. The library especially was continually his debtor, and after his retirement he bestowed upon it in 1887 his own noble historical collection, perhaps the richest private library in America. His gifts must aggregate a couple of hundred thousand dollars. In proportion to his income he has perhaps been the university's most liberal donor.

But during these years of his presidency he was not wholly divorced from outside activities. His fertile mind and restless temperament could not brook such slavery. He was always in touch with the republic of letters and with the larger interests of State and nation. His open letters and occasional addresses amount to volumes. In 1870 he was appointed by President Grant a member of the commission created by Congress for the investigation of the condition and resources of Santo Domingo, and into his hands fell the scientific direction of the expedition. Though its youngest member, he proved the conservative element of the commission, and it was in deference to his protests that no recommendation as to annexation was made by it. In the fall of 1871 he presided at the State convention of his party at Syracuse. The next year saw him a delegate at large to the national convention at Philadelphia which renominated President Grant, and a little later the head of New York's delegation in the electoral college. In 1876 he was again a delegate at large to the Republican National Convention, but was hindered from attendance by other official duties in connection with the Centennial Exhibition at Philadelphia, where he had been made chairman of the Jury of Public Instruction. Soon after this ill health drove him abroad, and before his return in 1878 he served the United States as its Honorary Commissioner to the Paris Exposition, and was there given a place upon the Jury of Appeals. In the spring of 1879, by appointment of President Hayes, he became American minister to the German Empire, and in that post he remained till 1881.

After his resignation, in 1885, of the presidency of Cornell, he again crossed the Atlantic, and tarried in Europe till the spring of 1887. Returning, with renewed vigor, he had not yet entered on any serious work when the heaviest blow of his life, the unforeseen and almost instantaneous death of Mrs. White, threw all his plans into confusion. His married life had been singularly happy, and Mrs. White his almost constant companion. On the expedition to Santo Domingo he had been forced to leave her behind, and after the false rumor of the loss of the commissioners at sea, and the publication of their obituaries in the metropolitan journals, he had come back in safety to find her hair turned to snowy white. Now it was his turn to suffer, and the friends who saw him breaking beneath his grief persuaded him again to go abroad. There he lingered till the late summer of 1889; then, returning, he again took up his home in Ithaca, where—though he had declined the honorary presidency and the deanship of the School of History, which had in turn been tendered him by the university—he was still bound to Cornell by his duties as a trustee. And now, in 1892, there came to preside in his home a second wife, Miss Helen Magill, a daughter of President Magill, of Swarthmore—herself well known as scholar and as educator. In 1892 he was made, by President Harrison, minister of the United States at St. Petersburg, and, retained in that post by Mr. Cleveland, spent at the Russian capital the next two years. It was a pleasing visit, after forty years, to the scene of his earliest diplomatic experiences. His return to this country in 1895, and his appointment in January, 1896, to a place upon the important Commission of Inquiry into the Venezuelan boundary are fresh in the memory of all American readers.

In this busy life, so filled with the cares of the teacher, the politician, the man of affairs, there has been little leisure for the research that goes to the making of books; and few of the literary plans with which he began his career have been realized. His biography of Jefferson was never written. Of his long-dreamed-of history of the French Revolution, for which he collected a material unequaled on this side of the Atlantic, only his admirable little monograph on Paper Money Inflation in France, and his stimulating Bibliography of the Revolution, in the book of Judge Morris, are the visible results. Of his inspiring academic lectures on the general history of modern Europe, but two or three have seen the light as magazine articles; though their topical outlines, printed for his students and by them scattered abroad, have suggested more than one book to younger scholars—as, for example, the excellent study of Mr. Lewis Rosenthal on America and France. The Manual of Historical Literature which Mr. White had proposed as a joint task to his pupil and successor, Prof. Charles Kendall Adams, had finally to be worked out alone by the latter. It is, indeed, as an inspirer of books that his activity has been greatest. Yet he has remained himself a wide reader and a tireless student; and not alone the addresses and magazine articles in which he has brought to bear so tellingly upon a host of present-day problems the fruits of a ripe historical scholarship, but at least one book of serious proportions will attest the quality of his work.

This book, so many of whose chapters are familiar to the readers of the Popular Science Monthly, is his Warfare of Science, or, to give it its full title, his History of the Warfare of Science with Theology in Christendom. It was in the troublous early days of Cornell, when the nonsectarian character of the university was bringing it from its rivals on every side the charge of godlessness, and when Mr. Cornell and Mr. White himself were rewarded for their labors by such epithets as infidel and atheist and by the suspicion of good Christian people everywhere, that it first occurred to him to find comfort and assurance in the study of this stage in the history of all the great intellectual movements through which civilization has been won. From its earliest form, as a mere lecture in 1875, it has grown through twenty years to the two stately volumes now about to be published. In the gathering of its materials, scattered over almost the whole territory of human knowledge, Mr. White has known how to use the aid from time to time of sundry helpers; but even in this preliminary labor his own immediate share has far outweighed all others, and in the digestion and interpretation of his materials no other hand was ever given a part. Clear as is his statement of its thesis, few books have suffered such misjudgment from careless or unkindly critics. What interested him was never the opinions, normal or abnormal, of forgotten theologians; but their interferences, in the mistaken interest of religion, with that freedom of thought and research out of which alone science can grow. Nor was he actuated by any hostility to religion. A man of profoundly religious nature, impatient of irreverence of any kind, and deeply attached to the Christian communion in which he was reared, he seeks only to lift the timid faith which dares not trust the God of the universe to deal truly with the human mind he has made to the loftier conviction that—in his own noble words—"there is a God in this universe wise enough to make all truth-seeking safe, and good enough to make all truth-telling useful."

PROFESSIONAL INSTITUTIONS.

X.—SCULPTOR.

By HERBERT SPENCER.

THE association between architecture, sculpture, and painting is so close that the description of their origins, considered as distinct from one another, is not easy; and those who judge only from the relations under which they are found in the remains of early civilizations are apt to be misled. Thus Rawlinson remarks that—

> "Sculpture in Egypt was almost entirely 'architectonic,' and was intended simply, or at any rate mainly, for architectural embellishment. . . . The statues of the gods had their proper place in shrines prepared for them. . . . Even the private statues of individuals were intended for ornaments of tombs."

Here the implication appears to be that as, in historic Egypt, sculpture existed in subordination to architecture, it thus existed from the beginning. This is a mistake. There is abundant reason to conclude that everywhere sculpture, under the form of carving in wood, preceded architecture, and that the tomb and the temple were subsequent to the image.

In the first volume of this work (§§ 154–158) * evidence of various kinds, supplied by various peoples, was given proving that in its initial form an idol is a representation of a dead man, conceived as constantly or occasionally inhabited by his ghost, to whom are made offerings, prayers for aid, and propitiatory ceremonies. Confusion arising in the uncritical mind of the savage between the qualities of the original and the like qualities supposed to accompany a likeness of the original, long survived. Its survival was shown among the Egyptians by their seemingly strange practice of placing, in a compartment of the tomb, a wooden figure (or more than one) intended as an alternative body for the spirit of the departed on his return, in case his mummied body should have been destroyed. Still more strange is the fact referred to in the sections named above, that among ourselves and other Europeans but a few centuries ago, the effigies of kings and princes, gorgeously appareled, were duly presented with meals for some time after death: such effigies being, some of them, still preserved in Westminster Abbey. Merely recognizing this long persistence of the primitive idea, it here concerns us only to note that the making of a carved or modeled figure of a dead man begins in low stages of culture, along with other elements of primitive religion; and that thus sculpture has its root in ghost-worship,

* Principles of Sociology, vol. i.

while the sculptor, in his primitive form, is one of the agents of this worship.

The tomb and the temple are, as is shown in § 137,* developed out of the shelter for the grave—rude and transitory at first, but eventually becoming refined and permanent; while the statue, which is the nucleus of the temple, is an elaborated and finished form of the original effigy placed on the grave. The implication is that, as with the temple so with the statue, the priest, when not himself the executant, as he is among savages, remains always the director of the executant—the man whose injunctions the sculptor carries out.

Of evidence to be set down in support of this general proposition we may begin with that, relatively small in amount, which is furnished by existing uncivilized races.

Concerning the Gold Coast Negroes, Bosman tells us that they "generally build a small cottage or hut . . . on the grave," and also that in some parts "they place several earthen images on the graves." Bastian, writing of the Coast Negroes, says clay figures of departed chiefs with their families are placed in groups under the village tree. Nothing is added about the makers of these clay images; but in another case we find evidence of priestly origin. According to Tuckey, a certain fetich-rock on the Congo "is considered as the peculiar residence of Seembi, the spirit which presides over the river;" that on some of the rocks "are a number of raised figures," made of some composition which appears "like stone sculptured in low relief"—rude representations of men, beasts, ships, etc.: "they were said to be the work of a learned priest of Nokki who taught the art to all those who chose to pay him."

The Polynesian races yield some evidence: relevant facts are narrated of the Sandwich Islanders by Cook and Ellis. The one describes the burying places as containing many wooden images representing their deities, some in huts, others not; and the other tells us that "each celebrated tii [spirit] was honored with an image." That these celebrated spirits were originally the ghosts of deceased chiefs, is implied by the account given of an allied Polynesian race, the New Zealanders. Among these, according to Thomson, the bodies of chiefs, in some cases "interred within the houses where they died," where they were bewailed by relatives for weeks [a rude temple and a rude worship], had "rude human images, twenty or forty feet high," erected as monuments to them. Though in neither of these cases are we told by whom such images of deceased men were made, yet since of New Zealand artists the best are found among the priests, as asserted by

* Principles of Sociology, vol. i.

Thomson, while Angas tells us that the priest is generally the operator in the ceremony of tattooing, he being supposed to excel in all sorts of carving, the implication is that he is the maker of these effigies—in the cases of chiefs, if not in other cases. For while it is alleged that the house-posts, rudely representing deceased members of an ordinary family, are made by members of the family, we have, in the special characters of the effigies made of chiefs, evidence that priests have been the executants. Dr. Ferdinand von Hochstetter says:—

"The carved Maori-figures, which are met with on the road, are the memorials of chiefs who, while journeying to the restorative baths of Rotorua, succumbed to their ills on the road. Some of the figures are decked out with pieces of clothing or kerchiefs ; and the most remarkable feature in them is the close imitation of the tattooing of the deceased, by which the Maoris are able to recognize for whom the monument has been erected. Certain lines are peculiar to the tribe, others to the family, and again others to the individual."

As the priests are the professional tattooers, probably being also the authorities concerning tribal and family marks, it is a fair inference that they are the makers of these images of chiefs, in which the tribal, family, and individual marks are represented.

Certain usages have been found among the Australians which, if not directly relevant, are indirectly relevant. At an initiation ceremony in the Murring tribe, according to Howitt—

"A similar rude outline of a man in the attitude of the magic dance, being also Daramūlŭn, is cut by the old men (wizards) at the ceremonies, upon the bark of a tree at the spot where one of them knocks out the tooth of the novice. . . .

"At a subsequent stage of the proceedings a similar figure is molded on the ground in clay, and is surrounded by the native weapons which Daramūlŭn is said to have invented."

Here the obvious implication is that the traditional hero, Daramūlŭn, is represented by the figures which the wizards (medicine-men or priests) make; while the initiation ceremony is the dedication of the novice to him, considered as present in the figure: to which figure, indeed, a road is marked out on the tree, down which Daramūlŭn is supposed to descend to the image.

By the above-named house-posts which, among the New Zealanders, are erected as memorials of members of the family, we are introduced to the further set of illustrations furnished by household gods. These the accounts of various races in various parts of the world make familiar.

Concerning the Kalmucks and Mongols, who have such domestic idols, Pallas tells us that the priests are the painters, as well as the makers, of images of copper and clay.

According to Ellis the idol-worship of the Malagasy "appears to have sprung up in comparatively modern times, and long subsequently to the prevalence of the worship of household gods." But who were the makers of either does not appear.

How it would naturally happen that while, in the first stages, the priest was the actual carver of images, he became, in later stages, the director of those who carved them, will be easily understood on remembering that a kindred relation between the artist and his subordinate exists now among ourselves. The modern sculptor does not undertake the entire labor of executing his work, but gives the rough idea to a skilled assistant who, from time to time instructed in the needful alterations, produces a clay model to which his master gives the finished form: the reproduction of the model in marble by another subordinate being similarly dealt with by the sculptor. Evidently it was in something like this sense that priests throughout the East were sculptors in early days, as some are in our own days. Writing of the Singhalese, Tennent says:—

> "Like the priesthood of Egypt, those of Ceylon regulated the mode of delineating the effigies of their divine teacher, by a rigid formulary, with which they combined corresponding directions for the drawing of the human figure in connection with sacred subjects."

From Egypt, here referred to, may be brought not only evidence that the sculptured forms of those to be worshiped were prescribed by the priests in conformity with the traditions they preserved, but also evidence that in some cases they were the actual executants. Mentu-hotep, a priest of the 12th dynasty, yields an example.

> "Very skilled in artistic work, with his own hand he carried out his designs as they ought to be carried out." He "besides was invested with religious functions" and "was the *alter ego* of the king." His inscription says:—"I it was who arranged the work for the building of the temple."

An inscription of the 18th dynasty refers to one Bek, architect of Amenhotep IV, who being described as "the follower of the divine benefactor" was apparently a priest, and who was both an executant and a supervisor of other's work. He is referred to as—

> "overseer of the works at the red mountain, an artist and teacher of the king himself, an overseer of the sculptors from life at the grand monuments of the king for the temple of the sun's disk."

A further fact is given. Bek says of himself—"My lord promoted me to be chief architect. I immortalized the name of the king . . . [I caused] to be made two portrait-statues of noble hard stone in this his great building. It is like heaven. . . . Thus I executed these works of art, his statues."

What evidence Greek records yield, though not extensive, is to the point. Curtius, who, referring to actions of the singers and composers of hymns as well as to those of the plastic artists, says that "the service of the temple comprehends the whole variety of these efforts," also says that "the earliest sculptors were persons of a sacerdotal character." On another page he adds, concerning sculpture—

" . . . in this domain of artistic activity, all things were bound by the decrees of the priests and by close relations with religion. . . . They [artists] were regarded as persons in the service of the divine religion."

The extent to which sculpture subserved religious purposes may be judged from the statement of Mahaffy that—

"The greatest sculptors, painters, and architects had lavished labor and design upon the buildings [of the oracle at Delphi]. Though Nero had carried off 500 bronze statues, the traveler estimated the remaining works of art at 3,000, and yet these seem to have been almost all statues.".

As showing the course of professional development it may be remarked that though, in archaic Greek sculpture, the modes of representing the various deities were, as in Egypt and India, so completely fixed in respect of attitudes, clothing, and appurtenances that change was sacrilege, the art of the sculptor, thus prevented from growing while his semi-priestly function was under priestly control, simultaneously began to acquire freedom and to lose its sacred character when in such places as the pediments of temples, figures other than divine, and subjects other than those of worship, came to be represented. Apparently through transitions of this kind it was that sculpture became secularized. Men engaged in chiseling out statues and reliefs in fulfillment of priestly dictates were regarded simply as a superior class of artisans, and did not receive credit as artists. But when, no longer thus entirely controlled, they executed works independently, they gained applause by their artistic skill and "became prominent celebrities, whose studios were frequented by kings.

To the reasons, already more than once suggested, why in Rome the normal development of the professions was broken or obscured, may be added, in respect of the profession of sculptor, a special reason. Says Mommsen :—

"The original Roman worship had no images of the gods or houses set apart for them; and although the god was at an early period worshiped in Latium, probably in imitation of the Greeks, by means of an image, and had a little chapel (*aedicula*) built for him, such a figurative representation was reckoned contrary to the laws of Numa."

The appended remark that the representation of the gods was "generally regarded as an impure and foreign innovation" appears to be in harmony with the statement of Duruy.

"Even after the Tarquins, the images of the gods, the work of Etruscan artists, were still made only in wood or clay, like that of Jupiter in the Capitol, and like the quadriga placed on the top of the temple."

The contempt felt by the Romans for every other occupation than the military, and the consequent contempt for art and artists imported from conquered peoples, resulted in the fact that in the time of the Cæsars sculptors and painters "were generally either slaves or freedmen." Probably the only concern the priests had with sculpture was when prescribing the mode in which this or that god should be represented.

Such records as have come down to us from early Christian times illustrate the general law of evolution in the respect that they show how little the arts of design were at first specialized. It has been often remarked that in days comparatively modern, separation of the various kinds of mental activity was much less marked than it has since become: instance the fact that Leonardo da Vinci was man of science as well as artist; instance the fact that Michael Angelo was at once poet, architect, sculptor and painter. This union of functions seems to have been still more the rule in preceding ages. Evidence about the sculptors' art is mingled with evidence about kindred arts. Says Emeric-David—"The same masters were goldsmiths, architects, painters, sculptors, and sometimes poets, as well as being abbots or even bishops." We are told by Challamel that the industrial art by pre-eminence was gold-working. The great artists in it were monks or at least clerics. The great schools of it were monasteries. And it was for the use of churches—ecclesiastical vestments and decorations, funeral monuments, etc.

In the last part of this statement we see the implication that the sculpturing of figures on monuments was a priestly occupation. This is also implied by the statement of Emeric-David that in the 10th cent. Hugues, monk of Monstier-en-Der, was painter and statuary. Further proof that miscellaneous art-works were carried on by the clerical class is given by Lacroix and Seré, who say that early in the 11th cent. a monk, named Odoram, executed shrines and crucifixes in gold and silver and precious stones. In the middle of the century another monk, Theophilus, was at once painter of manuscripts, glass-stainer, and enameling goldsmith.

Concerning these relationships in England during early days, I find no evidence. The first relevant statements refer to times in which the plastic arts, which no doubt were all along shared in by those lay-assistants who did the rough work under clerical direction—such as chiseling out monuments in the rough according to order—had lapsed entirely into the hands of these lay-assistants. Having been in the preceding times nothing but skillful artisans, their work, when it came to be monopolized by them, was for a long time regarded as artisan-work. Hence the statement that—

"Previously to the reign of Charles I the sculptor seems hardly to have been considered an artist." "Nicholas Stone was the sculptor most in vogue. He was master-mason to the king."

I may add that in early days, monks—St. Dunstan being an example—occupied themselves in executing the details of ecclesiastical buildings—the foliations of windows, screens, and the like. It is said that when sculpturing the heads used for gargoyles, they sometimes amused themselves by caricaturing one another.

Recent stages in the development of sculpture are not easy to trace. But there seems to have occurred in modern times a process parallel to that which we saw occurred in Greece. During the first stages in the secularization of his business the carver of marble carried with him the character previously established—he was a superior artisan. Only in course of time, as his skill was employed for other than sacred purposes, did he become independent and begin to gain reputation as an artist. And his position has risen along with the devotion of his efforts more and more to subjects unconnected with religion.

Let it be observed, however, that even still sculpture retains in considerable measure its primitive character as an ancillary to ancestor-worship. A carved marble effigy in a Christian church differs but little in meaning from a carved wooden figure of a dead man placed on his grave in savage and semi-civilized societies. In either case the having an image made, and the subsequent conduct in presence of it, imply the same prompting sentiment: there is always more or less of awe or respect. Moreover, sculpture continues to be largely employed for the expression of this sentiment, not in churches only, but in houses. The preservation of a bust by descendants commonly implies recognition of worth in the original, and is thus in a faint way an act of worthship.

Hence only that kind of sculpture which is not devoted to the representation of deceased persons, in either public or in private edifices, or in open places, can be considered as absolutely secularized. One who takes his subjects from ancient myth, or history, or from the life around, may be considered as alone the sculptor who has lost all trace of the original priestly character.

With recognition of the completed process of differentiation there is nothing here to join respecting the process of integration. Sculptors have not yet become sufficiently numerous to form entirely independent unions. Such combination as has arisen among them we shall have to recognize in the next chapter, in association with the combinations of painters.

LORD SALISBURY ON EVOLUTION.*

By HERBERT SPENCER.

ENTHUSIASTIC adherents have compared the principle of natural selection with the principle of gravitation. The comparison is not warranted. In the first place the one is far from having a like cardinal value with the other as a scientific truth; and in the second place it is not the sole cause of the phenomena to be explained, as Mr. Darwin himself admitted when recognizing the inherited effects of use and disuse. Nevertheless, after making these reservations, I will for a moment adopt the comparison; because, by its aid, I shall be enabled clearly to show the nature of a widely prevalent misconception.

Let us suppose that our days were the days when Newton had lately propounded his theory, and that the newspaper reader (or as there were few such in those days, let us say "the man in the street") had been told about it. Suppose it had been explained to him that, according to Newton, bodies attract one another directly as their masses and inversely as the squares of their distances, and that the phenomena presented by the Solar System had been accounted for by him as conforming to this law. Suppose that presently the man, thus far instructed, learned that there were skeptics: Clairaut, for instance, having found that certain of the Moon's motions could not be explained as results of gravitation, and that consequently Newton's interpretation of planetary motions was untenable. Now suppose the man inferred that along with the theory of gravitation the theory of the Solar System must be abandoned; and that certain views of Copernicus, of which he had heard, and certain other views of Kepler, had been disproved. What, in such case, should we say? Evidently that the man made a profound mistake in identifying the theory of gravitation with the theory of the Solar System. We should say that there were independent reasons for accepting the Copernican system and the laws of Kepler; and that though, were the law of gravitation disproved, the pre-existing theory of the Solar System would lack that rational interpretation which the law of gravitation gave to it, yet it would remain standing on conclusive evidence.

Mr. Darwin's doctrine of natural selection and the doctrine of organic evolution are, by most people, unhesitatingly supposed to be one and the same thing. Yet between them there is a difference analogous to that between the theory of gravitation and the theory of the Solar System; and just as the theory of the Solar

* Inaugural Address to the British Association, 1894.

System, held up to the time of Newton, would have continued outstanding had Newton's generalization been disproved, so, were the theory of natural selection disproved, the theory of organic evolution would remain. Whether it were shown that natural selection is inoperative, or whether it were shown that though a partial cause it is inadequate to explain all the facts (the inheritance of functionally-wrought modifications being a co-operative cause); or whether it were shown that no cause hitherto alleged is adequate; the general doctrine that organisms of all kinds have arisen by the continual superposing of modifications upon modifications would maintain its place, though it would not be fortified so strongly. Lord Salisbury, however, in common with the immense majority of men, assumes that the hypothesis of organic evolution must stand or fall with its alleged causal agencies. Though in one paragraph he distinguishes between natural selection as an alleged agent, and the facts regarded as implying evolution which are said to be explained by it, yet, at the close of his address, he assumes the two to be so indissolubly connected that, if natural selection goes, evolution must go with it—that the facts are not naturally explicable at all, but must be regarded as supernatural. He says, referring to Prof. Weismann:—"I quite accept the Professor's dictum that if natural selection is rejected we have no resource but to fall back on the mediate or immediate agency of a principle of design." And thus he indorses the popular notion that Darwinism and Evolution are equivalent terms.

Though, speaking on behalf of biologists, who are conscious of the difference, Prof. Huxley, in seconding the vote of thanks, demurred to this identification, yet the above-quoted sentence reappears in the revised and republished form of Lord Salisbury's address.

Absence of direct proof of natural selection is duly emphasized by Lord Salisbury. He says:—"No man or succession of men have ever observed the whole process in any single case, and certainly no man has recorded the observation." And, as direct proof of the hypothesis is not forthcoming, it is tacitly assumed that we must accept the alternative hypothesis, which is equally without direct proof. Here I may be excused if, *à propos* of this position, I reproduce some passages from an essay published in pre-Darwinian days, when the development hypothesis, as it was then called, was universally ridiculed. The first part of the essay runs as follows:—

In a debate upon the development hypothesis, lately narrated to me by a friend, one of the disputants was described as arguing that as, in all our experience, we know no such phenomenon as transmutation of species, it is unphilosophical to assume that transmutation of species ever takes place.

Had I been present I think that, passing over his assertion, which is open to criticism, I should have replied that, as in all our experience we have never known a species *created*, it was, by his own showing, unphilosophical to assume that any species ever had been created.

Those who cavalierly reject the Theory of Evolution as not being adequately supported by facts, seem to forget that their own theory is supported by no facts at all. Like the majority of men who are born to a given belief, they demand the most rigorous proof of any adverse belief, but assume that their own needs none. Here we find, scattered over the globe, vegetable and animal organisms numbering, of the one kind (according to Humboldt), some 320,000 species, and of the other, some 2,000,000 species (see Carpenter); and if to these we add the numbers of animal and vegetable species which have become extinct, we may safely estimate the number of species that have existed, and are existing, on the Earth, at not less than *ten millions*. Well, which is the most rational theory about these ten millions of species? Is it most likely that there have been ten millions of special creations [each implying a conscious design and acts in pursuance of it] ? or is it most likely that, by continual modifications due to change of circumstances, ten millions of varieties [i. e. kinds] have been produced ? . . .

Doubtless many will reply that they can more easily conceive ten millions of special creations to have taken place, than they can conceive that ten millions of varieties have arisen by successive modifications. All such, however, will find, on inquiry, that they are under an illusion. . . . Careful introspection will show them that they have never yet realized to themselves the creation of even *one* species. If they have formed a definite conception of the process, let them tell us how a new species is constructed, and how it makes its appearance. Is it thrown down from the clouds ? or must we hold to the notion that it struggles up out of the ground ? Do its limbs and viscera rush together from all the points of the compass ? or must we receive the old Hebrew idea, that God takes clay and molds a new creature ? . . .

Should the believers in special creations consider it unfair thus to call upon them to describe how special creations take place, I reply that this is far less than they demand from the supporters of the development hypothesis. They are merely asked to point out a *conceivable* mode. On the other hand, they ask, not simply for a *conceivable* mode, but for the *actual* mode. They do not say—Show us how this *may* take place ; but they say —Show us how this *does* take place. So far from its being unreasonable to put the above question, it would be reasonable to ask not only for a *possible* mode of special creation, but for an *ascertained* mode; seeing that this is no greater a demand than they make upon their opponents.

It is true that the contrast of evidences here emphasized refers not to the theory of the origin of species through natural selection, which at that time (1852) had not been propounded, but refers to the theory of organic evolution considered apart from any assigned causes, or rather, as due to the general cause—adaptation to conditions. The contrast remains equally strong, however, if, instead of the general doctrine the special doctrine is in question; and the demand for facts in support of this special doctrine may similarly be met by the counter-demand for facts in support of the doctrine opposed to it. Perhaps Lord Salisbury will meet this demand by quoting the statements contained in the book of Genesis. But even if, ignoring the skepticism of professed biblical critics, such as the Rev. Prof. Cheyne, he puts absolute faith in these statements current among nomadic groups of shepherds three thousand years ago, he is obliged to admit that these alleged facts are not of the class he refers to when he asks for proof of the hypothesis of natural selection: they are not facts of direct observation.

Thus, supposing the two hypotheses—special creation and evolution by natural selection—are to be tested by the directly observed facts assigned in their support, then, if the hypothesis of evolution by natural selection is to be rejected because there are no directly observed facts which prove it, the hypothesis of special creation must be rejected for the same reason. Nobody has seen a species evolved and nobody has seen a species created.

But now from the question of direct evidence let us pass to the question of indirect evidence. Let us ask if there are any positive facts of observation which tend to justify the one, and whether there are any positive facts of observation which tend to justify the other. Here a comparison leads to widely different results. Familiar though some of the facts are, I must be excused for specifying them, since Lord Salisbury ignores them.

Though, because most of the geological record has been destroyed while the remnant has been dislocated or blurred, and because so small a part—an infinitesimal part—of this remnant has been examined, paleontology furnishes but broken evidence, yet the more the Earth's strata are examined the more they testify that organic forms have arisen by modifications upon modifications. Recent discoveries, especially those which show by intermediate forms that the bird-type is derived from the reptile-type, and those which show that, beginning with the four-toed *Orohippus* of the Eocene strata, we ascend in later strata, through *Mesohippus*, *Miohippus*, *Protohippus*, and *Pliohippus*, up to the modern horse, have given strong support to the hypothesis of evolution: support so strong that Prof. Huxley, who had up to the time he saw Prof. Marsh's fossils made reservations in his acceptance of the hypothesis, thereafter accepted it without reserve. Not only do fossils furnish in this and other cases the lines of linear ascent to existing forms, but they simultaneously disclose a general fact of great significance—the fact that early types of creatures in any class display the commonest or most general traits of structure, and that later types of the same class are more specialized in this or that direction: relationships which are necessarily implied by the evolutionary process of divergence and redivergence with accompanying modifications.

The truths of classification, again, have a kindred meaning. Ordinary people, and even naturalists of the old school, pass by as of no significance the remarkable relations which, in both plant and animal kingdoms, exist among their divisions, subdivisions, and sub-subdivisions—their classes, subclasses, cohorts, orders, genera, species, varieties. The fact that these fall into groups within groups, successively decreasing in size, consists perfectly with the supposition of common origin. Suppose an arm of a large tree to have been buried in such wise as to leave only the tips of its twigs visible; and suppose a man from the Faroe Isles, ignorant of trees, taking one of these protruding tips for a separate plant, attempted to uproot it. He would find that below the surface the twig he uncovered joined with others like itself to form a small branch; and explorations all around would prove that everywhere the local clusters of twigs thus converged. Further excavations would show that the adjacent branchlets, composed of clusters of twigs, themselves united a little deeper down, and were subdivisions of a medium-sized branch. Again digging he would discover that several such branches formed parts of a still larger branch; and so on continually, until complete clearance made it manifest that all these great branches, small branches, branchlets, and twigs, in their respective groups, had diverged from the one original arm of the tree, which itself had diverged from the stem; and that they formed groups within groups diminishing in size as they became more remote from their common parent. And now observe that while there are thus symbolized the relationships of species, genera, orders, etc., as they now exist, there are also symbolized the relationships which, so far as we know them, exist among remains contained in the Earth's crust: the two sets of phenomena correspond.

The lesson taught by the facts of distribution in Time, is also taught by the facts of distribution in Space. In various regions there are alliances between the present fauna and the past fauna found fossil: though different, they are near akin. It was "this wonderful relationship in the same continent between the dead and the living" which especially forced on Mr. Darwin the belief in descent and modification: this relationship having been demonstrated by Prof. Owen between the existing South American forms and the buried forms of extinct species. The fact that in Australia, long cut off from the other continents, all the indigenous mammals are of the implacental type, and that the fossil mammals found there are also exclusively implacental, illustrates these connections very clearly. And these likenesses of nature between present faunas and past faunas in the same localities are implications agreeing exactly with the implications pointed out above.

Once more there are the facts of embryology. In various ways these tell us with endless repetition the same story.

Von Baer "found that in its earliest stage, every organism has the greatest number of characters in common with all other organisms in their earliest stages; that at a stage somewhat later, its structure is like the structures displayed at corresponding phases by a less extensive multitude of organisms; that at each subsequent stage, traits are acquired which successively distinguish the developing embryo from groups of embryos that it previously resembled—thus step by step diminishing the class of embryos which it still resembles; and that thus the class of similar forms is finally narrowed to the species of which it is a member."

Obviously these groups, dividing and subdividing into smaller ones as they diverge and re-diverge, correspond completely to the groups within groups which the classifications of animals and plants show us, and with the groups within groups of the buried branch, which symbolize both their relations and the relations of fossil forms, so far as we know them. That is to say, what we may call the embryological tree corresponds with the classificatory tree, and with those more modern parts of the paleontological tree which we have been able imperfectly to trace. Moreover, if we accept the hypothesis of evolution, the strange transformations undergone by a developing embryo become intelligible, though otherwise unintelligible. Every superior animal commences as a nucleated cell, a form common to the smallest and simplest creatures, the *Protozoa*. While, among the *Protozoa*, this nucleated cell, by undergoing fission gives rise to others which part company (which derived cells again divide and part company), the trait common to the *Metazoa* is that, instead of parting company, the cells formed by successive fissions remain together and constitute a cluster. The members of this cluster divide into two layers, between which, in higher types, there arises a third; and from these all the external and internal organs are formed. In each great class of *Metazoa*, further development of each higher type is accompanied by a "recapitulation" of traits distinctive of lower types. In the *Vertebrata*, for instance, the embryo of a bird or a rabbit has, at one time, traits resembling those of the fish-embryo—structures roughly representing gill-clefts being one. And in the case of the human embryo, it is only after exhibiting successive kinships of organization to lower mammals, that it at last assumes the form proper to man. Marvelous as is this repetition of traits belonging to lower types, rudely indicated, it is quite congruous with the hypothesis of evolution—implies a kind of transcendental heredity. On the other hand, the hypothesis of design furnishes no explanation, but presents an insurmountable difficulty. For if the development of the embryo had been divinely arranged, it would surely have gone along lines of direct growth from the germ to the finished form: would not have displayed various metamorphoses having no relations either to passing needs or to ultimate structure and mode of life. With which evidence may be joined the evidence furnished by rudimentary organs, which are full of meaning on the evolution hypothesis, but worse than meaningless in the special-creation hypothesis.

But these four great groups of facts, suggesting in different ways the same history, stand thus far without assigned cause. How come these progressive modifications to have taken place? and why are the modified forms connected with one another in the ways shown alike by paleontology, by classification, by distribution, and by embryology? The reply is that we need only look around to see everywhere at work a general cause which, if it has been at work throughout all time, yields an explanation. Take any plant or animal and expose it to a new set of circumstances (circumstances not so unlike its previous ones as to prove fatal), and it begins to change; and the change is one which eventually adapts it to the new conditions. By what special causes the adaptive modifications are effected does not at present concern us. Here the argument requires us only to recognize the truth that in some way the organization is molded to the new conditions. Though—to illustrations furnished by cultivated plants and domesticated animals—it may be objected that artificial selection has been at work, yet, since artificial selection implies variations, it implies that the selected plants and animals have been modified by external influences, and that the modifications have been inherited and accumulated. And then, if there needs a case in which artificial selection has not come into play, we have a sufficiently striking one in the human race itself. Unless there be adopted the hypothesis (excluded by Lord Salisbury's implied belief) that varieties of men have been independently created, the conclusion is irresistible that their differences have been caused by unlikenesses in their lives carried on in unlike environments. Either their differences are uncaused, which is absurd, or they are differences which have *un*fitted each variety for its conditions, which is also absurd, or they are differences which have fitted each variety for its conditions; and, if so, they have resulted from the response of the constitution to the conditions themselves: the only supposition which is not absurd. And that this is the necessary interpretation is shown by cases in which—either by the killing off of unfit individuals, or by the effects of habit, or by both—extraordinary adaptations have been produced. There are, as examples, the Fuegians, who in their wretched islands go about naked while the falling snow melts on their bodies; there are the Yakutes—the "iron men," as they are called—who, in their rigorous climate, sleep in the open air and wake covered with hoar-frost; there are the Hindus, constitutionally adjusted to the tropics in such way that they can sleep in the burning sunshine; and, again, there are Indian hill-tribes living comfortably in malarious localities which are fatal not only to Europeans but to Hindus. Moreover, while we thus get proof that organisms fit themselves to their environments, we also get proof that there simultaneously result divergences and re-divergences of races and varieties. Men have spread from some original locality into other localities in all directions; and there have resulted sundry widely unlike families appropriate to their respective habitats, and less unlike breeds diverging within them, such as the Aryan peoples of Europe. This process which the human species shows us is, and always has been, the process with every kind of organism. While we are shown a general cause which has been superposing modifications upon modifications from the beginning, we are also shown how there has arisen a concomitant formation of class within class. The cause we find in operation is a cause of the kind needed to explain the remarkable relations above described.

Thus we have four great groups of observed facts (or five if we include those concerning rudimentary organs) all suggesting the same history, all converging to the same conclusion: their joint significance being immense in comparison with the significance of each group taken by itself. And in the adaptation of organisms to their conditions, directly or indirectly brought about, we have a cause which makes these aggregates of phenomena intelligible. On these mutually-verifying sets of evidences the hypothesis of evolution stands by itself, quite apart from any conclusions respecting its special causes. Hence the meaning of the assertion made above, that even were all theories about the special causes disproved, the doctrine of evolution would remain standing.

And now, having contemplated the observed facts which indirectly support the hypothesis of evolution, let us ask for the observed facts which indirectly support the alternative hypothesis. There are none. Neither in the air, nor on the earth, nor in the water do we find anything implying special creation. Nay, indeed, not only do we see no facts favoring the supposition, but we see a world of facts conflicting with it. From hour to hour incidents showing the uniformity of law and the constant relations of causes and effects generate in us convictions so incongruous with it as to produce instant disbelief of an alleged special creation now occurring. Should any one say that having taken into his room a bowl containing nothing but clear water, he saw a fish suddenly appear in it; or should he say that he had seen near the ground a mass of cloud which, contracting and getting more dense, assumed the form of an unknown animal, what comment should we make? Simply that he was either deluding himself or trying to delude us. We should show by our ridicule that the idea of a special creation, when brought distinctly before us by alleged cases, is too absurd to be entertained.

See, then, the antithesis. While the hypothesis of organic evolution is indirectly supported by great masses of observed facts, the hypothesis of special creation is not only without indirect support from observed facts, but is indirectly contraindicated by the enormous accumulation of observed facts constituting our daily experience.

Striking as this antithesis is, it becomes still more striking when we contemplate the two hypotheses under another aspect. Lord Salisbury implies that in the absence of observed facts directly proving the formation of a species by natural selection, the hypothesis of natural selection can not be sustained. He says:—"I think Prof. Weismann is justified in saying that we can not, either with more or less ease, imagine the process of natural selection"; and he presently implies that in the absence of positive proof the hypothesis of natural selection is "mere conjecture." Let me in the first place point out that Prof. Weismann's meaning is here seriously misrepresented. In the passage Lord Salisbury refers to, Prof. Weismann says of natural selection:—"We accept it—not because we are able to demonstrate the process in detail; not even because we can with more or less ease imagine it [in detail], but simply *because we must*, etc." And that this is his meaning is proved by the fact that a previous passage to which he refers by the words "as already indicated," runs as follows:—"For *it is really very difficult to imagine this process of natural selection in its details.*" Surely there is an immense difference between the meaning intended and the meaning ascribed. It is perfectly easy to imagine that a flying cannon-ball will presently fall and do damage, while it may be "very difficult to imagine," "in its details," the damage it will do. But, passing over this, let us now consider whether, in the absence of observed facts proving the production of a species by natural selection, we have warrant for the theory of natural selection.

I have always regretted that Mr. Darwin chose this phrase to describe his hypothesis. The word "selection" connotes a *conscious process*, and so involves a tacit personalization of Nature. By tacitly personalizing that aggregate of surrounding agencies which we call Nature, it introduces vaguely the idea that Nature may select as a human breeder selects—can select and increase a particular quality—which is true only under certain conditions. Further, it raises the thought of choice—suggests the notion that Nature may or may not operate in the alleged way.

It was partly the consciousness that wrong ideas are called up in these ways which led me, when writing *The Principles of Biology*, to substitute the phrase "survival of the fittest"—partly, I say, because, as is shown in § 164 of that work, the phrase naturally emerges when we contemplate, from a purely physical point of view, the phenomena of life and death in connection with surrounding actions. My belief is that had Mr. Darwin used this phrase, many misunderstandings of his theory would never have arisen, and many objections to his inferences would have been excluded. Among other excluded objections would have been that raised by Lord Salisbury, who thinks that, lacking a basis of observed facts, the hypothesis of natural selection has no basis. For if we substitute the phrase "survival of the fittest," it becomes manifest that the process is a necessary one. To see this it needs but to affirm the opposite and say that the law is survival of the unfittest—that those creatures which were fit to live have died, and those have lived which were unfit to live. These statements embody a contradiction. Hence survival of the fittest is inevitable—is just as certain a truth as a mathematical axiom, which we accept because the negation of it is inconceivable.

Heredity, otherwise manifest, being clearly proved by the experience of breeders, survival of the fittest necessarily implies that those individuals which have structures best adapted to their environments, will, on the average, have better adapted posterity than the rest; and that so the fitness to the environment will be maintained. A further unavoidable corollary is that if the habitat changes in character, or if there occurs a migration to another habitat, the most unfitted will disappear in a greater proportion than the least unfitted; and that from destruction of the most unfitted in successive generations, there will result a continually-diminished unfitness to the new habitat, until there is reached a fitness for it. These are inferences which it is impossible to escape.

Whether by this process a particular variation will be perpetuated and increased, is quite another question. The answer depends on the answer to another question—in what degree, all things considered, does the particular variation conduce to maintenance of life? But while the survival and multiplication of individuals having some advantageous modification of structure, is not a necessary result, the survival and multiplication of individuals having natures, or *aggregates of characters*, which best fit them to the requirements of their lives, *is* a necessary result; and it is a necessary truth that this involves the establishment of a varied structure where this in a predominant degree aids them in fulfilling the vital requirements of their lives.

Mark, now, how the strong contrast set forth in the preceding section is thus strengthened. We saw that the evolution-hypothesis is indirectly supported by five great classes of observed facts; and that the perpetual adaptation and re-adaptation of constitution to conditions is a general cause of the kind required to account for these facts. Here we see that, of the special causes which effect adaptation, the chief one, survival of the fittest, is not only one the operation of which we can clearly conceive, but one which it is impossible to conceive as not operating. On the other hand, we saw that there are absolutely no observed facts which yield indirect support to the hypothesis of special creation; but that, contrariwise, all the observed facts of daily experience, proving a constant order among phenomena, negative the hypothesis. And we also saw that while the process of special creation can not be rationally conceived, the negation of it is perfectly conceivable. Thus, bringing the contrast to a focus, it appears that the one is credited both *a posteriori* and *a priori*, and the other is discredited both *a posteriori* and *a priori*. No stronger contrast in credibility can well be imagined.

Authoritative expositions of the process of natural selection afford no basis for that burlesque of it with which Lord Salisbury amused the public. The *Origin of Species* does not assume, as a requisite, the chance meeting of similarly varied individuals; and in Chapters III. and VI. of Mr. Wallace's *Darwinism*, where are assigned evidences which have accumulated since Mr. Darwin wrote, there are described processes quite other than that which Lord Salisbury describes. After referring to artificial selection, and implying that the success of breeders in producing a desired variety depends on their skill "in bringing the right mates together," he goes on to ask:—

"But in natural selection who is to supply the breeder's place? . . . What is to secure that the two individuals of opposite sexes in the primeval forest, who have been both accidentally blessed with the same advantageous variation, shall meet, and transmit by inheritance that variation to their successors?"

Even in the absence of the expositions above referred to, knowledge of familiar facts should have excluded this representation of the requirements. The contents of stud-books and herd-books might have been expected to suffice. It needs but to remember the care with which is specified a descent from some noted sire which lived several generations ago, to recognize the prevailing belief that a variation existing in a particular animal is transmitted in a greater or less degree to posterity, quite apart from the possession of the same variation by the animal with which it is mated; and this belief is held by men who, as breeders, stake large profits on its truth. How, then, can it be said that without the union of two similarly varied individuals, "the new breed would never even begin, let alone the question of its perpetuation after it had begun." And here, to show still more clearly how experience negatives Lord Salisbury's assumption, let me give some evidence furnished not by domestic animals, but by human beings. Referring to a controversy which I have recently been carrying on with Prof. Weismann, Dr. Lindsay Johnson, F. R. C. S., who practices as an ophthalmic surgeon, and who tells me that the experience of other oculists verifies his own, testifies to the transmission of acquired myopia through several generations. He says (I quote with his permission) :—

> "I have seen a very large number of myopic patients who have had long-sighted parents and grandparents, but who have, during their studies or occupations, acquired a considerable degree of short sight and astigmatism, and then having had children from a normal or long-sighted wife (with normal-sighted parents and grandparents) it has been found that several of these children have grown up myopic and perpetuated it to their offspring again."

And he sends me a genealogical tree showing that in a family of six children descending from long-sighted ancestry on both sides, four remained normal-sighted, but two, who were miniature painters, became myopic. Of these one, marrying a normal-sighted wife, had two children, of whom one was myopic; and the other, marrying also a normal-sighted wife, had three children, all myopic. Two of these three married normal-sighted wives, and among their children there was in each case one who had become myopic, while the rest are as yet too young to display the defect, for it never occurs until after eight years old. That the inherited trait is in this case one caused by use, and not one arising spontaneously, does not affect the issue. There is proof that a modification of structure existing in one parent may descend to children when no similar modification is possessed by the other parent; and, further, that this modification may be re-transmitted, also without the aid of the second parent: facts which negative Lord Salisbury's assumption.

Let us now consider what is the corollary as respects modification of varieties and formation of species. Travelers tell us that the Bushmen are so long-sighted that they can see as far with the naked eye as a European can with a telescope. Allowing for some exaggeration, it is safely to be inferred that they have marvelous powers of discerning objects at great distances. How has this trait arisen? Small men as they are, wandering about in single families, Bushmen have to guard against enemies, brute and human, and must be ever on the alert to kill or snare animals serving for food. To identify distant moving objects as such or such, is therefore essential to the preservation of life. Here is one who, perhaps from some advantageous variation in the forms of the lenses, or in the adjusting muscles, or in the retinal elements, has vision so keen that he recognizes a man, or a lion, or a springbok, when its distance is half a mile greater than that at which other Bushmen can recognize it. What happens? He is enabled the sooner to take measures for his safety, or to make preparations for a hunt; and in either case has an increased chance of preserving life. By his wife, who has but the ordinary keenness of vision, he has children, some of whom, if not all of whom, inherit this peculiarity; and for the same reasons as before, these have, other things equal, better chances of surviving than the rest. If among their descendants some have the peculiarity in an increased degree, if some inherit it in the same degree, and others in smaller degrees in consequence of intercrossing, there will be a tendency, in virtue of the more frequent survival of individuals who are wholly inheritors or partially inheritors, to increase the distance-vision of the tribe: the stirp will spread more than other stirps. So that even were there no other way of establishing a variation save inheritance from a single varying individual, we may see how it will, if of life-saving efficiency, become established.

But there *is* another way in which variations become established. Creatures inhabiting the same region as the Bushmen furnish an illustration. The general structure of the giraffe is interpretable only as resulting from the co-operation of both factors in the production of species: the selection of variations and the inheritance of acquired characters. But there is one trait of structure attributable to natural selection alone. The giraffe has a prehensile tongue, almost snakelike in form. This it curls round the small branches of trees and pulls them into its mouth. So that, other things equal, a giraffe with an unusually long tongue is able to obtain twigs and clusters of leaves that are beyond the reach of those not similarly endowed; and, when food is scarce, has an advantage. As with the long-sighted Bushman so with the long-tongued giraffe, descendants wholly or partially inheriting the variation will form a prosperous and increasing stirp. But now observe that besides extraordinary variations there are the ordinary variations—variations such as those occurring in the sizes of the hands among ourselves. Let us suppose the average length of the giraffe's tongue to be one foot, and that there are all degrees of greater lengths up to thirteen inches, and all degrees of smaller lengths down to eleven inches: the numbers above and below the average being assumed equal. In the prehension of the highest branchlets a number of the shortertongued will fail where a number of the longer-tongued succeed. As every creature multiplies up to the limits set by the means of subsistence, herds of giraffes must be from time to time underfed. At such times the short-tongued ones must be more underfed than the long-tongued ones. The difference of feeding may not be such as to produce in a direct way greater mortality in the one class than in the other, but it may readily tell indirectly. Especially will there be more deaths of the weaker adults, and the less vigorous young they have produced, when the herd is chased by carnivores. Those which are a yard or two behind the rest lose their lives; and a very small defect in the constitutional state of the adults, or the strength of the young, may entail the slight difference in speed implied. So that, other things equal, more of the short-tongued and their offspring will die than of the long-tongued and their offspring. Hence, without any special choice of mates, it will result that in the next generation the average of length of tongue will be greater. Through subsequent generations the same process will go on increasing this advantageous variation, until some limit is reached at which disadvantages check it, or at which the life-sustaining advantages from some other variation become greater.

So that in the absence of any such improbable events as those Lord Salisbury supposes to be necessary, there are two co-operating ways in which survival of the fittest establishes in a species a useful modification of structure.

The great length of time required for the production of species by the evolutionary process, is supposed by Lord Salisbury to furnish a reason for disbelief. In support of his argument he cites Lord Kelvin's conclusion that life can not have existed on the Earth more than a hundred millions of years. Respecting Lord Kelvin's estimate it may be remarked that the truth of a conclusion depends primarily on the character of the premises; that mathematical processes do not furnish much aid in the choice of premises; that no mathematical genius, however transcendent, can evolve true conclusions out of premises that are either incorrect or incomplete; and that while putting absolute faith in Lord's Kelvin's reasonings, it is possible to doubt the data with which he sets out. Suppressing criticism, however, let us accept in full the hundred million years, and see what comes of it. Lord Salisbury argues:—

"If we think of that vast distance over which Darwin conducts us, from the jelly-fish lying on the primeval beach to man as we know him now; if we reflect that the prodigious change requisite to transform one into the other is made up of a chain of generations, each advancing by a minute variation from the form of its predecessor, and if we further reflect that these successive changes are so minute that in the course of our historical period—say three thousand years—this progressive variation has not advanced by a single step perceptible to our eyes, in respect to man or the animals and plants with which man is familiar, we shall admit that for a chain of change so vast, of which the smallest link is longer than our recorded history, the biologists are making no extravagant claim when they demand at least many hundred million years for the accomplishment of the stupendous process."

I will not stop to criticise the assumption that the jelly-fish is a remote ancestor of man; but, accepting all his data, will simply inquire how far Lord Salisbury's conclusion is warranted by them. As introductory to the criticism, I can not do better than quote another passage from the early essay named at the outset: merely remarking that the physiologist referred to as adverse in 1852, would not be thus referred to now. After remarking that those who know nothing of the science of life may naturally "think the hypothesis that all races of beings, man inclusive, may in process of time have been evolved from the simplest monad, a ludicrous one," the passage continues:—

"But for the physiologist, who knows that every individual being *is* so evolved—who knows, further, that in their earliest condition the germs of all plants and animals whatever are so similar, "that there is no appreciable distinction amongst them, which would enable it to be determined whether a particular molecule is the germ of a Conferva or of an Oak, of a Zoophyte or of a Man"; *—for him to make a difficulty of the matter is inexcusable. Surely if a single cell may, when subjected to certain influences, become a man in the space of twenty years; there is nothing absurd in the hypothesis that under certain other influences, a cell may, in the course of millions of years, give origin to the human race."

Suppose we pursue the comparison indicated in the last sentence. Lord Salisbury invites us to reflect on "the prodigious change" required to transform his hypothetical jelly-fish into a man. He appears never to have reflected upon "the prodigious change" which in a few months transforms the human ovum into an infant. The contrast in structure may not be absolutely as great, since, in the course of the change from infancy to maturity, there is not only increase of size but some increase of structural development. In their essentials, however, the two organizations are alike: differences of proportion and finish chiefly distinguishing them. Let us, then, compare the embryological changes with the evolutionary changes, in their amounts and in the times taken by them. The nine months of human gestation, more exactly stated, is 280 days, that is 6,720 hours or 403,200 minutes. Thus, then, the total change from the nucleated cell constituting the human ovum to the developed structure of the infant just born, is

* Carpenter, Principles of Comparative Physiology, p. 474.

divisible into 403,200 changes each occupying a minute. No one of these changes is appreciable by the naked eye, or even by a micrometer. Turn now to the other member of the comparison. Let us suppose the total change between the primitive *Protozoon*, or nucleated cell, and the human being proceeding from it, to be divided into increments of change, equal in their number to those gone through by the fœtus. To compare the two sets of changes we divide 100,000,000 years by 403,200. What is the result? We get nearly 250 years as the interval available for an amount of change equal to that which the fœtus undergoes in a minute. Another way of presenting the facts yields results still more striking. Many creatures of superior types take more than a year to reach the reproductive age, and even among insects there are some which retain their larval forms for a longer period. But, bearing in mind that even among the *Vertebrata* the immense majority of species reach the reproductive age in a year, while some of them, as the inferior Rodents, reproduce in a shorter term, and remembering that throughout the lower divisions of the undetermined phylogenetic series preceding the vertebrates, consisting of relatively small and simple creatures, the succession of generations was probably more rapid, we may fitly, contemplating the whole series, take a year as the equivalent for a generation. If so, it follows that to achieve the transformation of the *Protozoon* into Man, it requires only that in the space of 250 generations the change shall be as great as that which the human fœtus undergoes in a minute; or, otherwise stating the fact, it requires that each generation shall differ from the last by as much as the fœtus differs from itself after an interval of a fourth of a second.

Should it be urged that the successive stages of the transformation gone through by the infant do not represent fully the stages of transformation gone through in progressing from the primitive nucleated cell to the human being, but that there have been periods of excursive modification on various sides of the direct line, and periods in which there was no advance, or in which there was even some retrogression, it would still result that if, in one generation, there occurred as much change of form as the fœtus undergoes in a minute, the remaining 240 odd generations might be set aside for non-progressive changes: a sufficiently wide margin.

One more misconception embodied in Lord Salisbury's address remains to be noted—not a misconception peculiar to himself, but one which men at large entertain. Speaking of the groups of chemical elements, he says:—

"The discovery of these co-ordinate families dimly points to some identical origin, without suggesting the method of their genesis or the nature of their common parentage. If they were organic beings all our difficulties would be solved by muttering the comfortable word 'evolution'—one of those indefinite words from time to time vouchsafed to humanity, which have the gift of alleviating so many perplexities and masking so many gaps in our knowledge. But the families of elementary atoms do not breed; and we can not therefore ascribe their ordered difference to accidental variations perpetuated by heredity under the influence of natural selection."

This passage obliges us to infer that Lord Salisbury supposes the theory of evolution to be concerned only with things that "breed." If the molecules of matter were "organic beings," he says, "the comfortable word 'evolution'" might be thought to suggest a solution; but since they are not organic beings, evolution has no place. Apparently, then, Lord Salisbury thinks evolution is concerned only with animals and plants. It is difficult to believe that, well acquainted as he is with the science of the day, he really means that which his words imply. We seem almost bound to assume an inadvertence of expression or a lapse of thought. Still as his statement and his apparent belief have been put before a million or two of readers, it seems needful to do something toward dissipating the misapprehension caused, by briefly indicating what is meant by evolution as rightly understood.

The Cosmos as a whole and in all its parts has reached its present state either supernaturally or naturally; and if naturally then not living things only but all other things have come naturally to be what they are. A doctrine which alleges evolution for the animate world and assumes creation of the inanimate world is absurd. Evolution, if alleged at all, must be alleged as coextensive with all existence—save that which is undergoing the reverse process of dissolution.

One who sees that our interpretations must leave us for ever ignorant concerning the data of the process—the space and the time, the matter and the motion, as well as the ultimate energy manifested through them—may yet rationally seek a proximate interpretation. If things of all kinds, inorganic, organic, and superorganic, have become what they are, not supernaturally but naturally, the implication is that their present state is the outcome of preceding states; and that the genesis of changes throughout the past has been of like nature with the genesis of changes at present. What, then, is the most dominant trait common to successions of changes?

A thing ever being modified and re-modified diverges more and more from its original condition: accumulated changes produce transformation. What is the general nature of that progressive transformation which constitutes evolution? The first answer to this question was suggested on observing the changes passed through by every unfolding plant and animal. Immeasurably as do the multitudinous kinds of organisms differ from one another, yet the unfoldings of them proceed in similar ways. The detailed changes gone through are infinitely varied, but the general change is the same for all. It has since become apparent that the abstract formula expressing this transformation in all living things, also expresses the transformation which is, and has been, in progress everywhere. The Solar System, in passing from its primitive state to its present state, has exemplified it; and, if we accept Lord Kelvin's conclusion respecting the dissipation of its energy and consequent ultimate fate, it will continue to exemplify it. The transformation of the Earth from those early stages in which its surface began to solidify, down to its present stage, has likewise conformed to the general law. Among living things it is conformed to not only in the unfolding of every organism, but also, if we draw the conclusion pointed to above, by the organic world in general, considered as an aggregate of species. The phenomena of mind, in rising from its lowest forms in inferior creatures up to its form in Man, and again in rising from the lowest human form to the highest, illustrate it. It is again illustrated by the successive stages of social progress, beginning with groups of savages and ending with civilized nations. And we see it no less displayed in all the products of social life—in language, in the industrial arts, in the development of literature, in the genesis of science.

Is this inductive generalization capable of deductive verification? Does this uniformity of process result from uniformity of cause? The answer is—Yes. As the changes universally in progress now and through all past time have resulted in transformations having certain common traits, so also, in the actions everywhere producing them, there are certain common traits. However vast or however minute, every aggregate is like every other aggregate in being subject to the actions of outer things and in having parts that act on one another. Be it the Solar System, which by its motion through space shows that the Stellar Universe around influences it, and which shows that its component bodies influence one another, or be it an infusorium exposed to currents and to living things in the surrounding water, and made up of interdependent organs, we are equally shown that external incident forces affect everything, and that everything is affected by the mutual actions of its parts. But if there is a fundamental unity in the relations of aggregates to their environments and of their components to one another, there must also be a fundamental unity in the processes of change set up in all cases. Hence, then, a certain community of character in the transformations gradually produced. The empirical generalization indicated above as reached by contemplation of phenomena of various orders, becomes a rational generalization on finding that throughout these various orders of phenomena a like co-operation of causes inevitably works out similar observed effects. It is not by accident but by necessity that these transformations of all kinds have common traits.

This is not the place in which to explain and illustrate this universal law of transformation and these universal causes of transformation. Here I am concerned merely to indicate their scope, and to say that the Doctrine of Evolution, rightly conceived, has for its subject-matter not the changes exhibited by the organic world only, but also the changes which went on during an enormous period before life began, and the changes which have gone on since life rose to its highest form, and Man, passing into the associated state, gave origin to the endlessly varied products of social life. It has for its subject-matter the entire cosmic process, from nebular condensation down to the development of picture-records into written language, or the formation of local dialects; and its general result is to show that all the minor transformations in their infinite varieties are parts of the one vast transformation, and display throughout the same law and cause—that the Infinite and Eternal Energy has manifested itself everywhere and always in modes ever unlike in results but ever like in principle.

How utterly different the popular conception of evolution is from evolution as rightly conceived will now be manifest. The prevailing belief is doubly erroneous—contains an error within an error. The theory of natural selection is wrongly supposed to be identical with the theory of organic evolution; and the theory of organic evolution is wrongly supposed to be identical with the theory of evolution at large. In current thought the entire transformation is included in one part of it, and that part of it is included in one of its factors. From his place of vantage Lord Salisbury might have done much to dissipate these delusions; but, unhappily, both his language and his arguments have tended to do the reverse.—*Nineteenth Century.*

Sir Joseph Lister has been chosen president for the Liverpool meeting of the British Association, to be held in 1896, beginning September 16th. The meeting for 1897 was appointed to be held in Toronto.

Prof. Weismann proposes germinal selection as the name of a hypothesis supplementary to that of natural selection, by which he explains an apparent protection of useful variations from their first appearance, so that when wanted for natural selection they are always at hand.

EXPIRED AIR AND PROBLEMS OF VENTILATION.

THE following are substantially the conclusions reached by Drs. J. S. Billings, S. Weir Mitchell, and D. H. Bergey regarding the composition of expired air and its effects upon animal life, which are published in the Smithsonian Contributions. These contradictions of certain accepted views are important and likely to give rise to discussion.

There is no peculiar organic matter which is poisonous to animals (excluding man) in the air expired by healthy mice, sparrows, rabbits, guinea-pigs, or men. The injurious effects of such air appeared to be due entirely to the diminution of oxygen or the increase of carbonic acid, or to a combination of these two factors. It is very improbable that the minute quantity of organic matter contained in the air expired from human lungs has any deleterious influence upon men who inhale it in ordinary rooms. In ordinary quiet respiration no bacteria are contained in the expired air. In the act of coughing or sneezing such organisms may be thrown out. The minute quantity of ammonia, or of combined nitrogen, or other oxidizable matters found in the condensed moisture of human breath appears to be largely due to products of the decomposition of organic matter which is constantly going on in the mouth and pharynx. The air in an inhabited room, such as a hospital ward, in which experiments were made, is contaminated from many sources besides the expired air of the occupants, and the most important of these contaminations are in the form of minute particles or dusts. The experiments on the air of the hospital ward showed that in this dust there were micro-organisms, including some of the bacteria which produce inflammation and suppuration, and it is probable that these were the only really dangerous elements in this air. The results of experiments, in which animals were compelled to breathe air vitiated by the products of either their own respiration or by those of other animals, make it improbable that there is any peculiar volatile poisonous matter in the air expired by healthy men and animals other than carbonic acid. The effects of reduction of oxygen and increase of carbonic acid, to a certain degree, appear to be the same in artificial mixtures of these gases as in air in which the change in their proportions has been produced by respiration. An excessively high or low temperature has a decided effect upon the production of asphyxia by diminution of oxygen and increase of carbonic acid. At high temperatures the respiratory centers are affected, where evaporation from the skin and mucous surfaces is checked by the air being saturated with moisture; at low temperatures the consumption of oxygen increases and the demand for it becomes more urgent. The proportion of increase of carbonic acid and of diminution of oxygen which has been found to exist in badly ventilated churches, schools, theaters, or barracks is not sufficiently great to account for the discomfort which such conditions produce in many persons, and there is no evidence to show that such an amount of change in the normal proportion of these gases has any influence upon the increase of death-rates which statistical evidence has shown to exist among persons living in crowded and unventilated rooms. It has been well established by observation and statistics that tuberculosis and pneumonia are the diseases most prevalent among persons living and working in unventilated rooms. But consumption and pneumonia are caused by specific bacteria, which for the most part gain access to the air passages by adhering to particles of dust which are inhaled, and it is probable that the greater liability to these diseases of persons living in crowded and unventilated rooms is to a large extent due to the special liability of such rooms to become infected with the germs of these diseases.

The discomfort produced by crowded, ill-ventilated rooms in persons not accustomed to them is not due to the excess of carbonic acid, nor to bacteria, nor in most cases to dusts of any kind. The two great causes of such discomfort, though not the only ones, are excessive temperature and unpleasant odors. The cause of the unpleasant, musty odor which is perceptible to most persons on passing from the outer air into a crowded, unventilated room is unknown; it may, in part, be due to volatile products of decomposition contained in the expired air of persons having decayed teeth, foul mouths, or certain disorders of the digestive apparatus, and it is due in part to volatile fatty acids given off with, or produced from, the excretions of the skin. The results of this investigation, taken in connection with the results of other recent researches, indicate that some of the theories upon which modern systems of ventilation are based are either without foundation or doubtful, and that the problem of securing comfort and health in inhabited rooms requires the consideration of the best methods of preventing or disposing of dusts of various kinds, of properly regulating temperature and moisture, and of preventing the entrance of poisonous gases, like carbonic oxide derived from heating and lighting apparatus, rather than upon simply diluting the air to a certain standard of proportion of carbonic acid present.

It would be unwise, however, to conclude from the facts given in this report that the standards of air supply for the ventilation of inhabited rooms, which are based on the results of Pettenkofer's work, are too large.

Editor's Table.

THE ECCLESIASTICAL VIEW OF EDUCATION.

OUR attention has been drawn to an article by an excellent contributor of our own, Dean Carmichael, of Montreal, which appeared a few months ago in the Canada Educational Monthly, on the subject of "Religion and Education." The writer is candid, able, and eminently well-meaning, but we find it impossible, nevertheless, to agree with the views he puts forth, or at least with his main contention.

The dean is much impressed with the rapid progress which education has been making in the modern world, and he prophesies that, if the same rate of progress is maintained for seventy-five or a hundred years longer, it will be impossible in any civilized country to gather together so ignorant a crowd as that which tore down the Bastile in 1789. Does that mean that society will then be safe from such convulsions as marked the French Revolution? By no means: crowds may again gather for deadly work, but they will be educated crowds, each man able to write his name and read his paper and proceed with the business of destruction "as an intelligent being, instead of being whirled to it as an atom in a vortex." The dean sees signs of great disturbance in the present day, and he thinks that education, as it is now being imparted to the masses, is rendering society not more but less stable. "The millions," he says, "that in times past were only used to dig and delve, to fill up giant armies, to crowd pauper workhouses, to tenant penal settlements," are being reached by the light of education and are "fast growing into mental as well as physical power." One would be disposed to think that this was not a very lamentable prospect, but it fills Dean Carmichael's mind with the gravest apprehensions. Why? Because he does not see how the minority are going to hold this vast educated majority in check. That the majority must be held in check, unless society is to go to smash, he seems to consider axiomatic. The specific complaint he makes against modern education is that it is virtually divorced from religion. "The whole tide," he says, "of modern civilization, as set going and lauded by the middle and higher classes of society, desires either to sweep distinctive religious teaching clean out of the world's curriculum, or to put it into a corner with a fool's cap on its head. . . . No greater anomaly, I think, has ever existed than that of institutions based upon the open principle that the Bible is the foundation of all education, practically joining hands with unbelievers the world over to make the Bible the least prominent volume of instruction in public education."

These quotations at once indicate the writer's standpoint and suggest our reply. The "anomaly" which appears so striking and inexplicable in his eyes loses much of its extraordinary character on close examination. The question is this: Why are Christian parents so generally willing, where they are not actually desirous, that the Bible should not be made an authoritative text-book in the public schools? Many reasons may be assigned. In the first place, they know that the Bible as it stands, in its entirety, is not adapted to be a school-book. A school-book, as the term is now and has always been understood, is one specially prepared for the uses and needs of the school, and containing nothing that is not required for purposes of instruction. This is not the case with the Bible, which was not written or put together with any such view, and much the larger part of which is quite unsuited to school use. In the second place, parents know that the Bible is not a book which the first comer can interpret; certainly they are not prepared that the first comer should interpret it to their children. In large part it is a repertory of mysteries which the ordinary certificated teacher has no recognized fitness for handling. If we take even those teachings of the sacred volume which might be considered of the greatest practical importance for purposes of moral instruction, we find that they are far from being viewed in the same light by all professedly Christian parents. Take, for example, the subject of future punishment: the views which one parent might think salutary another would exceedingly object to having placed before his child. We know of a case in which a clergyman of Dean Carmichael's communion was called in to visit a dying man who had previously been visited by a Methodist minister. He found the man's mind greatly disturbed by what the Methodist had told him of the nature of sin and the necessity of conversion, and had much difficulty in relieving him from the excessive fears—excessive from *his* point of view—which this teaching had awakened. Finally, he told the man that what the Methodist had said was all stuff, and that, if he was sorry for his sins, that was enough; he need have no anxiety. We mention this to illustrate the radically different views which different sects hold, not on minor but on major and most practical questions of biblical doctrine. If on these there are divergent views, what anomaly is there in the general disposition of Christian parents to acquiesce in the disuse of the Bible as a public-school text-book, and to look for its proper interpretation and application to their own chosen and specially-trained spiritual pastors?

But these are not the only reasons. The fact can not be ignored that there is much in the Bible which, from a scientific and historical point of view, does not harmonize with the general character of modern education. Take the several branches of so-called "secular education," and we find that each bears in the strongest manner the impress of the "positive" spirit. If there is any idea that is excluded more rigorously than any other from the whole compass of ordinary scholastic studies it is the idea of the supernatural. No secular history would be read in our schools to-day, or in the schools of any enlightened community, in which the fortunes of nations were represented as controlled by special divine intervention. The time has passed when plagues, earthquakes, and famines could be historically interpreted as expressions of divine displeasure; and the time has almost passed for any useful introduction of the doctrine of design in connection with the study of Nature. The spirit of the inductive philosophy has penetrated everywhere: we should not seek in vain for its signs even in the kindergarten. How, then, we are compelled to ask, can the Bible, which deals in miracle from the first page to the last, be employed as a regular text-book in the schools without either suffering in its influence from the prevalent tone of the other school studies, or marring more or less the effect of those studies by its constant championship of the supernatural idea? It may be said that so long as the Bible is read and expounded and treated as authoritative in the churches, the same conflict between naturalism outside the Church and supernaturalism within it will exist; but to this may be answered that on the clergy rests the responsibility for finding a *modus vivendi* between the two, and that, with their special learning and the special interest they have in the matter, much may be possible to them that is wholly beyond the scope of the lay teacher in a public school. There are clergymen who tell us to-day that it is in no wise necessary to believe in the biblical story of creation as a record of facts, and some are almost prepared to dispense with all belief in the miraculous; but could the school teacher in whose hands the Bible was placed as an authoritative text-book be allowed or expected to indulge in such critical exercitations? The idea is ridiculous: a text-book is a text-book, and its meaning must lie on the surface; its words must be susceptible of being taken at their face value; and no special gifts or graces must be required for its satisfactory use as a text-book.

That the Bible as a whole is a most impressive book; that it bears a noble stamp of earnestness and moral elevation; that it contains moral teaching of inestimable value—these are propositions which we should be the last to deny; but, admitting them to the full, we still consider that it is a wise and true instinct which reconciles the majority even of those who place the highest estimate on the Bible to dispensing with its use in the public schools.

But how about those masses who, according to Dean Carmichael, are becoming educated, and owing to that very fact more dangerous than the mob that stormed the Bastile? That all the signs of the times are favorable we by no means think; but as regards the influence of popular education, what we dread is not the awakening of the intellect of the multitude so much as the stifling of it and the enslaving of it to false ideas. So far as popular education has an awakening effect, its influence, we doubt not, will be good. A man does not become dangerous because he has learned to sign his name; but he becomes dangerous both to himself and to others if he has been taught to dissociate cause and effect; if he has got it into his head that benefits may be obtained without labor; if his brain has been muddled with the notion that others are responsible for making him happy and prosperous. We dread an education which in any way withdraws a youth from the salutary influence of natural reactions and tends to give him an artificial conception of the world he lives in. We dread an education which favors the formation of indolent habits, or which confuses and enfeebles the mind by calling upon it to pursue abstract trains of thought when it should be occupied with the concrete. We dread an education which at once excites ambition and disinclines for toil; which gives a smattering of many things, but no true sense of power or competence in regard to anything; which represses individuality and so robs character of a main element of strength. And all these unfavorable results, we fear, are wrought by much of the education that is imparted to-day. But to try to conquer our evils or avert our perils by driving back the masses into ecclesiastical penfolds is as chimerical an idea as could well be conceived. The world is willing, and more than willing, to listen to those who can shed a glory upon human life borrowed from regions of faith and hope that lie above our ordinary range of thought; but it is not willing, and never henceforth will be willing, to substitute any form of theological prescription for the authority which it has learned to attach to verified truth. If we have battles to fight we must fight them, and perhaps, when it comes to that, we may learn a wisdom which in times of comparative ease and prosperity we were incapable of learning. Certain it is that in this world everything has its specific cause, which means that every evil has its specific remedy. Trouble, it was long ago observed, does not spring out of the ground; it is for us to find out where it does spring from; and when the trouble becomes acute, our intellectual operations are wont to be greatly stimulated.

The dean would have us restore the Bible to the schools and place the latter in effect under the control of the clergy. Our idea is to study out the problem of education in the widest sense until we have, in a really effectual manner, correlated it with the whole life of society. The former is the ecclesiastical remedy for social ills; the latter is the scientific, and we believe it to be that which the future is destined to justify.

THE HUNDREDTH ANNIVERSARY OF THE FRENCH INSTITUTE.

The Institut de France, popularly known as the French Academy, and which is undoubtedly the oldest and the most famous of the world's learned societies, celebrated with great ceremony and with the active participation of the Government of France, on October 23d–26th last, the hundredth anniversary of its existence; one of the most noted and pleasant features of which was the hearty welcome extended to its foreign associates and corresponding members. As it is generally understood that these two titles are the highest honors which France can award in testimony of intellectual work actually done by foreigners—the cross of the Legion of Honor being often conferred for merely political reasons—it is a matter of interest to know what citizens of the United States have been the recipients of these honors. Preliminary, however, to their specification, it is desirable to explain the organization of the institute. It consists of five departments or divisions, each of which is designated as an academy—namely, the Académie Française, Académie des Inscriptions et Belles-Lettres, Académie des Sciences, Académie des Beaux-Arts, Académie des Sciences Morales et Politique. Each academy, except the Académie Française, which comprises a general reunion of all the other academies, is divided into sections for the consideration of special subjects, and is made up of members of the institute who are regarded as specialists, or acknowledged authorities in different departments of learning. Thus, the domain of the "Académie des Inscriptions et Belles-Lettres" embraces the learned languages, antiquities, monuments, Oriental literature, and history; that of "Sciences," astronomy, geography, navigation, general physics, chemistry, zoölogy, botany, medicine, and surgery; that of "Beaux-Arts," painting, sculpture, architecture, engraving, and music; and that of "Sciences Morales et Politique," morals, philosophy, jurisprudence, political economy, finance, and philosophical history. Each of the academies holds weekly meetings, and once a year the five academies as a rule hold a public meeting in common; and occasionally other general meetings for the reception of new members and the distribution of prizes. In virtue of endowments, bequests, and the like, the institute is in receipt of annual revenue of at least five million francs ($100,000), which it distributes annually in the form of prizes for merit in respect to literary work, inventions, scientific discoveries or researches, and also for examples of what are termed "impecunious" virtue.

The institute, comprising the above five academies, is primarily composed of forty members, who by rule or custom are always and exclusively natives of France, and who, on the assumption that their achievements in the various departments of learning have assured to them permanent reputation, are popularly designated as the *Immortels*. Each one of these receives an annual life salary from the state of twelve hundred francs, and a small additional sum contingent on personal attendance at the regular meetings of the academies and Institute.

Besides the primary or permanent members, the institute is made up of two other classes of members—namely, *Associés Étrangers* (foreign associates) and *Correspondants*. The number of the former is limited to thirty-two persons of foreign birth and residence, and comprises such names as Gladstone, Alma Tadema, Sir Frederick Leighton, President of the British Royal Academy, Max Müller, Sir William Thomson (Lord Kelvin), Sir John Millais, and Verdi, the Italian composer. Of the names of members of this class deceased within a comparatively recent period may be mentioned those of Agassiz, Helmholtz, De Candolle, Richard Owen, Curtius, the German historian, and Bunsen and Wohler, the celebrated German chemists. As yet the name of no citizen of the United States has been inscribed on the roll of the foreign associates of the institute, although it is understood that in a recent election to fill the vacancy occasioned by the death of a member, the name of Prof. Simon Newcomb, of Washington, lacked but a few votes of receiving this honor.

Next in order in the organization of the institute is the class of corresponding members, an election to which, irrespective of nationality, is regarded as a very high honor, though not as great as a membership among the thirty-two foreign associates. The number of correspondents reported in the *Annuaire* of the institute for 1893 was two hundred and fifty-six, about one third of whom were French citizens. The following list exhibits the names and the date of the election of the correspondents, including those recently deceased, who have been elected from the United States:

Prof. James D. Dana, zoölogist, New Haven, Conn., 1873, deceased; David A. Wells, economist, Norwich, Conn., 1874, elected to fill the vacancy occasioned by the death of John Stuart Mill; Prof. Simon Newcomb, astronomer, Washington, D. C., 1874; Prof. William Whitney, linguist, New Haven, 1877, deceased; George Bancroft, historian, 1877, deceased; Asaph Hall, astronomer, Washington, D. C., 1879; Benjamin Apthorpe Gould, astronomer, Cambridge, Mass., 1881; Richard Morris Hunt, artist, 1882, deceased; James Hall, geologist, Albany, N. Y., 1884; Alexander Agassiz, naturalist, Cambridge, Mass., 1887; Prof. Samuel Langley, Superintendent Smithsonian Institution, astronomer, 1888—seven living members, none of whom were present at the centennial celebration. Among some of the present or recent correspondents from countries other than France and the United States may be mentioned the names of Momsen, the distinguished German historian; Struve, the Russian astronomer; Lockyer, Huggins, Huxley, Burne-Jones, Bryce, Fitzjames Stephen, Goschen, Sir John Hooker, England; Nordenskiold, Sweden; Vogt, Switzerland; Virchow, Roscher, Germany; Lanciani, Rome; Jacoby, Austria, etc.

The Institute of France is not as important an organization as it was fifty years ago, but it is still influential through its elections, which are regarded as acknowledgment of scientific merit, and the prizes it annually awards for original research, discoveries, and inventions. It maintains its authority not upon its prestige in the past, but upon the fact that it always enrolls among its members the most distinguished scientists and writers of France, and such citizens of other countries as have in its judgment done great and original work in any department of human knowledge. In the opinion of one of its most distinguished living members, M. Berthelot, the noted French chemist, and present (1895) French Minister of Foreign Affairs, the Academy of Sciences, "if it no longer has the initiative of discoveries, it at least constitutes a dike against charlatanism, and aids in giving the widest publicity to the achievements of French and foreign *savants.*"

Scientific Literature.

SPECIAL BOOKS.

THE world is always conscious of an addition to its intellectual wealth when a leader in original scientific work writes a book. Men like to hear from the masters, especially when they speak, as Prof. Young does, a language that inspires while it instructs.* When the first edition of this uniquely interesting book was put forth in 1881 a warm welcome awaited it, not only from astronomers who were eager to learn what one of the foremost investigators of solar phenomena had to say about the sun, but from all readers who take pleasure in seeing the literary powers of our mother tongue turned to useful account in the presentation of the facts of science. And the welcome grew as the circle of the book's readers rapidly widened. No volume of the International Scientific Series has proved more continuously popular.

But the fourteen years that have elapsed since the first appearance of Prof. Young's book have witnessed remarkable advances in astronomy, and particularly with regard to our knowledge of the sun. For a time it was possible to keep the book up to date by notes and appendices to its successive editions. At length this method of revision no longer sufficed, and the author undertook a thorough rehandling of the work, involving the rewriting of considerable portions, and the addition in the text of much that was needed "to make the book fairly representative of the solar science of to-day." That in its revised form it now answers the above definition, quoted from the author's new preface, no one who knows Prof. Young's habitual caution and precision of statement will doubt.

No authoritative utterance concerning a progressive branch of science

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* The Sun. By Charles A. Young, Ph. D., LL. D., Professor of Astronomy in Princeton University. New and revised edition. Pp. 363, 12mo. New York: D. Appleton & Co. Price, $2.

ever came more opportunely than this new edition of The Sun. Within the past few years discovery has followed discovery, and theory has obscured theory in solar physics so rapidly that the general reader, desirous to keep on safe ground, has found himself in a more or less uncomfortable position. One authority, of great weight, has been telling him that the "faculæ" and the "prominences" are identical phenomena; another authority, of perhaps equal weight, has assured him that this is not so. Likewise, in regard to the most interesting question of the connection of sun spots with terrestrial magnetism: on the one hand stand positive assertions of an intimate relationship of that kind, and on the other hand stands Lord Kelvin with his dictum—and the dicta of Kelvin in science have frequently been deemed of equal weight to those of Lord Coke in law—asserting that "we may be forced to conclude that the supposed connection between magnetic storms and sun spots is unreal, and that the seeming agreement between the periods has been a mere coincidence."

Then there have been new theories of sun-spots, new determinations of the solar parallax, new identifications of elements in the sun, the wonderful work of Langley on the infra-red portion of the spectrum, the questions raised by Lockyer's theory of the "dissociation" of elements in the sun, the question of the existence of oxygen in the solar atmosphere, the question whether the sun-spots are really depressions, and many other new and puzzling things, the most surprising of all being, perhaps, the discovery in a Norwegian mineral of "helium," an element which had been found in the sun as long ago as 1868, but the presence of which on the earth had never been detected.

Amid such a confusion the unprofessional wayfarer in science needs a guiding hand, and that is what Prof. Young now most seasonably offers. There is a fairness, a power of discrimination, and a judicial balance in our author's treatment of vexed questions that must create in the reader's mind both confidence and admiration. His brief, shrewd reply to the remark of Lord Kelvin, quoted above, concerning sun-spots and magnetic storms, will find many highly interested readers, and it is made all the more attractive by the vista of possible future discovery which it opens with the suggestion that "it is not perhaps outside the limits of possibility that both the solar and terrestrial disturbance have a common origin in some invasion of power or matter from outer space—that the solar tumult is the brother, and not the father, of our own aurora."

Prof. Young's discussion of Helium, its Identification and Properties, is, of course, luminous and informing in the highest degree. Nothing can be more pleasing than to note the manner in which an unexpected discovery, full of momentous consequences for the work with which he is identified, is received, assimilated, and irradiated by the mind of a leader in science.

Among the new matters treated, one of the most interesting, because it relates to hoped-for advances in the future, is the effort to render the corona visible when the sun is not eclipsed. It is certainly encouraging to know that to Prof. Young "the case appears by no means absolutely hopeless." When we remember the advance in our knowledge of the prominences following Janssen's and Lockyer's discovery in 1868, that those phenomena could be rendered visible with the spectroscope in ordinary daylight, and consider the ignorance that probably would have prevailed concerning them if they had remained unseen except during eclipses, we can echo our author's opinion that success in revealing the mysterious corona in a similar manner "is certainly devoutly to be desired."

Prof. Young has so long been a conspicuous and brilliant figure in the field of spectroscopic investigation that one naturally turns to his revised chapter on The Spectroscope and the Solar Spectrum with pleasing anticipations which are not disappointed. The results of the immense work accomplished in the last decade are here ranged in order with an expert hand, and the remaining gaps in the line of acquired knowledge are made clearly apparent. The list of elements known to exist in the sun has been largely extended in the past few years, but still many that go to constitute a great portion of the crust of the earth have not been recognized in the solar spectrum. Why are they absent? Is it simply a failure to show themselves, or do they not exist there at all? Prof. Young indicates his preference for the view that the missing elements are not really absent from the sun, but only nonapparent, although he points out that the answer to the question is not easy. And then he goes on to marshal some most interesting facts and considerations relative to this subject, and discusses briefly but luminously such topics as the multiple spectra of certain elements, Lockyer's revival of the old "pantogen" speculation and his theory of "basic lines" common to the spectra of different substances, the later work on the question of solar oxygen, etc.

While this book is a record of facts and achievements rather than of theories and attempts at the interpretation of mysteries, yet the great questions still remaining to be answered are, of course, discussed, and in a masterly manner. A fine instance of the author's method of dealing with such subjects is shown in the chapter on The Sun's Light and Heat, where he succinctly reviews questions like these: "How is the sun's heat maintained?" "How long has it lasted already?" "How long will it continue?" "Are there any signs of either increase or diminution?" It is undoubtedly true, as Prof. Young remarks, that to such questions, "in the present state of science, only somewhat vague and unsatisfactory replies are possible," yet they are questions the replies to which, however incomplete, will always command deep interest. And if the facts and speculations accumulated since 1881 have not thrown much light upon these subjects, something has been gained in a clearer comprehension of both the strength and the weakness of prevailing theories. Those are pregnant sentences, for instance, in which, after pointing out the objections to the late Dr. Siemens's theory of the sun, he remarks: "And yet one almost regrets that the theory can not be accepted, for it would remove very serious difficulties that now embarrass the problem of the evolution of our planetary system. The accepted contraction theory of Helmholtz certainly appears to allow too little time for the sun's lifetime of radiant activity to be consistent with a reasonable explanation of the process by which the present state of things has come about."

In briefly summarizing the principal additions noted in the new edition the following may be particularly mentioned: The latest work on the solar parallax, including Newcomb's results and the observations on the minor planets Victoria and Sappho; accounts of all recent advances and discoveries in solar spectroscopy and spectro-photography, including the work of Hale, Deslandres, Dunér, etc.; a statement of the latest accredited theories concerning sun spots, such as Schæberle's and Oppolzer's, and an account of Dunér's and the author's work on sun-spot spectra; a summary of recent progress in prominence photography, etc.; facts and conclusions concerning the corona, based on recent eclipses; an account of Langley's infra-red spectrum investigation, and of the work of De Chatelier, Wilson, Gray, and Scheiner on solar radiation and temperature; and, finally, a most interesting supplementary note, already mentioned, on Helium. The size of the volume has been increased by nearly thirty pages, and the number of illustrations has been raised from eighty-two to one hundred.

The Sun, in its new form, certainly deserves, and will unquestionably obtain, an even greater circulation than that which it has hitherto enjoyed.

"Live" natural history is what Prof. *Miall** would lead the young naturalist to. While he has no disparagement for systematic zoölogy, he wishes to revive an interest in the writings of Swammerdam, Réaumur, Lyonnet, and De Geer, and to promote that observation of the structure and habits of living animals which those authors pursued with most profitable results. In so doing, he is only restoring a balance that has been disturbed of late years. It is certainly an attractive field into which our author invites the amateur. Who does not love to follow a stream through its alternations of still deeps and rippling shallows, or to stroll along the shore of the ever-moving sea? Whether one be occupied with sport or science, the movement of the water and the succession of traces of its action upon the land yield no small enhancement of pleasure. Aquatic insects do not form a distinct class. Representatives of eleven orders are described in this book, so that the spice of variety is not wanting in their study. Under the guidance of Prof. Miall one may watch at leisure the swiftly darting whirligig beetle or examine the fine case of instruments of the female gnat (there are no mosquitoes, our author says, in zoölogy). Other insects classed as aquatic, because they pass their larval and pupal stages in water, are drone flies (the oxen-born bees of the ancients), dragon flies, pond-skaters, tube-making caddis-worms, etc.; all are air-breathers in the adult form. A phenomenon which profoundly affects the lives of these creatures is the surface film of water. By curious adaptations they take advantage of its tension, while on the other hand some minute creatures find it a death-trap. The reader must not look for a severely logical arrangement in this book. There is an introduction in which the invasion of the waters by insects, the surface film, live natural history, and other topics are discussed philosophically. Directions for capturing specimens will be found not among the preliminary matter, but on page 114, and there are biographical notes about the old naturalists where the first extended citations from their respective writings occur. In the illustrations sufficient magnifying power has been used to make the organs of the insects readily distinguishable, with the result of giving some of the little creatures a truly formidable appearance.

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* The Natural History of Aquatic Insects. By L. C. Miall, F. R. S. Pp. 395, 12mo. London and New York: Macmillan & Co. Price, 6s.; $1.75.

GENERAL NOTICES.

We can hardly conceive a more fascinating subject than the one treated of in this book.* Birds, by their song, their marvelous flight, their mysterious migrations, the independent intelligences among them, which have led in past times to many species becoming the associates of man, offer a most delightful subject for study. It is interesting to recall the fact that Cuvier and his contemporaries regarded the birds as a closed type, a group that seemed completely isolated from the other classes of vertebrates, and now they are known to be closely related to the reptiles. Mr. *Headley* has devoted considerable space in his book to these reptilian affinities. In his chapter on the embryo bird he might have added other reptilian characters, such as the claws which are seen on the fingers on the embryo sea-pigeon; particularly he might have described more fully the tarsal bones, showing that the ascending process of the astragalus had an independent center of ossification, and represented in the embryo the intermedium wedged in between the distal end of the tibia and fibula as shown in the salamanders. Birds may be cited for almost every point defined by Darwin in his theory of natural selection, not only in their reptilian affinities, as shown in their embryological and paleontological history, but in the very remarkable examples of variation in habits, color markings, albinism, molting, sexual selection, protective coloration, etc. The author's ideas of homology and analogy are somewhat obscure. Having correctly defined analogy by the common example of a bird's wing and an insect's wing as being alike in function, but different in origin of structure, and hence analogous and not homologous, he proceeds to say that there is no homology between the wing of a bird and the wing of a bat; whereas there is the strictest homology in origin, structure, and function. In the next sentence he says that the tails of all vertebrates are homologous, which is correct. Yet here we have a few vertebræ in one tail and over fifty in another. We have the broad fin of a fish, the trowel of the beaver, and the climbing appendage of the monkey, and all are indeed homologous. In the same way limbs of the vertebrates are homologous; whether it be the pectoral fin of a fish, the leg of a turtle, the wing of a pterodactyl, of a bird or a bat, or the arm of man, a strict homology runs through them all. Mr. Headley has managed his material admirably, and one gets in a condensed form many facts about birds which have been brought to light within recent years. The clearness of the illustrations gives an added value to the book.

* The Structure and Life of Birds. By F. W. Headley, M. A. Pp. 417, with Illustrations. New York: Macmillan & Co. Price, $2.

A difficult problem can be solved only by attacking it from one side after another. Prof. *Donaldson* has made his contribution to ascertaining the nature and action of the mind by setting forth the mode of growth of the chief portion of the nervous system.* He introduces his specific subject by three chapters discussing the general phenomena of growth and the rate of increase of the whole body. Then taking up the brain and spinal cord, he presents statistics showing at what rates these organs increase in weight and what weights they attain. He finds that the facts now available "contribute mainly to a healthy skepticism concerning the current interpretations of brain-weight." The author next traces the growth of the nerve elements and describes the architecture of the nervous system, calling attention to the changes of structure that are due to the growth of the organism. The process of dissolution in old age is also traced. Chapters on localization of function, physiological rhythms, and fatigue furnish additional data for the author's discussion of the subject of education, which concludes the volume. From these data he finds that "education must fail to produce any fundamental changes in the nervous organization, but to some extent it can strengthen formed structures by exercise, and in part waken into activity the unorganized remnant of the dormant cells. . . . On neurological grounds, therefore,

* The Growth of the Brain. By Henry Herbert Donaldson. The Contemporary Science Series. Pp. 374, 12mo. London: Walter Scott, Ltd. Price, 3*s.* 6*d.* New York: Charles Scribner's Sons. Price, $1.25.

nurture is to be considered of much less importance than Nature, and in that sense the capacities that we most admire in persons worthy of remark are certainly inborn rather than made." From his point of view, therefore, "the formation of habit and reduction of mental friction, by means of concentration, must ever remain the chief objects of a formal training."

Dr. *Parkes's* book,* dealing, in small compass, and in simple language, with the important subject of hygiene, is well suited for use in either the school or the household. The opening chapter, entitled Water, treats of such questions as the proper sources of drinking water, dangers from wells and cisterns, and the filter problem. In the second chapter, on domestic refuse, the sanitary disposal of garbage, dust, etc., is discussed, considerable space being given to sanitary methods of plumbing. Air and ventilation are next taken up, the composition of air, its fouling by respiration, combustion, and organic refuse, cubic space and floor space, introduction of fresh air into rooms, and the practical examination of the ventilation of rooms being some of the important topics. The various methods of heating and lighting are compared in the next two chapters. The open fireplace and the incandescent electric light are selected as the methods which most nearly approach hygienic requirements. When considering the Welsbach lamp the author makes a curious mistake. In speaking of the incandescent mantle, which is composed of the oxide of some of the rarer refractory earths, he calls it the "*asbestos* gauze mantle." How to construct a healthy house—floors, walls, ceilings, cellars, etc.—and the proper site for building occupy Chapters VI and VII. Classification and composition of foods, vegetarianism, cooking, meal times, appetite, infant feeding, condiments, alcohol, tea, coffee, cocoa, and mineral waters are some of the special topics considered in a long chapter devoted to Food. Physical Exercise, Clothing, and The Care of the Skin, Teeth, and Bowels form the last three chapters of the book. The intention has apparently been to make a practical guide for the average householder, and this result has been well attained.

* The Elements of Health. By Louis C. Parkes, M. D. Pp 246, 12mo. Philadelphia: P. Blakiston, Son & Co. Price, $1.25.

Animal life is coextensive with the earth. The sea swarms with it, the air teems with it. The extreme cold of the arctic regions and the torrid heat of the equator have each their own special forms. The most elementary knowledge of zoölogy is sufficient to show us that, while much of the difference between the faunas of separated islands and continents and even of approximately contiguous regions is due to the differing flora and climatic conditions, these two factors do not in all cases explain the phenomena of distribution. Mr. *Beddard's* book* is a study of animal life in its relation to latitude and longitude. In Chapter I the author treats of the general facts of the distribution of animals. The special regions which have been arranged for the study of zoölogical geography by various authors are dealt with in Chapter II, and Mr. Sclater's chosen as the ones most convenient. In the third chapter the causes which influence the distribution of animals—temperature, means of dispersal, capacity for migration, human interference, large bodies of water, etc.—occupy fifty of the most interesting pages of the book. The fauna of islands and some theoretical considerations, the latter comprising a discussion of the bearing of distribution on origin, the place of origin of the marsupials, and the theory of the polar origin of life, make up the two closing chapters. The book contains five maps, which graphically show the distribution of special forms of animal life.

In order to make the Werner edition of the Encyclopædia more serviceable to its users, *A Guide to Systematic Readings in the Encyclopædia Britannica*, prepared by *James Baldwin*, has been published (Werner Co., $2). The Guide is designed to enable a person to read up a subject thoroughly by directing him to all articles or parts of articles bearing upon it which the Encyclopædia contains. A great cyclopædia is more than a work to be referred to for detached facts. It is a biographical dictionary and a gazet-

* A Text-book of Zoögeography. By Frank E. Beddard. Pp. 246, 12mo. London: C. J. Clay & Sons. New York: Macmillan & Co. Price, $1.60.

teer; it contains a history of the world, a treatise on each of the arts, sciences, and professions, a history of every literature, and many other treatises which are frequently issued as separate volumes. Fifty-two text-books now used in colleges consist of articles prepared by their authors for the Britannica. There are three divisions of the Guide. For boys and girls it has home readings in history, biography, science, and on sports and games. For the student it has courses of reading in history, language, literature, the sciences from astronomy to zoölogy, the Bible, etc. In another division it has lists of articles of interest to the merchant, the builder, the electrician, the gardener, the physician, the journalist, the miner, the home-maker, and many others. Many of the references are to the American Additions and Revisions, which the Werner Company has inserted in its edition of the Britannica.

The History of English Literature, by Prof. *W. M. Nevin*, is based on the conception that literature, like history in general, is an organic process or growth. It springs up out of a nation's life and is its proper expression, always modified by its racial tendencies, its degree of civilization, its climate and soil, and its relations with surrounding nations. The book is designed to furnish interesting and useful information to readers generally, as well as to students in particular. It was arranged to meet the needs of the author in lecturing to his classes, and hence ought to be of practical value to the teacher as well as the student. (Intelligencer Printing Office, Lancaster, Pa.)

The financial essays by *Allen Ripley Foote*, collected in the book entitled *A Sound Currency and Banking System* (New York, G. P. Putnam's Sons), were written with the conviction that business panics are ultimately the result of incorrect monetary education finding its expression in unsound legislation. Believing that the immediate return and continued maintenance of a high degree of prosperity for all the people are not prevented by any natural economical condition, the author seeks the appointment of a monetary commission, which, he assumes, acting discreetly, can devise a sound currency and banking system that will remove the cause of financial panics; and the purpose of his essays is to assist in securing the appointment of such a commission and help to a right understanding of the importance, aim, and direction of the work it should do.

While studying the Salishan languages of Washington and Oregon, Dr. *Franz Boas* learned that the dialects of the lower Chinook were on the verge of disappearing, and that some of them were remembered by only a few individuals. This fact determined him to make an effort to collect what little remained of them. With considerable difficulty he found a person who understood the Chinook, was acquainted with its stories, and intelligent enough to communicate them to him. The results of his labors are embodied in a paper on *Chinook Texts*, which is published with the originals and interlineal and current translations of the mythological and other stories, by the United States Bureau of Ethnology.

In the *Spirit of the Papacy*, *J. S. Hittell* examines the papacy in its political, intellectual, and ethical, as distinct from its theological, aspects. He undertakes to show by what devices it has tried to enslave the human race, and to prove that it is now dwarfing the intellects of those Catholics who submit to its control. He says that there are at present two great classes of Catholics—those including the high clergy, who resist everything in the shape of an innovation or advance; and a larger class, who have drawn near to the Protestants, and who plead for greater friendliness between the adherents of the two great branches of the Christian Church. (The author, San Francisco.)

The two great sources of difficulty to the beginner in geometry are the comparative novelty of the subject-matter and the unaccustomed clearness of conception and exactness of expression required in this new study. In *Elements of Geometry*, by *John Macnie*, edited by E. E. White (American Book Co., $1.25), the author says that the second source of difficulty is most easily diminished by reducing the first to a minimum. He has tried to present the subject of geometry with a "logical strictness approaching that of Euclid, while taking advantage of such improvements in arrangement and notation as are suggested by modern experience. . . . The function of a geometry is only secondarily the presentation of a system of useful knowledge, its greatest value lying in affording the only course in strict reasoning with which the majority of students will become acquainted." With these two beliefs as guides, the author has made an attractive and useful little text-book.

Magnetism: its Potency and Action, is the title of a volume in which *George W. Holley* has recorded some of his observations, experiments, and speculations on the magnetic force (Arena Publishing Company, $1.25). Among the topics that he discusses are the influence of magnetism on animal and vegetable life, the experiments of M. Hertz, "electric girls," spiritual phenomena, thought transference, hypnotism, and the action of the planchette. He sees magnetism manifested in the action of the brain and the heart, in the homing faculty of animals, the transformation of grubs, and various other phenomena. In this volume also the author outlines a new cosmography, which he illustrates by a diagram.

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Fragments of Science.

The Anniversary Meeting of the Royal Society.—The anniversary meeting of the Royal Society was held in its apartments at Burlington House, London, on St. Andrew's Day, Saturday, November 30, 1895. After the delivery of the presidential address by Lord Kelvin, the medals were presented as follows; The Copley medal to Prof. Karl Weierstrass, for Mem. R. S. (received on his behalf by the Foreign Secretary), for his investigations in pure mathematics; a Royal medal to Prof. James Alford Ewing, for his investigations on magnetic induction in iron and other metals; a Royal medal to Dr. John Murray, for his services to biological science and oceanography, in connection with the Challenger reports, and for his original contributions to the same; and the Davy medal to Prof. William Ramsay, for his share in the discovery of argon, and for his discoveries regarding gaseous constituents of terrestrial minerals. The officers elected for the ensuing year are as follows: President, Sir Joseph Lister, Bart.; Treasurer, Sir John Evans; Secretaries, Prof. Michael Foster and Lord Rayleigh; Foreign Secretary, Mr. Edward Frankland. Lord Kelvin closed his address with the following remarks: "I thank you all, my colleagues of the Royal Society, for electing me five times to be your president, for forgiving me all my shortcomings, and for the inestimable benefit which you have conferred on me by giving me your friendship." In the evening the anniversary dinner was held at the Hôtel Métropole, when the newly elected president, Sir Joseph Lister, occupied the chair. The retiring president, in his anniversary address, and several of the speakers at the dinner, dwelt at some length on the great loss which science and humanity had sustained through the deaths of Huxley and Pasteur.

Pasteur's Successor.—We take the following note from the Practitioner: M. Émile Duclaux, who has just been appointed Director of the Pasteur Institute, in succession to M. Pasteur, was his former chief's oldest collaborator, and had held the post of subdirector under him since the foundation of the institute. He was born at Aurillac in 1840, and was Pasteur's assistant in the École Normale from 1862 to 1865. After teaching for a time in the Tours Lycée in 1865–'66, he was appointed Professor of Chemistry at Clermont in 1866, and afterward of Physics in the Lyons Faculty of Sciences in 1873. In 1878 he came back to Paris as Professor of Physics and Meteorology in the Institute Agronomique, and in 1888 he was appointed Professor of Biological Chemistry in the Faculty of Science. M. Duclaux took the degree of Doctor of Science in 1862; but, like Pasteur himself, he is not a member of the medical profession, although in 1894 he was elected a member of the Academy of Medicine. He is the editor of the Annales de l'Institut Pasteur. Apart from his contributions to chemistry, silkworm culture, the phylloxera, etc., he has done valuable work on ferments and their relation to disease, digestion, milk, and microbiology.

The Feeding of Infants.—The time when a bottle-fed baby was a rare thing is within the memory of all of the older physicians; but now it is the exception rather than the rule for a mother to suckle her child. Many a mother who really wants to nurse her baby, but because of her small supply of milk is prevented, might, by a little judicious advice as to diet and proper habits, be rendered perfectly competent. Instead of this, that convenient bottle is adopted, which is thus graphically described by Dr. Mary A. Willard: "When the poor, pinched, blue, weazened little creatures were brought to me in the dispensary in New York, where they used to come by the dozen, I would call for their nursing-bottles, take a whiff of their sour, putrid contents, swarming with bacteria, pull off the rubber nipple and the ivory guard, rip up the long tube with my penknife, and scrape off the green, poisonous matter, tyrotoxicon, and spread it out on my palm before the astonished mother." Combine with such a state of affairs in the bottle some one of the dry milk foods, or a diluted condensed milk, and the babies' chances are pretty slim. The dry milk powders, including malted milk, are, from their nature, deficient in fats and contain a large excess of sugar, which is harmful because of the readiness with which it undergoes fermentation. As for the condensed milks, during a recent examination of the milk supply of London, seventeen brands were examined; fourteen of these were found to have been prepared entirely from skimmed milk, and showed an average of only 0·72 per cent of fat. Genuine full-cream brands of condensed milk contain from ten to twelve per cent of fat. Considering the far-reaching and deplorable effects which reliance upon such foods must lead to, it is of the utmost importance that physicians and parents should understand the dangers of prepared-milk feeding.

Examinations.—From a recent address delivered by Jonathan Hutchinson, and published in the Lancet, we quote the following very pertinent passages: "Examinations should be made as little distasteful as possible. The candidate ought to feel throughout his studies that in presenting himself to an examiner he does that which is equivalent to placing himself on a weighing machine, and that the verdict recorded will be in exact relation to his deserts. . . . The personal element, that of the examiner, should be eliminated as far as possible. To this end *viva-voce* examinations should, as far as practicable, be avoided. I have heard a self-confident examiner allege that he could tell better what was in a man in five minutes' conversation than by reading any number of his written papers, and I did not doubt that he thought so. This judgment of men, as it were, by personal inspection is often most fallacious, and should be permitted only with the utmost circumspection. It by no means follows that the disuse of the *viva voce* would throw us back wholly on set verbal questions. There remains the extensive field of objective examination. . . . This kind of examination it is which conduces most of all to sound matter-of-fact objective teaching. It is perhaps the most important of all modes, and is one which in the future is destined to receive more and more attention. We come next to the consideration of papers and of paper-setting. It is the fashion to hold that any one who knows his subject can examine in it, but in truth it is not so, and the art of examining is one which, like other arts, needs to be learned. It is impossible to deny that many examination papers are ill expressed, and some wholly unsuitable. It is no legitimate part of an examination to take the candidate by surprise, or confound him with the unexpected. Nor should half of the time allowed be taken up in the effort to understand what the terms of the question are intended to mean. . . . Modern education, in its zeal to avoid the charge of being superficial, incurs, as it seems to me, that of being merely fragmentary. It aims at thoroughness, but is obliged at once to admit that it can attain it only in certain subjects which, compared with the sum of human knowledge, are but few and small. . . . Excepting a very few of us, we are all mere smatterers as regards almost all that we think we know. It is not possible to be otherwise, excepting at the cost of being wholly ignorant in many directions; and as regards fitness for the affairs of life, better by far a general acquaintance with all that is around us, though it be not very deep, than slices of profound knowledge placed sandwichwise between thick layers of utter ignorance."

Hygiene of Oysters.—Prof. Herdman and Prof. Bryce have found, from experiments on the effect upon oysters of various conditions—with especial reference to the typhoid germ—that beneficial results are derived from aëration, and therefore that it is salutary to lay the mollusks down where there is a good change of water. Of foods given to oysters, sugar caused them to lose weight and die; oatmeal and flour had like effects. Stagnation was deleterious, causing the accumulation of excretory products, and encouraging the growth of micro-organisms and the formation of scums on the surface of the water; yet the oysters were tolerant of sewage, and could, up to a certain point, render water clear that was contaminated with it, and they could live a long time in water rendered opaque by fecal matter. The fecal matter from typhoid subjects was more inimical than that obtained from healthy ones. The oysters were found very prone to infection by micro-organisms, but the typhoid bacillus will not flourish in clean sea-water; and the experiments seem to show that this organism decreases in numbers in passing through the alimentary canal of the oyster. It seems possible, therefore, that by methods similar to those employed in the clearing basins of the French ostreoculturists oysters previously contaminated with sewage can be freed from pathogenic organisms or their products without being spoiled for the market.

Bibliography of Zoology.—The International Bibliographical Bureau for Zoölogy, the organization of which was begun about three years ago, will be located, Mr. H. H. Field announces, at Zurich, Switzerland. It will publish a fortnightly bibliographical Bulletin, with an edition printed on thin paper and on only one side of the sheet, so that it may be cut up; and a complete card catalogue of all zoölogical literature published after 1895; besides which the *Zoologische Jahresbericht* will be federated with the undertaking, so as to afford an annual list of titles, arranged alphabetically, by authors. The bureau will be aided in various parts of the world by national committees, correspondents, and sub-bureaus.

Engineering as an Exact Science.—So far as it is based on mathematics, said Mr. L. F. Vernon Harcourt in the British Association, engineering is an exact science, and the strains due to given loads on a structure can be accurately determined; but the strength of the materials employed has to be ascertained before any structure can be properly designed. Accordingly, the resistance of materials to tension, compression, and flexure has to be tested and their limit of elasticity and breaking weight to be determined. Numberless experiments have been made on the flow of water in open channels, over weirs, through orifices, and along pipes, and the influences of the nature of the bed, the slope, depth, and size of the channel have been investigated. Electrical engineering is especially adapted for experimental investigation, but every branch of engineering science is more or less capable of being advanced in the same way; and when it is borne in mind that the force of waves, the ebb and flow of tides in rivers, the influence of training works in estuaries, and the motion of ships at sea have been subjected to experimental research, it appears impossible to assign a limit to the range of experiments as a means of extending engineering knowledge. The correct calculations of strains, the exact strength of materials, and a strict appreciation of the physical laws affecting designs are of the utmost importance, and the failure of many bridges might be explained by a neglect of these considerations. Occasionally failures of works might be attributed to exceptional causes or peculiarly unfavorable conditions, but in most cases they are the result of errors or deficiencies in design which might have been avoided by a more correct appreciation of the physical conditions involved.

Electrical Effects of Spray.—A correspondent, writing to us concerning the effect of various atmospheric conditions on health and bodily vigor, cites his own experience in a fire brigade as having led him to believe that deficiency of ozone and other unfavorable conditions and the effect of atmospheric impurities may be alleviated by inhalation through a spray of cold water. A method of ventilation of railroad cars which was very comfortable to passengers riding in cars so treated, but has been disused, depended upon the application of this principle. Its value is further confirmed by what Prince Kropotkin has said in one of his recent articles on current science concerning the theory of the development of electricity by spattering water. A few years ago Herr Lenard undertook a series of observations in Switzerland on the electrical effect of waterfalls. It appeared that even small cataracts, only a few feet high, send into the air considerable charges of electricity, provided they bring down a large amount of rapidly dashing water. The smallest jets of water that drip on the rock sides, and even roaring streamlets, have the same effect. He suggested that the chief cause of electrification is the tearing asunder of the drops of water as they fall on the wet surfaces at the bottom of the waterfall. The experiments on which these views are founded accord with the demonstration by Lord Kelvin and Messrs. Maclean and Goto that air, even absolutely dust free, can be electrified by a jet of water. This source of electrification is further shown to be by no means insignificant, and the amount of electricity sent into the air in this way is immense. The importance of these facts in the economy of Nature, says Prince Kropotkin, is self-evident. "The supply of electricity in the air is continually renewed. The waterfalls in the valleys, the splashing of the waves on the shores of lakes and rivers, and the splash of drops of rain on the ground send masses of negative electricity into the air; even the watering of our streets and of our plants in the orchards has the same effect on a limited scale. On the other side, the waves of the sea, as they break against the rocks and fall back in millions of droplets upon the beach, supply the air with masses of positive electricity the amount of which rapidly increases after each storm. And when we stand on a sea beach we not only inhale pure ozonified or iodized air; we are, so to say, surrounded by an electrified atmosphere, which, as already remarked by Humboldt and often confirmed since, must have a stimulating effect upon our nervous activity as well as upon the circulation of sap in plants."

The Sciences Auxiliary to Engineering.—Among the branches of science necessary for the engineer, Mr. L. F. Vernon Harcourt, in his address at the British Association meeting, named mathematics and physics as of the highest importance, and as those upon which the profession mainly depends. Other sciences of considerable though comparatively minor importance are those of chemistry, meteorology, and geology. All branches of applied mathematics have to be used by engineers, or, as in the case of several general principles and tidal calculations, by mathematicians, for their benefit; but graphic statics will probably gradually supersede analytical methods for the calculation of stresses, as more rapid and less liable to errors, which are also more easily detected in graphic diagrams Pure mathematics, in its higher branches, appears to have a less direct connection with engineering; but applied mathematics is so largely dependent upon pure mathematics that this, including the calculus and differential equations, can not be safely neglected by the engineer—though some of the more abstruse portions of the subject might be dispensed with. Physics is of great importance, for there are few problems in engineering in which no part is borne by physical considerations. The surveyor avails himself of physics when heights are measured by the barometer, or by the temperature at which water boils. Evaporation, condensation, and latent heat bear upon the efficiency of steam engines, and the expansive force of gases, the retention of the heat developed, and the diminution of friction on the economical working of heat engines. Considerations of temperature limit the height to which railways can be carried without danger of blocking by snow, and the depth at which tunnels can be driven. Compressed air is largely used by engineers. Electric engineering, too, is intimately connected with physics. Chemistry is of importance in the manufacture of iron, steel, and other metals, and the formation of alloys, and in its relation to explosives. A knowledge of geology is indispensable in directing a search for coal, iron ore, and the metals, and in the execution of all works going below the surface. Meteorology is useful to the engineer in that it enables him to know the force of the wind and the direction, duration, and periods of occurrence of severe gales—very important matters in the construction of bridges and harbor works.

A Valley of White Limestone.—A remarkable formation is described by Mr. Theodore Bent as observed by him while exploring the frankincense country of Arabia, near the presumed site of the Abyssapolis of Ptolemy. The valley leading down to the Red Sea has been filled in the course of ages by a calcareous deposit, which is collected on either side of an isolated hill in the middle of the hollow, about one thousand feet in height. This deposit has taken the form of a straight and precipitous wall five hundred and fifty feet high and three quarters of a mile long on the eastern side of the hill, and about a quarter of a mile long and three hundred feet high on the western side. Over these walls feathery waterfalls precipitate themselves, adding perpetually to the chalky accretions of which the cliffs are constructed. The general appearance of the walls is white and whitish-gray, with long, white stalactites hanging down in tumbled confusion. They are streaked here and there, where the water perpetually falls, with patches of green. Beneath plateaus twenty feet high enormous ricinuses, daturas, and other plants flourish; and the Bedouins have utilized the stream before it has lost itself in the rocky channel to make small gardens. The rocky channel below is also very curious, presenting a flat surface about fifty yards across of white calcareous rocks, while just below the wall where the water comes down is an enormous amount of white calcareous deposit, soft and spongy to walk upon. Mr. Bent pronounces this one of the most stupendous natural phenomena he has ever seen, characterizes the valley as "a stupendous abyss," and compares the whole with the pink and white terraces of New Zealand and the calcareous deposits of Yellowstone Park.

Geology and Paleontology at Union University.—The department of Geology and Paleontology of Union University offers the ordinary course of the college and special courses for such students as are interested in the science from a philosophical or professional point of view. The courses include mineralogy and lithology, general geology (with excursions), economic geology, in which are considered in the second half the occurrence and distribution of the mineral deposits and building stones of the United States; systematic and structural geology and paleontology, with especial consideration of the formations occurring in New York and adjacent States and their characteristic fossils; field and laboratory study of the geological formations readily accessible from Schenectady; the methods of preparing geological maps and reports; and advanced field work and independent research, in which the student selects some region for original work to which he can devote considerable time, and conducts his investigation in a professional manner. He is expected in this to demonstrate his ability to conduct original work, and to prepare a report containing a summary of the previous knowledge of the geology of the region, with a detailed account of his investigations—the whole to constitute a contribution to knowledge. In studying paleontology the student receives careful training in systematic classification. Candidates for honors must prepare theses of sufficient merit to warrant the publication of at least an abstract in some scientific journal. As aids, students have access to the library and museum of Union College, and to the State Library and Museum at Albany.

Antiquity of the Quichuas.—Dr. George A. Dorsey expresses his belief, in a paper on The Character and Antiquity of Peruvian Civilization, that the Quichuas came into Peru from the north, and that the time of their arrival must have been a great while ago, "perhaps several thousand years. The fact that they had thoroughly domesticated the llama as well as other smaller animals is in itself proof of great antiquity. The same holds true in regard to the high state of cultivation in which we find the cotton plant, several varieties of maize, and other cereals and food products. In the province of Huarochiri, Avila states that the origin of the great acequias and irrigating canals was only accounted for by a myth, their construction dating back to so remote a period that they were no longer ascribed to human agency."

MINOR PARAGRAPHS.

Through the co-operation of some private persons interested in the preservation of species and the Linnæan and other societies of New York, protection has been afforded to the terns on Great Gull Island, Long Island Sound. A sum of money was contributed to employ a gamekeeper, and the lighthouse keeper on Little Gull Island was authorized to act in that capacity. From three to four thousand birds were found on the island in 1886. They had been since diminishing year by year in numbers under the attacks of sportsmen and egg-hunters, till attention was called to the fact and a watch was placed over them. Under the care of the gamekeeper the numbers of the colony increased at least one half during 1894, and terns are now seen where they had not been observed for many years before.

Were Indians of the Sioux stock ever settled in the East? is asked by James Mooney, who finds evidences in languages that such tribes once lived in a particular territory in Virginia and the Carolinas. Traditions are cited in his paper on the subject, which are said to exist among some of the Sioux tribes, of a former residence on the Ohio, and of a migration prompted by the density of the population, which had become too numerous for the hunting grounds. The emigration was probably prehistoric, as the Sioux tribes were established in the West as early as three hundred and fifty years ago, and was caused, Mr. Mooney thinks, not by the disappearance of game—for the buffalo did not become extinct in the Ohio Valley till late in the last century—but by the pressure of hostile tribes from the north and south—Algonkins and Muskogees.

The encouraging fact is brought out in the reports of examinations published by the Regents of the University of the State of New York that a rapid and healthy increase is going on in the standard of proficiency of the candidates in all the grades. Even more significant than this is the evidence that desultory courses of study are giving way to longer and reasonably balanced courses. A very beneficent influence is exerted it is alleged by the new laws and regulations requiring candidates for admission to practice in law, medicine, and dentistry to submit evidence of a general preliminary education equivalent to a full high-school course.

From certain manuscripts left by Dalton, to which attention is called by Sir Henry Roscoe and Dr. A. Harden, it is made clear that his application of the atomic theory to chemistry was not the result of his own analysis of certain compounds of carbon, as has hitherto been supposed, but that his mind was saturated with Newton's notions on atoms, and he worked out the theory from physical conditions as to the constitution of gases. Somewhat later he quoted numerical results, not of his own, but of other chemists' analyses, in support of the theory, and seems to have worked out the law of chemical combination in multiple proportions as the only conceivable mode of combination between atoms.

The results of the experiments of 1894 at the New York Agricultural Experiment Station on spraying indicate that the dilute Bordeaux mixture when thoroughly applied is a practical preventive of pear scab. The treatment has been equally effectual in preventing apple scab and codlin moth. Some roughness, regarded as injury, appeared on the sprayed fruit, but it has not been determined whether this was caused by the Bordeaux mixture, by substances mixed with it, by the weather, or by some other cause. Some of the trees sprayed in 1893 overbore, and consequently did not produce as full crops in 1894; the only inference deducible from which is that spraying will not prevent the reaction that follows an excessive crop.

NOTES.

Meerschaum is extracted in much the same way as coal. Near Eski-Shehir, an important station on the Anatolian Railway, where rich deposits of meerschaum are found, pits from twenty-five to one hundred and twenty feet deep are dug, and as soon as the vein is struck horizontal galleries, sometimes of considerable length, are made. The stone as extracted is called *ham-tash* (rough block), and is soft enough to be easily cut with a knife. It is white, with a yellowish tint, and is covered with a red, clayey soil. The manipulation required before it is ready for export is long and costly.

The average annual production of wine in Spain, inclnding the Balearic Isles and the Canaries, is estimated at 770,000,000 gallons. The principal wine-growing districts are in Valencia, Catalonia, Old Castile, Aragon, Riojana, Navarre, Leon, Andalusia, Estramadura, and the largest production is furnished by the provinces of Alicante and Valencia-Catalonia. Andalusia produces the famous sherry and Malaga wines which compete very favorably in the foreign markets with the Italian products of Marsala and Syracuse. The amount of sherry alone which is shipped from Spain each year represents a value of over $12,000,000.

Animals in Mediæval Architecture, profusely illustrated, and The Criminal Prosecution of Animals in the Middle Ages, also illustrated, are the titles of two interesting volumes by Prof. E. P. Evans soon to be published by Henry Holt & Co., New York, and William Heinemann, London.

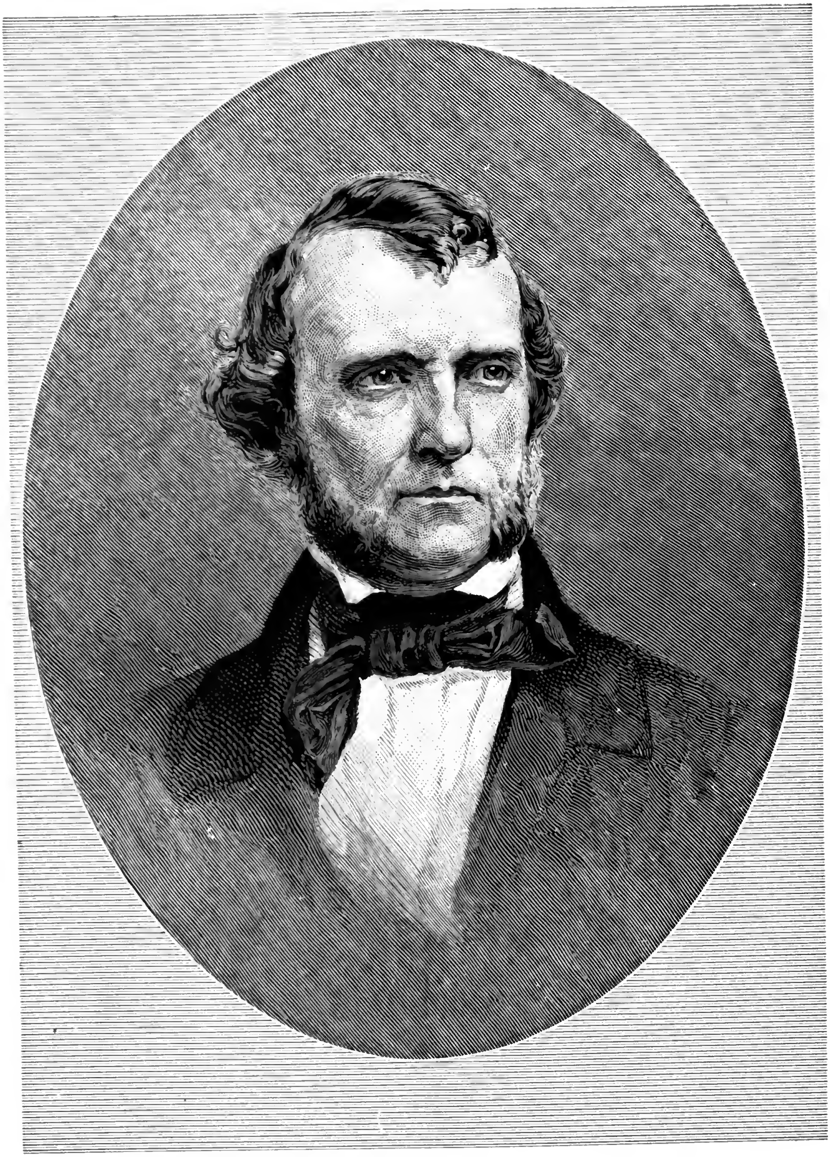
The following sentence from one of Pasteur's speeches seems worthy of widespread circulation: "I hold the invincible belief that science and peace will be victorious over ignorance and war; that the nations will agree not to destroy, but to build up; and that the future will belong to those who shall have done most for suffering humanity."

The part which ants play in the *ménage* of an orchid seems to be essential to its healthy growth. Mr. J. H. Hart, dealing with this question in a recent bulletin of the Royal Botanic Gardens, says that while there are several theories as to the part which the ants play, probably the correct one is that they supply the roots of the orchid with the mycelium of a fungus, which fungus enables them to take up food which would be otherwise unattainable.

The third International Congress of Psychology will meet in Munich next August The opening will take place in the great hall of the university on the morning of the 4th. Prof. Stumpf is the president of the congress. Information may be obtained from the general secretary, Freiherr von Schrenck-Notzing, or from Prof. Sully, East Heath Road, Hampstead, London, England.

It is stated that a biography of Prof. Huxley is being prepared by his son, Mr. Leonard Huxley, who will be greatly obliged if those who possess letters or other documents of interest will forward them to him at Charterhouse, Godalming. They will be carefully returned after being copied.

Dr. Robert Brown, who died in Streatham, England, October 26, 1895, in his fifty-fourth year, was a man of much versatility in science. He studied at the Universities of Edinburgh, Leyden, Copenhagen, and Rostock. Visiting Spitzbergen, Greenland, and Baffin Bay in 1861, he made some notable discoveries. During the next five years he traveled through some of the unexplored districts of America, visiting the West Indies, Venezuela, Alaska, Bering Sea, and places between, and the Pacific islands. He was botanist to the British Columbia expedition and commander of the Vancouver Island expedition. In these enterprises he introduced several new plants into Europe. He charted the interior of Vancouver Island, then unknown. With Mr. Whymper he made the first attempt of Englishmen in 1867 to penetrate the inland ice of Greenland. He afterward traveled extensively through the Barbary states; then settled down in Scotland, where he lectured to various institutions on geology, botany, and zoology; and later engaged in newspaper work in England. His name has been given to several new species of plants and animals, and to at least five geographical points in Vancouver Island, Spitzbergen, and Nova Zembla. He was the author of several scientific and other books, and an honorary or ordinary member of many learned societies.



WILLIAM STARLING SULLIVANT.

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PRINCIPLES OF TAXATION.

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

II.—THE PLACE OF TAXATION IN LITERATURE AND HISTORY. PART II.

TAXATION IN ANCIENT GREECE.—In Athens, according to Boeckh, the revenues of the state were derived from receipts from the public domains, including mines, partly from taxes analogous to our "customs" and "excise," and some taxes upon industry and persons which only extended to aliens and slaves; from fines and justice fees, from the proceeds of confiscated property, and from tribute from allied or subject states. All exports and imports into Athens, at one period, were subject to a small duty of two per cent; and in addition to this, foreign ships lying in the harbor paid a small fee, as did also aliens for the privilege of selling commodities, arriving by sea, in certain designated market places. "A special tax was also levied upon the proprietors or occupants of houses, the doors or windows of which opened outward on the public footway. And, as throwing further light on the social system of ancient Greece, we have the statement on good authority that the Greeks, having no pockets, used to leave valuable articles in sealed packets, trusting to the laws which punished the violation of a seal. Direct taxes," according to Boeckh, "imposed upon the soil, upon industry, or upon persons, excepting in cases of emergency, were looked upon in Greece as despotic and arbitrary; it being considered as a necessary element of freedom that the property of a citizen, as well as his occupation, should be exempt from all taxation, except when a free community taxed itself, which, however, is obviously an essential part of liberty." Poll taxes were exacted by the Athenian state, but as such taxes were considered ignominious and as implying subjugation, they were only assessed upon slaves or subjugated foreigners; and failure to pay was regarded in the light of a capital offense.

The income of Athens from fines appears to have been considerable, and to have constituted a singular and permanent feature of the fiscal policy of the state. Its method of assessment may be best illustrated by examples. Thus, if duly authorized officials did not hold certain assemblages, according to rule, or properly conduct the appointed business, they had each to pay a thousand drachmas ($200). If an orator conducted himself indecorously in a public assembly, he could be fined fifty drachmas (ten dollars) for each offense, which might be raised to a higher sum at the pleasure of the people. A woman conducting herself improperly in the streets paid a similar penalty. If a woman went to Eleusis in a carriage, she subjected herself to a fine of a talent ($1,180). In the case of wealthy or notable persons, fines for omissions or commissions in respect to conduct were made much greater, and so more productive of revenue; and there were very few notable or wealthy citizens of Athens who under the rule of demagogues, and through specious accusations of offenses against the state or the gods, escaped the payment of heavy fines; the experiences of Miltiades, Themistocles, Aristides, Demosthenes, Pericles, Cleon, and Timotheus being cases in point.* Every person who failed to pay a fine owing to the state was reckoned as a public debtor, and was subject to imprisonment and a practical denial of citizenship; Miltiades, the victor at Marathon, for example, having been cast into prison (where he afterward died) through an inability to pay a fine assessed against him of fifty talents.†

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* It was probably the contemplation of this state of things that led her great philosopher Aristotle to the conclusion, expressed in his essay on Politics, that "the rule of an irresponsible majority can be just as despotic as that of a single tyrant." He defines this extreme democracy as that "in which the majority, and not the law, is supreme"—in other words, "when decrees of the people, and not the law, govern." By "law" is meant a fixed code of statutes, which can not be changed or repealed by the ordinary legislative power. The latter can pass only decrees in conformity to the fixed code, which thus corresponds to our written constitutions. Such absolute power, he says, makes the people a monarch, and finally a despot refusing to be subject to law; and "such a democracy is analogous to tyranny." Both have the same character, for "both exercise a slaveholder's rule over the better citizens." In one we have decrees, in the other edicts; in one demagogues are in authority, in the other flatterers. When a dispute arises, the cry always is, "The people must settle it," and everything is determined by the momentary will of the supreme multitude. From this state of things the wisdom of our fathers has saved us, and the Supreme Court of the United States, as a rule, decides questions of constitutional law with far more wisdom and dignity than its predecessor, the popular court of Athens.

† Boeckh's Public Economy of Athens.

Another curious feature of the fiscal policy of Athens was an indirect augmentation of the public revenues, by diminishing the public expenditures by an institution which was essentially one of differential exaction (miscalled taxation), and was known as "liturgies." They consisted in the conferring upon ambitious and wealthy citizens certain honorary public offices to which nothing of salary or compensation was attached, but which entailed large expenditures for the entertainment of the people or defense of the country. The acceptance of these offices was compulsory; parsimony in expenditure on the part of the holder exposed him to public censure; and the institution undoubtedly found favor with the masses as a method of dividing the property or consuming the incomes of the wealthy. The system of liturgies was not, however, peculiar or restricted to the Athenian state. It existed in the Greek cities of Asia Minor, and also to a certain extent in Rome, where the persons accepting the office of ædile, whose business it was to take care of public edifices and superintend public festivals, were expected to appropriate large sums from their private resources for the convenience and amusement of the people. The office of ædile in Rome, which was one of great honor, was thus only made accessible to the very wealthy. But as the office was, however, in the direct line of preferment to some lucrative office in the provinces, the expenditures of its occupant were probably regarded in the light of an investment, from which more than complete remuneration was to be expected in the future. The principle involved in the liturgies would also seem to find recognition and exemplification in modern times, and under a different civilization, but in accordance with the same human nature; as, for example, in Great Britain, which by requiring members of Parliament to serve gratuitously, virtually restricts membership in that body to wealthy citizens; and also in the United States, which, by paying her judges and most of her other great officers of state inconsiderable and inadequate salaries, practically reduces the cost of her Government, and virtually makes merchandise of her honors by entailing a part of the proper expenses of such offices upon every first-class incumbent of them.*

The comparatively small expenditures of the Athenian state should also to be considered in connection with their revenue requirements. Thus, Mr. Grote estimates the annual expenditure of Athens, in the time of Pericles, at one thousand talents, or

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* It will not probably be disputed that the talent and experience which ought to be prerequisite to the holding and proper discharge of the duties of many of the important offices of the Government of the United States—judges, cabinet ministers, foreign ministers, consuls, etc.—will command in private life a much higher compensation or salary than is paid by the state.

$1,180,000; and, according to Mr. Boeckh, the revenues of the city never exceeded two thousand talents, or $2,360,000. The annual tax paid on the property of Demosthenes by his guardians amounted to only one fifth of one per cent of its valuation; and as, before the Peloponnesian war, the receipts from the silver mines owned by the state were so abundant that the surplus revenue was divided among the citizens of Athens, it is evident that for a time there was no necessity for taxation.

TAXATION IN ROME.—Up to the time of Servius Tullius taxation in Rome consisted of a *capitation* assessment, arbitrarily fixed, without regard to the means of the individual.* After the termination of the last Punic war, and down to nearly the epoch of the Empire—a period of at least one hundred and twenty-five years—the people of Rome were exempt from all direct taxation. This was due to the circumstance that Rome had accumulated great wealth, and was in receipt of an annual revenue from her conquered provinces fully adequate to defray all the expenses of the government, including the military establishment of the state. A large revenue for a considerable period was also derived from the imperial silver mines in Spain. Cicero, who lived before the empire, in one of his epistles to Atticus, laments the possibility of a resort to taxation by the state at some time in the future as something ominous of evil.

One of the first acts, however, of Augustus, after assuming the reins of government, was the gradual institution of an extensive system of taxation. He organized a land tax for the whole empire; and followed it up with what Gibbon terms "an artful assessment" on the real and personal property of the Roman citizens, who, as before shown, had been long exempted from any contributions for the support of the state. A tax of five per cent, or one twentieth, was also imposed on all legacies and successions, which did not apply to objects inherited of less than a specified value ("probably," says Gibbon, "of fifty or a hundred pieces of gold"); nor was it exacted from the nearest of kin on the father's side. †

This tax which appears to have been most productive, was one of the most permanent taxes of the empire, and its amount was increased by the successors of Augustus.

Gibbon seems to have been in doubt as to the motive which

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* Ortolan, History of Roman Jurisprudence, English edition, p. 257.

† "Such a tax was most happily suited to the situation of the Romans, who could frame their arbitrary wills according to the dictates of reason or caprice, without any restraint from the modern fetters of entails and settlements. From various causes, the partiality of parental affection also often lost its influence over the dissolute nobles of the empire; and if the father bequeathed to his son a fourth part of his estate, he removed all grounds of legal complaint."—(*Gibbon*, vol. i, p. 192.)

prompted Augustus to incorporate these new features of taxation in the Roman governmental policy, and suggests a desire to relieve the provinces from their burden of tribute, or to effect the impoverishment of the senate or the "equestrian" (knights) order. A more modern and probably a more correct view is, that Augustus recognized that, as Rome possessed all the known world that she considered worth possessing, the profitable results of further conquests, and the drain of accumulated wealth from subjugated nations, had practically come to an end; that her army henceforth existed mainly for maintaining the integrity of the empire, or for defense; and that for its support, in default of opportunities to plunder, an extensive and rigorous system of taxation had become necessary.

Under the system of taxation established by Augustus and extended by his successors, most of the taxes known to modern times were anticipated by the Romans. Apart from the taxes on land, they had export and import taxes; tolls for passage over bridges; a tax upon salt; a tax in kind upon corn (wheat), barley, wine, oil, meat, and wood; a tax upon the value of manumitted slaves; on sales; and a capitation or poll tax. Of other notable and peculiar Roman taxes was one on the wages of prostitutes; and apart from his wars with the Jews and the building of the Colosseum, the Roman Emperor Vespasian is best known in history as the originator of a tax on urinals.

Excepting possibly the land tax, there does not appear to have been any general and uniform system of taxation for the whole empire. The taxes on imports and exports were not uniform, and there were separate customs districts, each with a tariff of its own, and some with special immunities. Under the reign of Augustus and his successors, duties varying from an eighth to the fortieth part of the value of the commodity were imposed at Rome on every kind of merchandise, "which through a thousand channels flowed to the great center of opulence and luxury; and in whatsoever manner the law was expressed, it was the Roman purchaser and not the provincial merchant that paid the tax." *

A general tax (characterized by Gibbon as an excise), and seldom exceeding one per cent was also exacted at Rome on whatever "was sold in the market place, or by public auction, from the most considerable purchase of land and houses to those minute objects which can only derive a value from their infinite multitude and daily consumption." As exports were subject to Roman taxation as well as imports, and as the average rates imposed in both cases were probably low, these forms of taxation appear to have been in the nature of a payment for the privilege

* Gibbon, vol. i, p. 190, who in turn cites Tacitus, Annals, vol. xiii, p. 31, as authority.

of conducting commerce; imposed for the purpose of revenue only, and without the slightest reference to any contingent influences on trade or industry. In fact, the idea of promoting (protecting) industry through taxes on exchanges appears to have found no place in Roman or any other ancient economic history or experience.

In accordance with a practice on the part of the ancient Romans of deifying abstractions—as war, love, navigation, thievery, and the like—we find mention of the Genius of the Custom House, or of Indirect Taxes (*genius portorii publici*), a divinity that seems to have survived to our own times; inasmuch as many of the curious phenomena that have occurred in connection with modern efforts to prevent free exchanges through the agencies of customs taxation, seem only capable of explanation on the assumption that some occult power has been more potential in shaping economic events in this department of government than any proper exercise of man's reasoning faculties; and that it is the part of wisdom that large sacrifices should be made by the people in order to propitiate this deity.

Throughout the whole course of their history the principal taxes levied by the Romans appear to have been collected through the instrumentality of a class of officials known as "*publicans*," who paid the government for the privilege of so doing; and who, intrusted with extraordinary powers, were allowed, by way of compensation for their services, to collect and retain as much of additional revenue as they could force or extort from the taxpayers for their individual and private benefit. Such an administration of the publicans necessarily involved and required the employment of a large number of subcontractors and deputies, who, stationed at seaports, on public highways, at the gates of cities, and the market places, examined all goods exported, imported, or offered for sale, estimated their value, and collected the taxes to which they were legally liable, and as much more as they could extort with impunity, for the benefit of their masters or themselves—which last, in disorderly times and under the bad emperors, had a very wide latitude. This wretched system of "farming" or discounting the revenues of the state, which appears to have been a permanent feature of the government of Rome at all periods—under its kings, under the republic, and under the empire—has, moreover, a feature of general interest, as it clearly illustrates the exceeding limitation and narrowness of the general Roman policy in the sphere of civil administration.

Another fact pertinent to the general philosophy of taxation, which the historical study of Roman polity has developed, is also especially worthy of notice in this connection. As has been previously stated, the Romans, for a period of at least one hundred and twenty-five years before the establishment of the empire under Cæsar, were enabled, through the great spoils of war obtained from subjugated nations, to relieve themselves from taxation for the support of their government; and, in so doing, it appears that they first threw off their direct taxes, and at a later period those taxes that were indirect. But when under Cæsar it became necessary to reimpose taxes, they established them in a reverse order—that is, the indirect taxes were renewed first and in preference to those which were direct; thus recognizing and affirming in practice the idea that characterizes the fiscal policy of most modern governments—namely, that it is expedient to conceal as far as possible the burden of taxes from the people who are to pay them.

The gross amount of annual revenue which the empire of Rome collected in its best day is estimated by Gibbon to have been about twenty million pounds sterling ($100,000,000); later authorities place it at a much higher figure, or $200,000,000. In default, however, of exact information as to the purchasing power of money at the time, it is obvious that neither of these estimates can give us any true idea of the real amount of the Roman revenue; but, taking the probable price of wheat in Rome at the close of the republic as an indication of the price of other commodities, the purchasing power of Gibbon's twenty million pounds sterling ($100,000,000) must have represented a much greater sum, or at least $150,000,000. If the largest of these estimates of the revenue of imperial Rome should seem inadequate for the support of a government that extended over the greater part of the then known surface of the earth, that included a population of at least 150,000,000, and maintained a military and naval establishment of 450,000 men, it should be remembered that, apart from the greater increased purchasing power of money than now prevails, the expenditure by the state for the support of its military forces was comparatively small ("the ratio of military draft upon society before the inception of Rome's decadence being but little more than one third as great as that of the seven principal states of present Europe" *); that the present complexity and magnitude of expenditure in the form of taxes did not exist; and that a Roman national debt, with its burden of constantly accruing interest—the one thing most grievous to modern states—was entirely unknown.

The taxes, or rather exactions, on the people of the conquered provinces of Rome were always more numerous, discriminating, and onerous than those levied upon the population of the imperial city and its adjoining districts; and from the time of the

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* Baker. The Grandeur and Decadence of the Romans. D. Appleton & Co., 1894.

Emperor Diocletian they became more and more destructive of industry, and fell with special weight upon agriculture. According to Sir James Stephen, the land tax in Gaul rose to "the almost incredible amount of one third of the net produce of the land"; but what is more singular and incredible, the present tax on the peasant agriculturist of Italy is equivalent to the value of an even larger share of his product.

The provincial taxes which gave rise, however, to the greatest discontent were the poll tax and a tax upon funerals. These were easy to collect, and consequently in favor with the Roman tax-gatherers; but being levied at fixed and undiscriminating rates, pressed with great and unequal severity upon the poor. The last-mentioned tax—i. e., upon funerals, which required payment before the burial of the dead—was said to have formed one of the principal causes of the revolt of the Iceni (Britons), under their famous warrior, Queen Boadicea. The decree mentioned in St. Luke's Gospel, of Cæsar Augustus, that all the world should be taxed, and in pursuance of which "every one went into his own city," unquestionably referred to a poll-tax assessment, and to its required payment in person by every adult at the Roman tax-collector's office nearest to an established center of Roman authority.

In the province of Gaul the annual tribute exacted from every head under the reign of Constantine was reported to have been twenty-five pieces of gold. But the possibility of the payment of such a high capitation tax has been explained by the circumstance that in all the provinces of the Roman world the majority of the people were slaves, or peasants whose condition was little different from slavery; and that the rolls of tribute embraced only the names of citizens who possessed the means of an honorable or at least of a decent subsistence.

The whole record of Roman experience in respect to revenue collection or taxation before the decadence of the empire, alike in the city of Rome and in her provinces, is, however, of no value, save from an historical point of view. It does not appear, as before noted, to have been based upon any well-devised and harmonious fiscal system, or to have had any influence whatever in originating or developing one; for, unlike other Roman customs and institutions, it everywhere fell into disuse when the authority of Rome was withdrawn. In one feature alone was Rome consistent in her views and harmonious in her practice in respect to taxation: she always levied taxes for the purpose of getting money into the public treasury and for no ulterior reason. The nearest approach on the part of the Romans to a recognition of the policy of stimulating a branch of industry through the instrumentality of bounties or subsidies seems to have occurred in connection with the distribution of wheat gratuitously, or at artificially low prices, among the poor and idle masses of the imperial city; which practice, originally adopted under the republic, with a view of obviating popular discontent, and continued, with additions of oil and meat under the empire, finally became a cause of great anxiety to the emperors lest anything should interfere with the movement of grain, which was mainly by sea from Africa and Sicily. To insure regularity and efficient service, the state at first farmed out the right to transport the crops to certain wealthy individuals; and this inducement to enterprise proving insufficient, the Emperor Claudius gave a bounty for each successful trip of the grain fleet. The construction of ships was also encouraged by subsidies, and in this way there grew up a class of wealthy shipowners, whose profits and incentive to business were obtained from the state, and who by organization into an association (analogous to the modern trust) under the name of "*Naviculari,*" with branches in every city or town in the provinces, and with wealthy and influential senators among its stockholders or patrons, attained to great prominence and influence in the third and fourth centuries.

Taxation, in at least one notable instance, was also employed by the Romans as an instrumentality for the correction of a social evil—namely, a disinclination on the part of wealthy citizens, in the latter days of the republic and throughout the whole period of the empire, to contract marriages, with a view of avoiding the cares and burdens of a family. To counteract this tendency, a tax ("*œs uxorium*") was imposed on bachelors, with a limitation ("*lex Julia et Papia Poppœa*") on the transmission of property by will or gift by the unmarried and the childless.*

The statesmen and administrators of Rome seem never to have given a thought to the desirability of encouraging industry, trade, or commerce among their own people, much less among the people they had subjugated. There was, throughout all their literature and laws, the contempt which brigands and barbarians entertain for honest industry, at least when that industry is not agricul-

* In the seventeenth and eighteenth centuries there was well-nigh universal legislation of this kind, the most thoroughgoing specimens being a Spanish edict of 1623 and one of Louis XIV in 1666, which not only granted exemption from taxation, but positive subsidies in cash, as an inducement to early marriages. That the idea involved in such legislation has also found favor at the present time is shown by the fact that Prof. Richet, a German economist of repute, has recently proposed that in all systems of taxation the fathers of large families be favored, and that corresponding burdens be laid on those who contumaciously refrain from marrying; ignoring the fact that old Rome adopted and carried out this policy by measures much more drastic than the spirit of the present times would tolerate, and that the result is generally believed to have been a failure. It is also worthy of note, that at the present time, in the Canadian Province of Quebec, the fathers of the largest families receive bounties of public lands; the motive of which policy is unquestionably to bring the French Canadian element into the control of the Dominion Government.

tural. To create wealth appeared to them sordid; to take it was admirable, or, as M. Blanqui has put it, the economic policy of the Roman state may be expressed in the following single sentence, "*Les romains voulaient avant tout consommer sans produire*"*

The genius of the Roman government was military, not commercial. The Romans prohibited commerce to persons of rank and fortune; and no senator was allowed to own a vessel larger than a boat sufficient to carry his own food (grain) and fruit. They encouraged corn merchants to import provisions from Sicily, Africa, and Spain, because the cultivators of the soil of Italy, mainly slaves, did not produce a sufficient supply of food for the city of Rome. They seem, moreover, never to have had any conception of the impolicy of levying taxes in such a way as to dry up the channels of trade and enterprise; or of the fact, abundantly substantiated by all experience, that when government takes from its people more than a fair share of the savings of capital and labor, then accumulation will cease and capital be destroyed; and against social disorders thus engendered Rome was powerless. That the seeds of decay were thus planted in her governmental system, and that the fall of her empire was hence only a question of time and inevitable, is a point that historians seem very generally to have overlooked.

During the years of the later empire, although its resources and population had greatly decreased, its expenditures enormously increased; and the sequence of this was a system of grinding exactions, to which, more than any other one *immediate* cause, the utter decay and final complete downfall of the empire may be attributed. During the period intervening between the reign of Marcus Aurelius and Diocletian it has been estimated that a majority of the population of the empire, from Persia to Gaul, had died of the plague; and what the plague had been to the population, the "*fiscus*" or financial policy of the government was to industry. Under Constantius, A. D. 337, taxes were imposed on all trades and industries, and such was the comprehension and severity of the law, that Gibbon tells us, that "the honorable merchant, the usurer who derived from the interest of money a silent and ignominious profit, the ingenious manufacturer, the diligent mechanic, and even the obscure retailer of a sequestered village, and the public prostitutes," were all alike obliged to admit the officers of the revenue to a participation of their gains. Such, moreover, was the imperfect state of agriculture and of manufacturing processes that the net product of the individual was necessarily

* See Blanqui. Histoire de l'Economie Politique en Europe. American translation by Emily J. Leonard. G. P. Putnam's Sons, New York, 1880.

very small—so much so that it has been estimated that the labor of several individuals was required to supply even the necessary food of one inactive person. But as the people became exhausted, the demands of the government, contingent on the maintenance of an extravagant court and a large standing army of soldiers and officials, became greater, the severity in the methods of exaction increased, and in no two provinces was the authority of the government (sovereign) exercised in the same manner.* With malignant ingenuity, and with a view of perfecting the control of the state over the individual, and doubtless more especially for facilitating the operation of the officials charged with the duty of collecting taxes, every man's position was fixed for him by the conditions of his birth. The son of a cultivator of the soil was chained, as it were, to the lands tilled by his father. The workmen in all other departments of industry were bound to their position for life, and when they died their places were taken by their sons. "If any one of them deserted his work, he was sought out, even to the remotest provinces, and ruthlessly dragged back to his post." † If he failed to produce a prescribed result, the state intervened and forced its accomplishment. In making assessments for taxation, visible tangible property was enrolled with great minuteness by officers who corresponded to our modern assessors. The lands were measured by surveyors; their nature—whether arable or pasture, vineyards or woods—was distinctly reported; and an estimate was made of their value from their average produce for five years. Every new purchaser of land contracted all the obligations of former proprietors. Slaves and cattle were counted separately, and carefully reported for assessment; and by the Theodosian Code, which for the time was an almost universal law, death and confiscation of estate was the punishment to which every farming proprietor was liable who should attempt to evade taxation.

In respect to the assessment and collection of taxes on personal property, the accounts that have come down to us are most interesting, and ought to be full of instruction to legislators of the present day who believe in patterning tax administration after old and vicious experiences, so far as the changed conditions and ideas of civilization in the nineteenth century will admit. The proprietor of such property was, in the first instance, questioned under oath; and every attempt to prevaricate or elude the inten-

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* Alfred Rambaud. L'Empire Grec au Dixième Siècle.

† By a law of the Emperor Theodosius, in 438 A. D., it was provided that the *fabricenses* (meaning thereby the workmen engaged in the fabrication of arms) "shall be so closely bound to their appropriate duties that, worn out at last by their toil, they shall die in the profession to which they were born—both they and their children after them."—(*Codex Theod.*, ii, 9, 4.)

tions of the legislator was punishable as a capital crime, and was held to include the double guilt of treason and sacrilege. If the results of personal interrogation under oath were not satisfactory to the tax officials, they were empowered to administer torture; and when personal stoicism or absolute incapacity failed to effect the desired results, resort was had to other, most abhorrent, and unnatural methods for procuring the sum at which their property was assessed—"the faithful slave being tortured for evidence against his master, the wife to depose against her husband, and the son against his sire. Neither age nor sickness exempted from liability and personal inquisition. In taking ages, they added to the years of children and subtracted from those of the elderly. When the number of cattle fell off and the people died, the survivors were obliged to pay the assessments on the dead." Zosimus, a historian who wrote in the early part of the fifth century, says that the approach of the fatal period when the general tax upon industry was to be collected "was announced by the tears and terrors of the citizens."

That the result, so far as the execution of the law was concerned, was a success, can not be doubted; nor that by the methods employed large amounts of revenue were collected that otherwise could not have been obtained. But what were the final results? First, a demonstration of an economic truth, which in subsequent years has over and over again been repeated, that the productiveness of a tax is not its first consideration; and that a blight contingent on the method of assessing and collecting a tax may ruin a harvest which it can not gather. Under the state of things, as described, that prevailed under the latter days of the Roman Empire, the agriculture of its provinces was gradually ruined. Long before the footsteps of the barbarians had been seen in Italy, a large part of what had been its most fertile portion and the seat of "the delicious retirement of the citizens of Rome," had become uncultivated and a desert. "The desire and possibility of accumulation languished, and men produced only what would suffice for their immediate needs; for the government laid in wait for all savings. Capital vanished, the souls of men were palsied; population fled from what was called civilization, and sought concealment and relief in barbarism and with barbarians. Men cried for social death, and invited the coming of savages; and in the form of Goths and Vandals, Huns and Herulii, Franks and Lombards, they came, and the empire of Rome and its degraded civilization went down in almost universal turmoil, bloodshed, robbery, and woe." There is also good reason for believing that the Turks were greatly indebted for their success in overthrowing the subsequent Byzantine or Greek Empire to their simple methods and policy in respect to taxation; and that the subjects of the empire were glad to change their masters, because instead of multiplied, intricate, and vexatious taxes, the legacy of old Rome, they found themselves subject to a simple tribute, easily collected and easily paid.*

THE FAILURE OF SCIENTIFIC MATERIALISM.†

By WILHELM OSTWALD,
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THE complaint has gone up in all ages that so little agreement prevails respecting the most important and most fundamental questions of humanity. Only within our own days has the cry with respect to one of the greatest of these questions been silenced; and although many contradictions are still current, it may yet be said that rarely at any time has a so relatively great unanimity existed concerning the theory of the world of outward phenomena as prevails just now in our scientific century. From the mathematician to the practicing physician, every scientifically thinking man, in answer to the question how he supposes the world is intrinsically constituted, would sum up his view, by saying that the universe is composed of atoms in motion, and that these atoms and the forces operating between them are the ultimate realities of which individual phenomena consist. The phrase can be heard and read in hundredfold repetitions, that no other explanation of the physical world can be found than one that rests upon the "mechanics of atoms"; matter and motion seem to be the ultimate concepts to which the diversity of natural phenomena must be referred. This conception may be called scientific materialism.

I purpose to express my conviction that this so generally accepted conception is untenable; that this mechanical view of the world does not answer the purpose for which it has been formed, and that it is contradictory of indubitable and generally known

* The most available source of information on this subject is the historian Gibbon (Decline and Fall of the Roman Empire, edition with notes by Milman, Güizot, and Smith; New York, Harper's), who in turn specially cites as the authority for his statements the two collections of ancient laws designated by the names of the two Byzantine Emperors under whom they were made, as the Codex Theodosianus and Codex Justinianus, and the writings of Zosimus, a Greek historian, who lived in the early part of the fifth century A. D., and whose history of the Roman Empire is still extant. For an exceedingly graphic account of Roman experiences in attempting to tax personal property (from which quotations have here been made) see Roman Imperialism, by J. R. Seeley, London, 1870.

† An address delivered before the third general session of the meeting of the Society of German Naturalists and Physicians, at Lubeck, on September 20, 1895.

and recognized truths. There can be no doubt of the conclusion to be drawn from this proposition: this scientifically untenable conception must be given up, and replaced, if possible, by another and better one. I believe that I can answer the question that would naturally be asked here, whether another better view exists, in the affirmative. What I have to say on the subject will therefore be legitimately divided into two parts—the destructive and the constructive. It is easier in this case, as in others, to destroy than to build up, and the insufficiency of the usual mechanical view will be easier to demonstrate than the sufficiency of the new one, which I shall call the energistic view. But if I declare at once that this new theory has already had opportunity to show its quality in the field of experimental science, so favorable to calm examination and impartial testing, it will then be able, even if it can not secure conviction of its correctness, to demand recognition of its claim to consideration.

It may not be superfluous for me to announce in the beginning that I contemplate an exclusively scientific discussion. I put away absolutely and unconditionally all conclusions which might be drawn from the result for other, ethical and religious, purposes. I do this, not because I undervalue the importance of such considerations, but because my result has been obtained independently of them, purely on the ground of exact science. Even for the tilling of this ground the word holds good that he who puts hand to the plow and looks back is not made for the kingdom. The naturalist is pledged to declare what he has found, whomsoever it may hurt or help, and we may surely trust that earnest seeking, though it may lead us astray for a little while, will never do it permanently. I do not forget that my attempt places me in contradiction with the opinions of men who have achieved much in science, and to whom we all look up in admiration. I hope you will not impute conceit to me because I differ from them on so important a subject. It is not conceit when the sailor whose post is in the "crow's nest" causes the course of the great ship on which he is only a servant to be turned by the cry of "Breakers ahead!" It is his duty to tell what he sees, and he would fail in this duty if he neglected to do so. In the same sense I have a duty to discharge. Yet none of you is obliged to change his scientific course merely on my call of "Breakers ahead!" Each of you may test whether a reality stands before my eyes, or I am deceived by a vision. But since I believe that the special kind of scientific work which is my calling permits me for the moment to discern certain phenomena more clearly than they appear from other points of view, I should consider it wrong if I failed for reasons outside of it to speak of what I have seen.

In order to set ourselves right in the infinity of the world of phenomena, we pursue always and everywhere the same scientific method. We put like by the side of like, and seek what is common in diversity. In this way is the gradual mastery of the infinity of our phenomenal world achieved, and more effective means for compassing the purpose arise in successive development. From bare comparison we pass to system, from this to laws of Nature, and the most comprehensive form of these is compressed into the general principle. We perceive that the phenomena of the actual world, unlimited as is their diversity, still represent only quite definite and well-marked instances of formally conceivable possibilities. The significance of the laws of Nature consists in the determination of the real cases out of the possible, and the form to which they may all be traced back is the ascertaining of an invariant, a something which remains unalterable, even when all other criterions within the possible bounds defined by the law change. Thus we see that the historical development of scientific views is always associated with the discovery and elaboration of such invariants; in them are revealed the milestones of the highway of knowledge which mankind has trodden.

One such invariant of universal bearing is found in the idea of mass. This not only gives the constants of astronomical laws, but is not less invariably illustrated in the most incisive changes to which we can subject the objects of the outer world—chemical processes. For that reason this idea, as being highly adapted to the position, has been made the center of scientific legitimacy. It was, however, in itself too poor in substance to serve for the representation of the manifold phenomena, and had to be correspondingly extended. This was done by associating with that simple mechanical idea the series of properties, in their proportion, which are experimentally connected with the property of mass. Thus originated the idea of matter, in which was grouped all that was sensibly connected with mass, and continued with it, such as weight, volume, chemical properties, etc., and the physical law of the conservation of mass passed into the metaphysical axiom of the conservation of matter.

It is important to understand that with this extension a multitude of hypothetical elements were introduced into a conception that was in the beginning wholly free from hypotheses. Chemical processes, in particular, must be interpreted in the light of this view against the seeming, not as implying a disappearance of the matter affected by the change and its replacement by new matter with new properties. The theory rather became accepted that even when all the sensible properties of, for example, iron and oxygen disappear in iron oxide, iron and oxygen are nevertheless present in the resultant substance, and have only taken on other properties. We have now become so accustomed to this view that it is very hard for us to perceive the strangeness, yes, the absurdity of it. When we reflect that all we know of any particular substance is of its properties, we see that the thought that it is still present, but has no longer any of its properties, is not far removed from pure nonsense. In fact, this purely formal conception only serves to help us harmonize the general facts of chemical processes, particularly the stoichiometrical laws of mass, with the arbitrary conception of a matter unchangeable in itself.

But even with this extended conception of matter and the necessary corollaries besides, we can not comprehend the mass of phenomena—not once in inorganic Nature. Matter is thought of as something at rest, unchangeable; in order to reconcile this thought with the view of the constantly changing world, we have to complement it with another, independent of it, which shall bring changeableness to pass. Such a supplementary idea was set forth by Galileo, the creator of scientific physics, in the conception of force, as the constant cause of motion. Galileo had discovered a highly important invariant for the variable phenomena of free and induced falling. By the application of a self-existing gravity, the effects of which continuously accumulate, he made the complete explanation of these processes possible. The pregnancy of this conception was demonstrated by Newton, who, with his thought that the same force was operative as a function of the distance between the heavenly bodies, conquered the whole visible stellar world for science. This advance it was, chiefly, which aroused the conviction that all other physical phenomena could be accounted for in the same way as those of astronomy by the same auxiliary. Then when it resulted, further, at the beginning of our century, through the labors of a number of eminent astronomers, principally French, not only that Newton's law of gravitation could account for the motions of the heavenly bodies in their larger features, but that it sustained the closer and far more thorough second test of accounting for the deviations from the typical forms of motion, the perturbations, the confidence in the fruitfulness of this conception was increased in an extraordinary measure. What could be more readily suggested than the supposition that the theory which had been competent to account so completely for the motions of the great world was also the right and only means of reducing the processes in the smaller world of atoms to scientific control? Thus arose the mechanical view of Nature, according to which all phenomena, especially in inanimate Nature, were traced back ultimately to the motions of atoms under the same laws as were recognized for the heavenly bodies. It was a necessary consequence that this conception of the realm of inorganic Nature should be applied to animate Nature as soon as it was perceived that the same laws which prevailed there could also claim their inviolable right here. This view of the world found its classical expression in Laplace's idea of a "world formula," by means of which every past and future event could be brought about in a strictly analytical way according to mechanical laws. For such a work, a mind was required which was far superior to the human mind, but was still essentially like it and not fundamentally different from it.

We do not ordinarily remark in how extremely high a measure this generally current view is hypothetical, even metaphysical; but are accustomed, on the other hand, to regard it as the maximum of exact formulation of actual facts. In contradiction to this it should be declared that a confirmation of the consequence that should flow out of this theory—that all the non-mechanical processes, like heat, light, electricity, magnetism, and chemism, are really mechanical—can not be reached in any single case. It has never been possible in any one of these instances so to account for the actual conditions by a corresponding mechanical system that there should be no remainder.

Mechanical interpretations, it is true, have been given with more or less considerable success to individual phenomena; but when the attempt has been made to account for all the facts in any given field by means of a mechanical conception, it has always and without exception come to pass that an irreconcilable contradiction appeared at some point, between the actual state of the phenomena and that which the mechanical conception would lead us to expect. Such contradictions might remain hidden for a long time; but the history of science teaches us that they will inevitably sooner or later come to light; and that all that we can say with full certainty of such mechanical conceptions or analogies as are usually called mechanical theories of the phenomena in question is that they will at any rate fill the gap for the present.

The history of optical theories affords a conspicuous example of these conditions. So long as all optics included nothing more than the phenomena of reflection and refraction, an interpretation was possible under the mechanical scheme proposed by Newton, according to which light consists of small particles which, thrown out straightwise by shining bodies, behaved according to the laws of moving and perfectly elastic masses. That another mechanical view, the undulatory theory proposed by Huygens and Euler, accomplished quite as much, might make the exclusive validity of the former theory doubtful, but could not deprive it of its predominance. But when the phenomena of polarization and interference were discovered, Newton's mechanical conception was found wholly inadequate, and the other, the undulatory theory, was received as proved, because the essential facts at least of the new departments were deducible from its premises.

The life of the undulatory theory as a mechanical hypothesis has, however, been a limited one, for it has been borne to the grave in our own time without display, and been replaced by the electro-magnetic theory. The cause of its death is shown very plainly when we dissect the corpse. It was carried down by its mechanical constituents. The hypothetical ether, on which the task of undulating was imposed, had to do this under peculiarly hard conditions, for the phenomena of polarization demanded peremptorily that the undulations should be transversal; but such undulations presuppose a rigid body, and Lord Kelvin's calculations have shown, as a final result, that a medium with such properties as this ether must have is not stable; whence the conclusion is inevitable that it can have no physical existence. In order to spare the now accepted electro-magnetic theory of light from such a fate, the lamented Hertz, to whom this theory owes so much, expressly denied that he saw anything else in it than a system of six differential equations. This termination of the evolution speaks more impressively than I ever can against the permanent usefulness of the formerly current mechanical theorizing.

But I hear it said, Those theories have been so fertile. Yes, they have been so through the sum of correct constituents in them, as they have been damaging through their false ones. What were the correct and what the false had to be determined by long and costly experiments. The result of our discussion so far is first a pure negative. We have learned how not to do it, and it seems to be of little use to follow out such negative results. Yet we can point out a gain here, which will not appear worthless to many of you. We find it possible, as we go, to refute critically a view which had no small credit in its time, and caused great concern to many of those interested in the discussion. I refer to the widely known propositions which the eminent physiologist of the University of Berlin, Emil Du Bois-Reymond, made, first twenty-three years ago, on the occasion of the meeting of naturalists at Leipsic, and afterward in some more widely read writings, relative to the prospects of our future knowledge of nature, and which culminated in the famous expression *ignorabimus*. In the long controversy which followed this address, Du Bois-Reymond, so far as I can see, remained essentially the victor against all attacks, for all his antagonists proceeded from the same principle from which he inferred his *ignorabimus*, and his conclusions stood as firmly as that principle. This principle, which in the meanwhile had never been brought in question by any one, was the mechanical theory of the world—the supposition that the solution of the phenomena in a system of moving mass-points is the end which the theory of Nature is trying to reach. If this principle falls, and we have seen that it must fall, the *ignorabimus* falls with it, and science again has free course.

I do not believe that you will accept this result with surprise, for, if I can judge from my own experience, hardly a naturalist has seriously believed in the *ignorabimus* unless he has failed to make clear to himself in what point that in it which is untenable lies. But the gain to the negative criticism of the mechanical theory of the world accruing from the formal laying of that menacing specter may be of some value to many thinkers who have nothing to oppose to the inevitable logic of Du Bois-Reymond's demonstration.

What is here laid down for the sake of clearness, in respect to these particular discussions, has, however, a considerably wider bearing. The refutation of the mechanical construction of the universe touches the basis of the whole materialistic theory of the world, the terms being taken in the scientific sense. It appears a vain undertaking, with ultimate failure decreed to every earnest effort, to interpret known physical phenomena mechanically; hence the conclusion is unavoidable that the attempt can still less succeed with the vastly more complicated phenomena of organic life. The same contradiction of principle forces itself upon us here, and the supposition that all natural phenomena can be traced back primarily to mechanical factors can not even be designated an available working hypothesis. It is a mere error.

The following fact bears most plainly against this error: Mechanical equations all have the property of permitting the exchange of the sign of time—that is, the theoretically perfected mechanical processes can as well go backward as forward. In a purely mechanical world there are therefore no earlier and later in the sense of our world: the tree might be changed into a twig or a seed, the butterfly to a caterpillar, and the old man to a child. The mechanical theory has no explanation of the fact that this does not take place, and, on account of the property of mechanical equations which we have mentioned, can have none. The actual irreversibility of real phenomena also demonstrates the existence of processes that are not representable by mechanical equations; and with this the condemnation of scientific materialism is pronounced.

It thus appears to result certainly from these considerations that we shall have finally to renounce the hope of explaining the physical world intuitively by tracing its phenomena back to a mechanics of the atoms. But, I hear it said, if the conception of moving atoms is taken away from us, what means is left of forming a picture of the reality? To such a question I might reply, "Thou shalt not make unto thee any image or any likeness!" Our object is not to see the world in a more or less darkened or distorted glass, but as immediately as the constitution of our mind will permit. To set realities, demonstrable and measurable magnitudes, in definite relations with one another, so that when one is given the others will follow—that is the purpose of science, and it can not be fulfilled by the substitution of any hypothetical figure, but only by the demonstration of the mutual dependencies of measurable magnitudes.

This road is undoubtedly long and toilsome, but it is the only permissible one. We do not have to go upon it, however, despairing of ourselves seeing the end of it, and merely hoping that it may lead our children to the desired heights. No, we ourselves are the happy ones, and the most hopeful scientific gift which the departing century can offer the dawning one is the replacement of the mechanical theory by the energistic.

I lay at this point great weight on the declaration which I make that we are not dealing with some fresh novelty, first given in our time. No, we have been in possession of the truth for half a century without knowing it. If there ever was a place for the expression "mysteriously evident," it is here; we can read it every day, and do not understand it.

When fifty-three years ago Julius Robert Mayer first discovered the equivalence of the different natural forces, or, as we should say now, of the various forms of energy, he made a great advance toward an ultimate solution of the problem. But, according to a constantly recurring law in universal thought, a new fact is never accepted in its primary clearness and simplicity. The receiver, who has not inwardly felt the advance, but has taken it in from without, strives first of all things to connect the new as well as he can with what is already existing. Hence the new thought is obscured, and, although not exactly falsified, is robbed of the best of its force. So strong is this peculiarity of thought that it does not even leave the discoverer free; as even the powerful mind of Copernicus was competent to let the sun and earth change places in their motions, but not to comprehend the simple motions of the other planets; to account for these he adhered to the received theory of epicycles. So it was with Mayer. Hence, as it nearly always is, the work of the next generation consists, not in harvesting the results of the new knowledge, but rather in removing again, piece by piece, the involuntary additions that do not belong to the subject, till at last the fundamental thought can come out in its whole plain identity.

A similar development can be perceived, even in our case. After J. R. Mayer had defined the law of equivalence, his theory of the equivalent transformability of the different forms of energy was too paradoxical in its simplicity to be immediately accepted. Rather have the three physicists to whom we are most indebted for the continued study of the law—Helmholtz, Clausius, and Lord Kelvin—believed that it must be interpreted as implying that all the different forms of energy are fundamentally the same—mechanical energy. In this way, what was regarded as most pressing—close connection with the prevailing mechanical conception of Nature—was reached; but a decisive side of the new thought was lost.

It required a half century for the idea to mature that this hypothetical addition to the law of energy did not give depth to the theory, but detracted from it on its most significant side—its freedom from all arbitrary hypothesis. And not even the recognition of this methodical circumstance, but the ultimate failure of all attempts satisfactorily to explain all the other forms of energy mechanically, has been, so far as our advance has as yet proceeded, the decisive reason for giving up the mechanical explanation.

You are impatient to learn how it is possible to form, by means of so abstract an idea as energy, a theory of the world that can compare in clearness and intuitiveness with the mechanical theory. I do not find the answer hard. What do we know of the physical world? Evidently only what our organs of sense permit to reach us from it. But what are the conditions under which these organs act? Turn things as we will, we find nothing common but that the sense organs react upon differences of energy between them and the surroundings. In a world the temperature of which is everywhere that of our body, we would know nothing of heat, just as we have no idea of the constant atmospheric pressure under which we live, and as we never gain knowledge of it till we establish a different pressure.

You will admit this, but you will not therefore give up matter, because energy must have a bearer. But I ask you, why? When all that we learn of the outer world are conditions of its energy, what ground have we for presuming anything in this same outer world of which we have never learned anything? Yes, I may be answered, energy is only something thought of, an abstraction, while matter is real. I reply: The contrary! Matter is a thing of thought, which we have constructed for ourselves, rather imperfectly, to represent what is permanent in the change of phenomena. Now that we begin to comprehend that the effective thing—that is, that which affects us—is only energy, we have to determine in what relations the two stand; and the result is indubitable that the predicate of reality can be ascribed only to energy.

This decisive side of the new theory will come more plainly into view if I present the concept in a brief historical sketch. We have already seen that the progress of science is marked by the discovery of more and more general invariants; and I have shown how the first of these unchangeable entities, mass, has expanded into matter—that is, mass endowed with volume, weight, and chemical properties. Yet this idea was obviously insufficient from the beginning to cover the incessant variability of phenomena; and since Galileo's time, that of force has been added as a means of accounting for it. Yet force was destitute of the property of unchangeableness; and after functions were found in mechanics, in living force, and work which manifested themselves as partial invariants, Mayer discovered in energy the most universal invariant, dominating over the whole domain of the physical forces.

Conformably to this historical development, matter and energy continued existing together, and all that we could say of their mutual relations was that they mostly appeared with one another, or that matter was the bearer or the vessel of energy.

Are matter and energy, then, really different from one another like, for instance, body and soul? Or is not rather what we know and express of matter already comprised in the idea of energy, so that we can represent all phenomena with this one entity? In my opinion the answer can not be doubtful. What is included in the idea of matter is, first, mass—that is, the capacity for momentum; next, volume, or space-filling energy; then gravity, or the peculiar kind of static energy which is manifested in general weight; and, lastly, chemical properties, or chemical energy. We still have only energy; and if we think on about these various kinds of matter, there is nothing else left us, not even the space it occupies, for this, too, is knowable only by the application of energy, which is required to compress matter within it. Hence matter is nothing but a spatially contiguous group of different energies, and all that we can predicate of it we predicate only of these energies.

What I am at pains to assert here is so important that you will pardon me if I try to approach the subject more closely from another side. Permit me, therefore, to take the most drastic example I can find. Imagine that you are struck with a stick. What do you feel, the stick or its energy? The only possible answer is the energy, for the stick is the most harmless thing in the world, so long as it is not made to strike. But we can also run against a stick at rest. Very true; and what we feel then is, as I have already declared, the difference in the conditions of energy as opposed to our sense organs; and it is therefore all the same whether the stick is struck against us or we are pushed against the stick. If both have the same velocity, and that in the same direction, then the stick exists no more for our feeling, for it can not come in contact with us and effect an exchange of energies.

These premises show, I hope, that all that it has hitherto been possible to represent with the aid of the ideas of matter and force can be represented, and much better, by means of the idea of energy; all that is required is a transference of the properties and laws which have been ascribed to the former to the latter. We further gain the very great advantage of avoiding the contradictions which were attached to the former mode of conception, and which I have exposed in the former part of my thesis. While we make no other supposition concerning the connection of the different kinds of energy with one another than that given through the law of the conservation of forces, we gain liberty to study objectively the various properties appertaining to these several kinds of energy, and can thus, by the rational consideration and arrangement of these properties, set up a system of sorts of energy which will reveal to us exactly the similarities as well as the differences between them, and will therefore carry us scientifically much further than can be done by the obliteration of these differences by the hypothetical assumption of their intrinsic identity. We find a good exemplification of this position in the kinetic theory of gases, which is now almost universally accepted, according to which the pressure of a gas arises from the collisions among its moving particles. Now, pressure possesses no special direction: a gas presses equally in all directions, but a collision is dependent on a moving object, and the motion has a definite direction. Consequently, there can be no turning back of one of the bodies immediately upon the others. The kinetic hypothesis deals with this difficulty by artificially neutralizing the properties of direction appertaining to the collisions through the assumption that the collisions take place equally in all directions without distinction. In this case the artificial adaptation of the properties of the different energies may be successful, but in other cases it is not quite possible. Thus, for example, the factors of electric energy—tension and quantity—are magnitudes which I might propose to call polar; that is, they are not only designated by a numerical value, but they also possess a sign of such form that two equal magnitudes of opposite signs add up as nothing, and not as of double value. Such purely polar magnitudes are not known in mechanics. This is the reason why it will never be possible to find even a barely passable mechanical hypothesis for electrical phenomena. If such a mechanical entity with properties of polarity could be constructed—which is perhaps not impossible, and is at any rate worth a thorough investigation—then we should have the material for illustrating at least one side of electricity mechanically. It may, indeed, be said here with certainty that only one side is considered, and that here also the defectiveness, without exception, of all mechanical hypotheses is demonstrated, and the full completion of the figure prevented.

When we have really traced the laws of natural phenomena back to the laws of corresponding kinds of energy, what advantage have we gained? First, the very important point that a science free from hypothesis is possible. We inquire no longer for forces which we can not exhibit, acting between atoms which we can not observe, but we ask, when we would judge respecting a process, concerning the kind and number of the energies going into it and issuing from it. We can measure them, and all that it is necessary to know can be expressed in that form. How enormous a methodical advantage that is will be clear to everybody whose scientific conscience has suffered from the unceasing amalgamation of fact and hypothesis which the physics and chemistry of the present offer as rational science. The energistic is the way in which Kirchhoff's variously misunderstood demand for replacing what is called the theory of Nature by the description of phenomena can be fulfilled in its right sense. With this freedom from hypothesis of energistic science is at the same time associated a simplicity which, it can be said without hesitation, has not been reached before. I have already pointed to the philosophical significance of this simple principle in the comprehension of natural phenomena. It lies in the nature of the matter, but might also well be declared on other considerations, that an immense advantage will result to the teaching and comprehension of science by means of this philosophical simplification. To cite only one example, we might assert that all equations, without exception, which relate two or more different kinds of phenomena to one another, must be equations between magnitudes of energy; else they are not possible. This is a consequence of the fact that besides the conceptions space and time, energy is the only entity that is common to the different fields, and in fact to all, without exception; comparisons can not be made between different fields otherwise than by the portions of energy that come into question.

I shall have to refrain from showing here how an immense number of relations, a part of which were already known and a part are new, can be immediately written down by means of this view, while formerly they had to be deduced by more or less detailed calculations. I can not either set before you in comparison the new sides which other already, if not so perfectly known propositions of thermodynamics, the most extended part of energistics, have exhibited in the light of the general theory of energy. All these things must indeed be so, if what I have said to you of the significance of the new theory is well founded. I need not revert to this again.

But I can not forbear proposing a final question. When we have succeeded in grasping a significant and fruit-bearing truth in its entire, even magnitude, we are only too easily inclined to regard all as likewise concluded in its circle which comes within the field in question. We see this fault perpetrated every day in science, and the opinion which I have devoted half of the time allotted to me in contesting has grown out of just such an error. We shall therefore have to ask ourselves at once, Is the energy which is so necessary and useful for the understanding of Nature also sufficient for that object? Or are there phenomena which can not be wholly accounted for by the laws of energy as they are yet known?

I believe that the responsibility which I have assumed toward you through my thesis can not be better discharged than by my declaring that these questions must be answered with a denial of the universal competency of energy. Immense as are the advantages which the energistic theory of the world has over the mechanical or the naturalistic, there can still, it seems to me, some points be indicated which are not covered by the acknowledged principles of energistics, and which, therefore, point to the existence of principles transcending these. Energistics will exist by the side of these new principles. Only it is not, as we must already perceive, to be the future most comprehensive principle for the mastering of natural phenomena, but will be manifest, presumably, as a particular instance of still more general conditions, of the form of which we at this time can certainly have hardly a foreboding.

I do not apprehend that what I have said has depreciated the mental advance for which so much has been claimed; I have myself extolled that advance. For it has more than once occurred to us that science can never and nowhere recognize any limits to its progress, and even in the midst of the contest for a new possession the eye should not be blind to the fact that beyond the ground we have succeeded in winning extend other stretches that must be acquired later on. In the former time we could put up with the dust and smoke of the conflict preventing our looking into the narrow limits of the battlefield. To-day this is no longer permissible; to-day we shoot with smokeless powder—or, at least, ought to—and have, therefore, with the possibility, also the duty, of not falling into the errors of earlier epochs.

STEPPES, DESERTS, AND ALKALI LANDS.

By Prof. E. W. HILGARD.

THE average reader feels but a moderate interest in the subject of steppes, which he usually associates with roving herds and Tartar or Indian tribes, whose periodic raids have in the past been a standing source of disquiet to civilization, whether in the Occident or Orient. The predatory habits of these people seemed to be proof sufficient of the fact that the countries occupied by them are not able to support permanently a population devoted to agricultural and industrial pursuits, and that their inhabitants are under more or less natural stress toward levying forced contributions upon their neighbors in order to eke out their existence in a satisfactory way, as in the case of the tribes of the deserts properly so called.

As to alkali lands, so far as they are known and considered at all, they are regarded only as obstacles to the settlement and cultivation of the otherwise desirable lands whose continuity they mar, aside from the discomfort their pungent dust and saline water causes to the overland traveler; while their Old World equivalents, the "salt steppes" of southeastern Russia, central Asia, and northern Africa, are among the most disconsolate images conjured up by the imagination of those who traverse or read about them. Moreover, it is currently supposed that these regions owe their saline soil to the evaporation of former salt lakes or seas, and that an indefinite amount of similar salts lurks below the surface, ready to replace whatever may be removed in any attempt to reclaim the lands for cultivation.

From this point of view it is hard to understand why the people foremost in ancient civilizations should have chosen for their abodes, and should have developed their civilization rather predominantly, in regions either adjacent to deserts, or having, during a considerable portion of the year, the aspect and character of the ill-reputed steppe. Egypt is the example nearest to Europe, but Asia Minor, Syria (including Palestine, the "land where milk and honey flows"), Persia, Arabia, and (crossing the Indus) northern India, the classic ground of the Vedas and Mahâbhârata, are more or less tainted with "the breath of the desert," as well as with its actual presence to a greater or less degree. Looking westward, we again find the old Carthaginian and later Moorish civilization on the borders of the desert. Crossing the Atlantic, we find the empire of the Incas on the steep, bare, uninviting western slope of the Andes, when just across the divide there lay the rich countries now forming the Colombian republics and typically exuberant Brazil. In North America, likewise, the civilization of the Aztecs and Toltecs was developed not in the wonderfully prolific *tierra caliente,* but on the arid plateaus of Old and New Mexico; persisting while the builders of Palenque and Copan had already passed into oblivion. It seems as though a strange infatuation had possessed these ancient nations in the preference given to bare, sun-scorched plains and mountains, as against the cool shades of the forest-clad countries, which in later times have almost monopolized the abodes of advanced civilization.

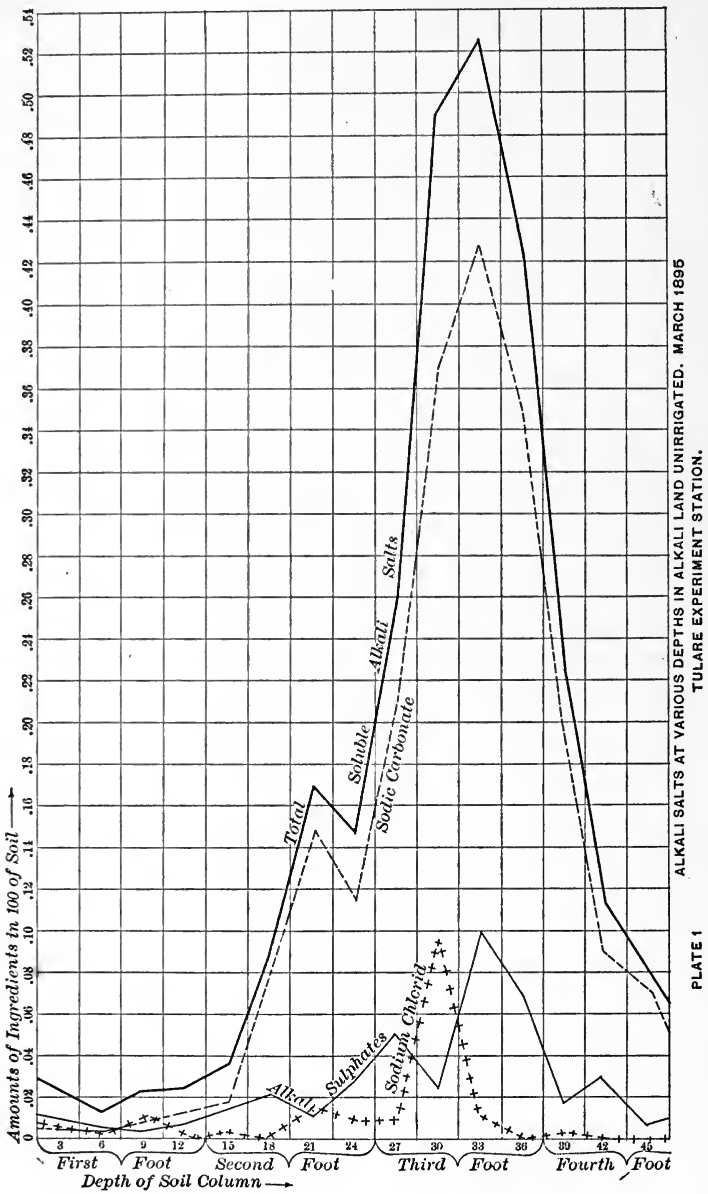
It may be said, of course, that forests offer the inconvenience of affording concealment to a lurking enemy; a serious consideration during the ages when a state of war was the normal condition of mankind. Again, it is said that the necessity of clearing away the forest before cultivation was possible offered an obvious inducement toward the utilization, first, of the treeless regions.

The former consideration doubtless weighed strongly in the first beginnings of settlement. And yet our Saxon forefathers, both in the old and new continents, have managed remarkably well in their forested countries, in the face of lurking enemies both animal and human. As regards the difficulty of clearing the forest lands for cultivation, it is amply offset by the necessity, almost universally existing in treeless countries, of providing irrigation if cultivation is to be anything more than a lottery. For forests are limited by a certain minimum of rainfall, below which regularity of crops is dependent upon artificial irrigation.

In other words, the countries which have harbored most of the ancient civilizations are regions of deficient rainfall and compulsory irrigation. And as irrigation means heavy investments of capital or labor, hence the co-operation of many and the construction of permanent works: it necessarily implies the correlative existence of a stable social organization, with protection for property rights, and (in view of the complexity of the problem of proper and equitable distribution of water) a rather advanced appreciation of the need and advantages of co-operative organization.

If, then, the general practice of irrigation is conditioned upon a not inconsiderable degree of advancement in social organization, shall we attribute the development of the ancient civilizations referred to only to its conservative influence, or are there other factors that have contributed toward the preference and long-continued permanence of these polities or populations?

The high cost of irrigation is usually found to be compensated by the high and regular production of the lands irrigated; it is almost a maxim that irrigated lands can support a much denser population than those of countries in which rainfall is relied upon for the production of crops, and where therefore frequent partial, or entire crop failures are to be looked for. The *regularity* of production, of course, results from command of the water supply as such; the *high* production has usually been ascribed



largely to the plant food brought to the land by the stream waters used in irrigation, whether in the form of suspended mud or in actual solution. Especially has the never-failing fertility of Egypt been ascribed to the mud carried down by the flood waters of the Blue Nile from the uplands of Abyssinia during the season when torrential rains prevail there.

Without denying a certain efficiency of this cause, a closer examination easily proves it to be inadequate to account for the millennially undiminished fertility of the Nile Delta. The average annual mud deposit of the Nile floods amounts to less than the thickness of a common pasteboard.* Were this the best of stable manure well worked in, it could not produce the effect claimed. But examination proves it to be simply a rich soil, such as thousands of farmers could haul and spread upon their lands if it could produce the effect ascribed to this Nile sediment. Besides, perpetual fertility belongs equally to the lands of the neighboring Fayoom, which, being irrigated only with the clear water of Lake Mœris, do not receive the benefit of any sediment. But the analysis of that water, or of the clear Nile water itself, does not show it to contain any unusual amount of fertilizing matter in solution.

There are other examples, too, of lands perpetually productive for thousands of years without fertilization. One is the "regur" lands region of the Deccan, forming part of the plateau of south central India; another is the "loess" region of China, drained by the head waters of the Yellow River, and for ages the granary of that empire. In both these cases no alluvial fertilizing deposits come into play, and there is little or no irrigation. But in both cases we have a semiarid climate, the rainfall being close to the limit of actual deficiency; in the case of Egypt the deficiency is extreme during nine months out of the twelve.

What, then, is the effect of a deficient rainfall upon the nature of soils formed under its influence? And can these effects serve to explain, in any measurable degree, the choice of the ancient civilizations?

In the course of his investigations of the soils of the United States, the writer has had occasion to make extensive comparisons of the soils of the Atlantic humid region with those of the arid and semiarid West. A summary of the results of these comparisons was given in Bulletin No. 3 of the United States Weather Bureau in 1892. They led to important conclusions of a general nature, some of which could have been readily foreseen on general principles. Continued investigations made since have given additional confirmation, and have developed new facts having important bearings upon the possible utilization and productive

* Taking this at one twenty-fifth of an inch, it would amount to about five tons per acre, or about two good two-horse loads. Three times that amount of stable manure is about the usual dressing for an acre.

value of vast land areas thus far considered either irreclaimable or adapted only to scanty pasturage.

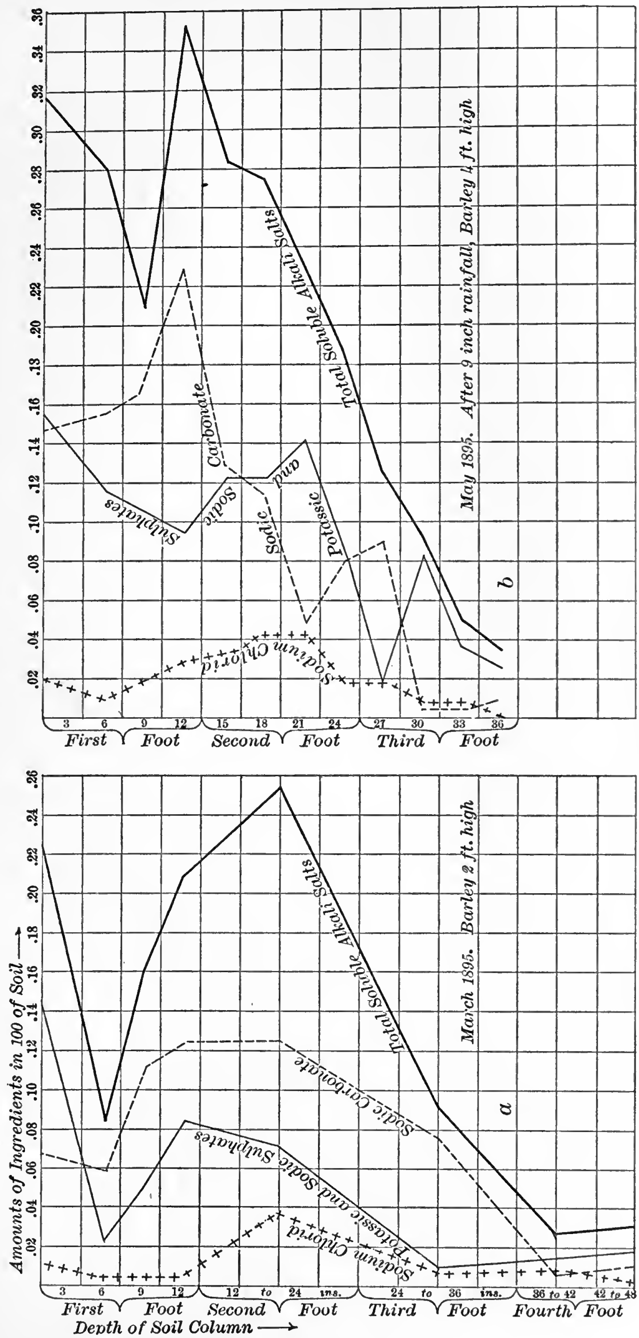
Without going into technical details or figures, the case may be stated thus: Soils are formed from rocks by the physical and chemical agencies commonly comprehended in the term *weathering*, which includes both their pulverization and chemical decomposition by atmospheric action. Both actions, but more especially the chemical one, continue in the soil itself; the last named in an accelerated measure, so as to give rise to the farmers' practice of "fallowing"—that is, leaving the land exposed to the action of the air in a well-tilled but unplanted condition, with a view to increasing the succeeding year's crop by the additional amount of plant food rendered available, during the fallow, from the soil itself.

This weathering process is accompanied by the formation of new compounds out of the minerals originally composing the rock. Some of these, such as zeolites and clay, are insoluble in water, and therefore remain in the soil, forming a "reserve" of plant food that may be drawn upon gradually by plants; while another portion, containing especially the compounds of the alkalies, potash and soda, are easily soluble in water. Where the rainfall is abundant, these soluble substances are currently carried into the country drainage, and through the rivers into the ocean; which shows in its saline portion (about three and a half per cent) the average composition of the matters permanently leached out of the land. Most of this is common salt—chloride of sodium—but a large portion, if not all, of the other elements known are represented in sea water in a greater or less proportion. Among these, potash, lime, magnesia, sulphuric and a trifle of phosphoric acids require mention here.

Where, on the contrary, the rainfall is insufficient to carry the soluble compounds formed in the weathering of the soil mass into the country drainage, those compounds must of necessity remain and accumulate in the soil. They then constitute what in the western United States is now universally known as "*alkali*."

"Alkali" is not, then, as is popularly supposed, something foreign to the soil, imposed as a special affliction upon the dwellers in the arid or irrigation regions. It is the normal product of soil-formation and soil-weathering everywhere; but in the humid regions it appears only in the bottom and stream waters, and is not perceived in the soil itself.

Nor does it in either climatic region consist only of salts injurious or useless to vegetation. Its origin, as well as the chemical nature of sea water, proves that it should contain the useful or plant-food ingredients as well; and direct analysis amply confirms this induction. But it also shows that while there are great variations in the composition of the alkali salts in different regions



AVERAGE COMPOSITION OF ALKALI SALTS AT VARIOUS DEPTHS IN PARTLY RECLAIMED ALKALI LAND
TULARE EXPERIMENT STATION.

PLATE 2

and even in contiguous localities, as a rule the *useless* ingredients are present in larger proportions than is the case in the original material from which the soil was formed, or in the latter itself.

The question as to what has become of the *useful* mineral plant food representing this difference is categorically answered by the analysis of the soils themselves. If we analyze, by identical methods, series of the soils of the arid and humid regions respectively, we find constant differences in their composition, that are manifestly due to the conditions under which they have been formed. They show in those of the arid regions, on the average, a markedly greater proportion of certain elements of plant food than in the soils that, under the influence of copious rainfall throughout the year, have been currently leached of whatever soluble matters were set free by weathering.

The explanation is, that when these soluble matters are retained in the soil for a length of time, they are given the opportunity of entering into the insoluble combinations already mentioned as repositories of "reserve" plant food—i. e., such as may be gradually drawn upon by plants, either by the direct solvent action of their acid root-sap, or by being again rendered water-soluble by a repetition of the weathering process.

Thus the soils of the arid region, whether containing a natural surplus of water-soluble salts in the objectionable guise of alkali or not, are found to be greatly superior, in the native stock of certain ingredients of plant food, to the average soils of the regions of abundant rainfall; their *average* being, in fact, equal to the *most highly productive* (usually alluvial) soils of the humid region.

The chief substances of which the arid soils thus retain considerable amounts that run to waste in the countries of abundant rainfall, are *potash, lime,* and *magnesia.* The average ratios of these as found in the United States, for the region east of the Mississippi, when compared with that west of the Rocky Mountains (or of the hundredth meridian), by the comparison of over a thousand analyses, are as one to three, one to fourteen, and one to six respectively.

But these numerical ratios do not adequately express some of the chief advantages enjoyed by the soils of arid regions. While the large amount of potash they contain relieves the farmer for a long time from supplying to his fields the potash fertilizers that prove so effectual and necessary in the East and in Europe, yet the almost universal presence of a surplus of lime (in the form of carbonate) is perhaps of even higher importance. To understand this it is only necessary to remind the reader of the common saying that "a limestone country is a rich country"—abundantly illustrated in the Atlantic States by the blue-grass region of Kentucky, the black prairies and "bluff"-lands of the Mississippi Valley, and hundreds of local examples. The common and beneficial practice of "marling" noncalcareous lands illustrates the same axiom. It logically follows that, inasmuch as actual examination shows practically *all* arid soils to be calcareous, "arid countries are rich countries" whenever irrigated; and the actual and concordant experience of mankind corroborates the conclusion.

In other words, the ancient civilizations have, consciously or unconsciously, chosen countries having naturally rich and durable soils, capable of supporting for a long time a denser population than the forested regions, without resort to artificial fertilization beyond irrigation. This seems to be the simple and rational explanation of their marked preference for arid countries; and unquestionably Egypt owes its perennially undiminished productiveness at least as much to its arid climate as to the alluvial deposits brought down by the Nile, as is shown in the oases of the Libyan Desert, as well as in India and China.

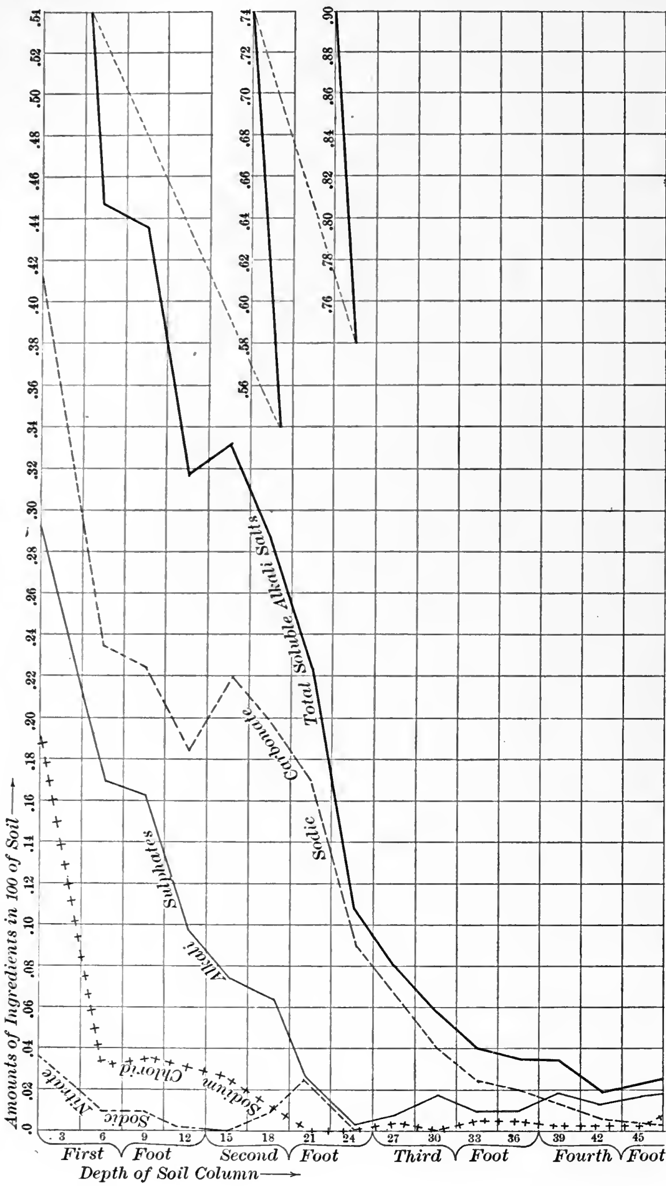
But if these things are true, then the steppes and alkali lands deserve the most earnest attention, both of agriculturists and of students of natural economy; for in them lie possibilities for the abundant sustenance and prosperity of the human race that have thus far been almost left out of account. While it is true that irrigation water may not be practically available for the whole of the arid regions of the globe, so much remains to be done in the study of the most economical use of water, of appropriate crops and methods of culture, that even an approximate estimate of actual possibilities in this direction can not yet be made. At all events, it is of the highest interest to study the problem of the reclamation of these intrinsically rich lands in all its phases.

Foremost in this problem is the question of the manner of dealing with the "alkali" salts, which, as experience proves, exist not only on the spots where they naturally show on the surface, for as soon as irrigation is practiced they appear at numerous points where no symptoms of alkali were noted before. Sometimes, indeed, the entire area of large farms may in the course of years become thus afflicted, so that orchards and vineyards that have been in bearing for a number of years become stunted, and in spots even perish.

Examination of the manner in which such injury comes about shows that it is rarely due to direct action of the salts on the roots. Almost always the injured part is at or near the root-crown, or base of stem or trunk; proving that it is the result of *accumulation of the salts at the surface* (so often obvious to the eyes), *in consequence of evaporation.*

It follows that the prevention of surface evaporation, to the utmost extent possible, is of the first importance.

Now, the simplest, cheapest, and most universally practicable mode of diminishing evaporation from a bare land surface is to



ALKALI SALTS AT VARIOUS DEPTHS IN BARE ALKALI LAND, IRRIGATED. MAY 1895.
TULARE EXPERIMENT STATION.

PLATE 3

keep it constantly in loose, fine tilth, to a depth which varies with soil and climate. In humid climates four inches has been found sufficient. In the hot summers of arid countries even more than twice that depth may be necessary. In that case the alkali salts left behind by evaporation will be diffused through so large a mass of soil that no injury can ordinarily result.

But experience proves that some alkali soils are, in their natural state, incapable of being reduced to a proper condition of tilth; and this, as well as the tendency of the obnoxious salts to come to the surface more and more when land is irrigated, has been made the subject of extensive investigations by the California Experiment Station, in order to determine the proper methods for the permanent repression of these obstacles to cultivation.

These investigations proved, as far back as 1880, that the cause of difficult tillage in alkali lands is carbonate of soda (sal soda), the presence of which is recognized by the blackish spots and rings left on the soil when rain or irrigation water evaporates; hence the popular designation of "black" alkali, known to be specially injurious and corrosive. It was also shown that the peculiar ill effects of such alkali can be overcome by the use of sufficient dressings of gypsum or land plaster, which—acting in conjunction with water—transforms the corrosive sal soda into bland and relatively innocuous sulphate, or Glauber's salt. The latter, with more or less of common salt, forms the bulk of the salts in the cases of mild or "white" alkali, of which a much larger proportion is tolerated by all plants. Gypsum also has the effect of rendering insoluble the humus and phosphoric acid that had been dissolved by the salsoda.

But the rise of the alkali brought about by irrigation seemed to indicate that an indefinite amount of these salts might lurk in the depths of the soil; and that as irrigation wets the land more deeply than would the scanty natural rainfall, and correspondingly increases the surface evaporation, permanent reclamation of alkali lands seems difficult if not hopeless.

To decide this question, at first examinations of the natural bottom waters of such lands were made, which showed in most cases saline contents not greater than those of many waters long successfully used for irrigation. It then became important to determine just to what depth the impregnation of salts actually reaches.

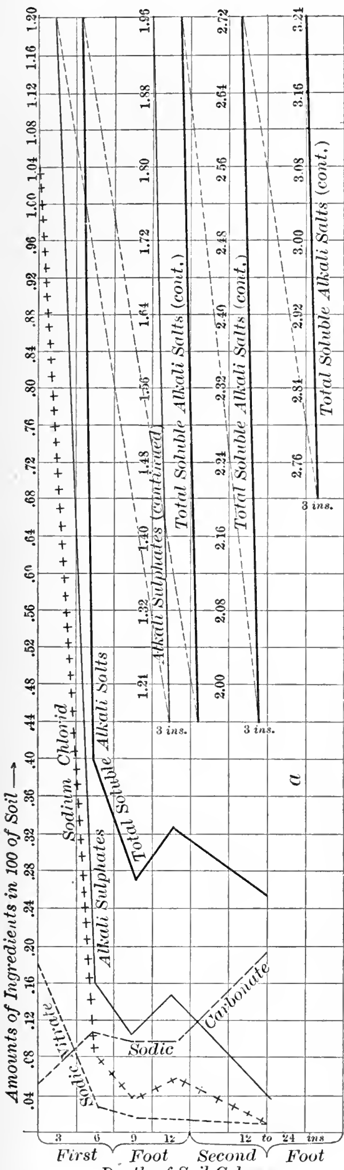
For this purpose borings were made at the Culture Experiment Station near Tulare, Cal., samples being taken by means of a posthole auger of each successive three inches of soil, down to the depth of two or four feet, as might be required. Each of these (twelve to sixteen) samples was then separately leached and analyzed, determining both the total amounts of salts present and the proportions of the three to five principal compounds. The results of this work in four typical cases are embodied in the curve diagrams below, which show the facts more plainly than would figures; the vertical line to the left representing the soil depth (in feet and inches), while on the horizontal lines the percentages of salts in the soil are entered at intervals representing two, or four one-hundredths of one per cent each. The area within the curve generated by connecting the points of actual observation represents, of course, the total of each ingredient indicated.

Diagram No. 1 represents the natural condition, the soil being at the time covered with the native spring growth of bright flowers. No alkali salts are seen on the surface at this point at any season.

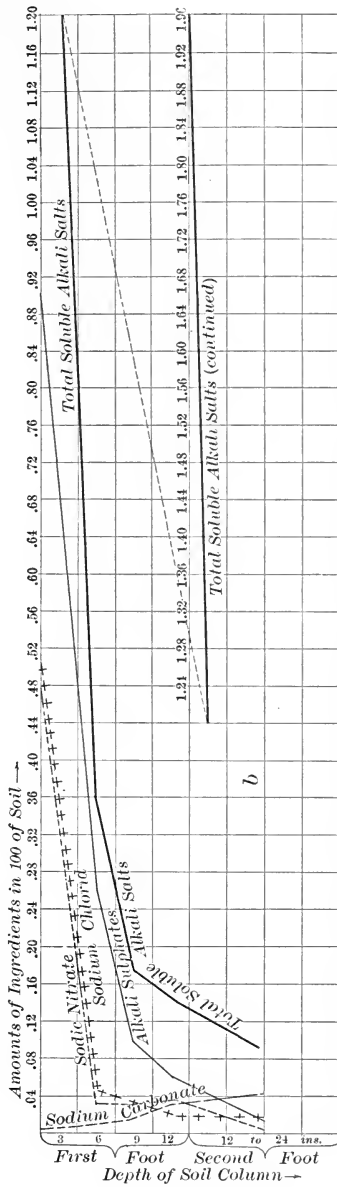
It will be noted that the alkali salts are almost wholly accumulated between the depths of twenty and forty inches. Both above and below these limits impregnation is not strong enough to interfere with vegetable growth of any kind; *within* them, the subsoil is hardened into a sheet of hardpan, which not only prevents the passage of roots by its resistance, but would corrode them by contact with a mixture of salts containing up to ninety-four per cent of carbonate of soda. But as the native vegetation is mostly shallow-rooted and annual, this does not interfere with its welfare. The moisture imparted to the land by the scanty rainfall (about seven inches) evaporates through the roots and leaves of this vegetation during its growing period; when it dies off it leaves the ground completely dry, so that no rise of the salts to the surface by evaporation can take place during the season, and the seeds dropped can germinate when the rainy season comes, without injury from alkali.

Diagram No. 3 shows, on the other hand, what happens when irrigation is practiced on this land (or when the water rises from below by seepage from leaky ditches), and the ground is left *bare.* The abundant water then dissolves the alkali salts in the subsoil hardpan; and evaporation continuing through the whole year, the entire salts are in the course of a few seasons carried upward nearer to the surface. Diagram 3 shows the state of things under these conditions at the same date as Diagram 1 (May 3, 1895); No. 4, *a* and *b,* shows the condition existing near the surface at the end of the dry season, in September or October. It will be seen that at that time the salts have accumulated so near the surface that by taking the soil away to the depth of six inches, from five sixths to seven eighths of the total mass of salts would be removed, leaving the land with no more than almost any crop can easily resist.

Diagram 2, *a* and *b,* shows the state of the irrigated land when sown to barley, it being understood that these samples were taken within ten feet of No. 3. A glance reveals that we have here a case intermediate between Nos. 1 and 3. The upward movement of the alkali salts has been partially checked by the evaporation through the roots and leaves of the crop; whose thin foliage, however, could not act as effectually as the dense, leafy mat formed



AVERAGE COMPOSITION OF ALKALI SALTS AT VARIOUS DEPTHS IN ALKALI SOIL ON WHICH BARLEY WOULD NOT GROW. TAKEN SEPTEMBER 1894.
TULARE EXPERIMENT STATION.



ALKALI SALTS AT VARIOUS DEPTHS IN PARTIALLY RECLAIMED ALKALI SOIL ON WHICH BARLEY GREW FOUR FEET HIGH. TAKEN SEPTEMBER 1894.
TULARE EXPERIMENT STATION.
PLATE 4

by the dense growth of the native herbage on No. 1. Some evaporation from the soil surface itself continued, although it did not suffice to injure the crop by the rise of the salts: and as at harvest time most of the soil moisture was exhausted, only a moderate efflorescence of alkali was seen on this land even late in the season.

It is thus obvious that when by any means a good "stand" of a leafy perennial crop with deep roots, like alfalfa, can be obtained on alkali land, the rise of the salts resulting from irrigation is measurably checked, and may remain wholly innocuous so long as that crop occupies the soil. Experience amply confirms this conclusion; but the difficulty of obtaining such a stand is often very great, especially on "black" alkali land, which "rots" the seed as often as sown. It is then that the use of gypsum to neutralize the carbonate of soda often becomes the saving clause, enormous crops being then grown on land formerly considered worthless. Diagram No. 5 may illustrate this in the case of wheat, which was grown in 1892 at the Tulare Station on ground that, prior to the reclamation work, would hardly grow even "alkali weeds," but then yielded grain at the rate of forty-five bushels per acre.

The diagrams, however, convey unanimously the fundamentally important lesson that *the amount of alkali salts in these soils is limited, and lies within such easy reach of the surface that ordinary underdrainage at the depth of from three to four feet will relieve these rich soils of their noxious surplus, once for all.* Also that toward the end of the dry season the removal of a few inches of surface soil will go far toward relieving the land of the same.

A few words should be said in regard to the *kind* of the salts as well as their quantities. As regards the main ingredients, which may be considered as useless or harmful to vegetation, inspection of the diagrams shows that in no case is the noxious carbonate of soda as abundant near the surface as in the case of the subsoil hardpan in Diagram No. 1. Investigation has shown this to be due to the aëration which occurs near the surface; while, on the contrary, in a water-logged soil, the "black" alkali is constantly in progress of formation from the "white" or neutral salts. Hence we find the worst of the "black" cases in low or badly drained ground, and in close soils. Here, again, underdrainage affords radical relief.

But underdrainage and washing-out of the salts would in many cases be like "throwing out the child with the bath." For, as has been stated at first, not only the *useless* but also the *useful* or plant-food ingredients, which the farmer purchases in the form of fertilizers, are present in them. They not unusually contain as much as twenty per cent of salts of potash, ten to twenty per cent of saltpeter, and several per cent of soluble phosphates. In one notable case the equivalent of one ton of Chile saltpeter (worth

On medium alkali. Partly reclaimed alkali soil. On fully reclaimed alkali soil.

PLATE 5.—WHEAT AND BARLEY GRAIN ON ALKALI LAND TREATED WITH GYPSUM.

about four cents a pound) per acre of ground to the depth of one foot, was found to be present.

It would clearly be folly to wash out such quantities of fertilizing material unnecessarily; and this consideration emphasizes the importance of the less radical means of reclamation already referred to, viz., *deep and thorough tillage to minimize evaporation, and in the case of "black" alkali the use of gypsum.* In California the opening of numerous gypsum mines has already followed the latter recommendation.

When once the high productive value of alkali lands is generally realized, enormous areas will be added to the producing lands, not only in the arid region of the United States but in the Old World as well. The Russian investigators in central Asia are rapidly coming to this conclusion, and notably Von Middendorff reports that the inhabitants of Ferghana say that "the salt is the life of their soil" provided there is not too much of it; and that they actually sometimes carry the alkali efflorescences to the poor spots. In India, on the Ganges and Jumna, the typically rich lands of that anciently civilized region have had alkali salts made to rise to the surface in consequence of the establishment of high-lying irrigation canals by the English. Similar reports of high productiveness come from the alkali lands of the border and oases of the Libyan and Sahara Deserts, and from the pampas of Argentina.

But it must not be forgotten that the reclamation of these fertile lands requires the command of some pecuniary resources; and that the farmer or settler who depends on an annual crop for his subsistence should not undertake their cultivation at first. As in the case of mines, the wealth that lies within them is not yielded to mere scratching or prospecting, but requires the use of some capital and trained intelligence to become available.

THE currency of romantic but incorrect translations of Indian names is illustrated by Gerard Fowke in his paper on the Archæology of the James and Potomac Rivers. Shenandoah, which is popularly interpreted as meaning "sparkling daughter of the shining stars," is a corruption, according to the author, of the Iroquoian word Tyonondoa, which means, literally, "there it has a large (high) mountain," or, "in that place there is a high range of mountains." On some old maps the name, "The Endless Mountains," is given to some of the ranges of Pennsylvania and Virginia. Mr. J. N. B. Hewitt is cited as pronouncing the definition "dark and bloody ground," of the name Kentucky, to be false, and as giving its true derivation from an Iroquoian word conveying the idea "a place where the grazing is good," almost identical in sound with Kentucky, "while there is no Indian word with anything like the popular meaning that bears the slightest resemblance to it." It will be observed that both the amended definitions are correctly descriptive.

THE STUDY OF INHERITANCE.

A Review of the Writings of Francis Galton.

By W. K. BROOKS, LL. D.

SECOND PAPER.

IT may be well to remind those who are not familiar with statistical reasoning that a type may exhibit the influence of inheritance and yet be of no value as a basis for generalization on inheritance.

The bullet type shows the influence of aim, but if we use it to test the accuracy of aim or the excellence of the rifle we may be led astray if some other influence, such as the weight of the bullet, act on all or on a majority of the shots and escape detection. In this case the type may seem to prove that the rifle is inaccurate or improperly sighted when it is not, and we can not assume that because a type shows the influence of aim it is a test of aim.

So a characteristic or a group of characteristics of living things may conform to the mathematical law of deviation from a mean, and may thus form a type, and this type may show the influence of inheritance, without being a safe basis for generalization regarding inheritance.

This may be illustrated by an example. If we were to tabulate the prices of all the horses sold within a given period, we should undoubtedly find that they would conform to a type: that there is a mean or average price; that the horses which fetch more than this price are equal in number to those which fetch less, and that the prices group themselves about the mean according to the law of error. If the term be long enough to include several generations, we shall find that inheritance or "blood" has a marked influence on price, and that the children of high or moderate or low priced parents are much more likely than horses selected at random to bring the same price. This type will exhibit the influence of inheritance, but it will be of no value in studying inheritance unless we can in some way separate the influence of blood from the influence of supply and demand which has far more to do with the average price and with the type.

That the price of horses is, on the whole, determined like that of other commodities is obvious, and it is also obvious that the type may be changed by events which have no relation to inheritance, such as the application of electricity to street cars.

A change of this sort, such as took place when steam replaced stage coaches, is a "sport" or sudden and fundamental change of type, but this may also be changed by slight and gradual modification with the slow growth of a complicated civilization and an increased demand for horses.

As inheritance has an influence on the price of horses, what will be the result if we destroy the children of all horses which fetch less than +2 of Galton's scheme, and breed only from that fourth of the whole which sell for more than 75° of his centesimal scale?

We may at first get fancy prices for our expensive stock, but if selection cease with this first step, and we supply as many colts as before, while the demand remains unchanged, the price will "revert" to the type, and the mean will become the same as it was.

Does this prove that those qualities in horses for which money is paid have "retrograded to mediocrity" in these descendants of high-priced parents? It proves nothing of the sort, for the qualities which command a price are one thing and the price another. Even if the horses have much more of these qualities than the old stock, the price will still be fixed by the ratio between demand and supply, and while blood will tell in use it will not tell in price.

It is clear, then, that characteristics of living things which are influenced by inheritance may conform to a type which exhibits "specific stability," "regression to mediocrity," an occasional "sport," and all the other properties of the types which Galton has studied, without furnishing proof that "inherited" qualities behave in the same way. To prove this we must cancel, or neutralize, or make allowance for all the factors which have an influence upon the type, except "inheritance."

Galton's generalizations upon the laws of inheritance from the statistical study of finger prints rests upon the belief that the patterns are inherited. If they are not, they can teach nothing of inheritance. He proves by statistics that they are, to some degree, dependent either directly or indirectly upon inheritance, just as the price of horses is, but this is not enough. To warrant his deductions he must prove that inheritance is the controlling factor in determining the type; that, in the long run, all the other factors will balance; and this, it seems to me, he fails to prove. He has studied in one hundred and fifty fraternal couples or children of the same parents the frequency with which the same pattern occurs on the same digit of both, and he finds that when marked on a scale in which 0 indicates no resemblance and 100° the greatest possible relationship, they show 10° of relationship. This number is great enough to prove the influence of inheritance, but it is too small to show that the patterns are themselves directly inherited, and it seems to indicate that they are indirectly influenced by some other inherited characteristic, such perhaps as the ratio between the growth in the embryo of the ball of the finger and that of the nail.

Inheritance is unfortunately a word which is not always used with scientific precision. Most of the qualities which give a horse its value, as compared with other horses, are due to *breeding*, but this word has many meanings. Orlando says: "His horses are *bred* better; for besides that they are fair with their feeding, they are taught their manage, and to that end riders dearly hired." The "*breeding* jennet, lusty, young, and proud," seems to be a wild mare, with no breeding in the first sense, and the horse which did not lack what a horse should have, "round-hoofed, short-jointed, fetlocks shag and long. Broad breast, full eye, small head, and nostrils wide. High crest, short ears, straight legs, and passing strong. Thin mane, thick tail, broad buttocks, tender hide," is a *thoroughbred*.

Recent speculations have enforced attention to the difference between these meanings of the word. In the last sense *breeding* is the *influence of ancestry*, and it may practically be treated as synonymous with theword *ancestry*.

In the first sense *breeding*, broadly used, is that influence of the ontogenetic environment for which that most objectionable term "acquired characters" has been thoughtlessly adopted.

In his earlier writings Galton, borrowing, I suppose, from the Tempest, uses the word "nurture" to designate it, and this term is so apt and expressive that it should not pass out of use, for it may be given a definite technical meaning without violence to its ordinary use.

Using *nurture* instead of *acquired characters* for the influence of the environment of the individual, we may speak of the two elements of breeding as *ancestry* and *nurture*.

At the present day it is obvious that our studies of inheritance can have little value unless we distinguish between these two factors, for many naturalists hold that there is good ground for questioning whether the effects of nurture are ever inherited, and most naturalists admit the possibility that the value of these two factors may be very different.

If breeding is to be studied by the statistical method for the purpose of exhibiting the laws of inheritance, we must employ types in which we can separate the effects of ancestry from the effects of nurture; for if we make use of types which do not admit of this analysis, our results may tell us no more of inheritance than the scheme of prices tells us of the value of blood in horses.

If, as many teach, inheritance is equivalent to ancestry, and nurture is not inherited, no type in which these two factors are combined can tell us anything about inheritance.

It seems probable from Galton's data regarding the resemblance between the finger marks of fraternal couples that this is due to nurture in the broad sense of the word, and not to inheritance, and there is ample evidence that the value in breeding of a given parental characteristic does depend upon its origin, and that one due to nurture has a very different value from one which is itself inherited.

Of the 2,459 deaf pupils of the American Asylum, nearly six hundred have married and have become the parents of over eight hundred children, of whom 104, or more than twelve per cent, were born deaf—a ratio which is great enough to prove that inheritance has some influence. Analysis of the records shows clearly, however, that these deaf children are not uniformly distributed among the married pupils of the asylum, but that the result is influenced by the character of the parental deafness. From 283 of the 590 marriages no children are reported, while from three other families no report is made except that all the children hear, so that the 811 childen which are reported are from only 304 families, and in many of them only one parent was deaf. Of the 101 children of forty of these marriages none are reported as deaf, and all but eleven are reported as hearing, and the 710 children are from the remaining 264 marriages. In fifty-two of the marriages both father and mother were congenitally deaf, and these are the parents of forty-eight out of the 104 congenitally deaf children, but they are the parents of only 151 of the total number of 811 children, and nearly thirty-two per cent of all the children of these congenitally deaf parents are congenitally deaf.

In two of the groups in which the marriages may be classified the number of marriages and the number of children are about equal, but there is a most remarkable difference in the number of deaf children.

In fifty-five marriages, with 139 children, both parents are reported as adventitiously deaf, while in fifty-two marriages, with 151 children, both were congenitally deaf. In the latter group fifty-two children, or 31·78 per cent, are congenitally deaf, only eighty-eight are stated to hear, and no facts are given about the hearing of fifteen of them. In the first group only four of the 139 children, or 3·87 per cent, are reported as congenitally deaf, 129 are reported as hearing, and six are not reported.

I have divided all the marriages into four groups: In one all the children hear; in the second from five to six per cent are deaf; in the third from twelve to eighteen per cent are deaf; and in the fourth 31·78 per cent are deaf. In the first group, in which all the children hear, five of the marriages, with eighteen children, are between a hearing husband and a wife who is adventitiously deaf; one marriage with four children between a hearing man and a woman the source of whose deafness is unknown; six marriages, with thirteen children, where the wife hears and the husband is adventitiously deaf; twenty-three marriages, with fifty-one children, where husband is adventitiously deaf and wife deaf from unknown causes; two marriages, with six children, where both were deaf from unknown causes; one marriage, with four children, where husband is deaf from unknown causes and wife hears; and two marriages, with five children, where wife is congenitally deaf and husband deaf from unknown causes. None of the 101 children of these forty marriages are reported as deaf.

In the second group, where from five to six per cent of the children are deaf, eighty-seven are the children of thirty-seven marriages where the husband was congenitally and the wife adventitiously deaf; and 139 are the children of fifty-five marriages where both husband and wife were adventitiously deaf.

In the third class, where from twelve to eighteen per cent of the children are congenitally deaf, 124 are children of fifty-one marriages where husband was adventitiously and wife congenitally deaf; sixty-six were children of sixteen marriages of hearing husband and congenitally deaf wife; seventy-two were children of twenty-six marriages where wife hears and husband is congenitally deaf; and seventy-one of twenty-nine marriages of congenitally deaf husband with deaf wife of unknown origin. In all the families of this group one parent was congenitally deaf.

In the fourth class, where 31·78 per cent of the children are congenitally deaf, all the parents in the fifty-two marriages with one hundred and fifty-one children are congenitally deaf.

While too few to give quantitative results, these statistics prove that it is the congenital and not the adventitious deafness which is transmitted.

Of the fifty-two families in which both parents are congenitally deaf, twenty-three have congenitally deaf children.

Of the thirty-seven families in which the husbands are congenitally deaf and the wives adventitiously deaf, two have deaf children—four in one family and one in the other.

Of the fifty-one families in which the fathers were adventitiously deaf and the mothers congenitally deaf, seven produced deaf children, and nine of the congenitally deaf children came from two families.

There are fifty-five families in which both parents are adventitiously deaf, and from these have sprung four congenitally deaf children—one in each of four families.

Four of the sixteen families in which the husbands hear and the wives are congenitally deaf have deaf children.

In five families out of the twenty-six in which the husbands are congenitally deaf and the wives hear, there are children born deaf.

Six of the twenty-seven families in which the husbands were congenitally deaf and the state of the hearing of the wives is unknown produced congenitally deaf children.

Of the twenty-six families in which both parents are deaf and have congenitally deaf children, there are five families in which one of the parents has one deaf parent, seventeen families in which both parents have deaf relatives of the same generation, four in which one parent has deaf relatives of the same generation, and five in which neither parent has deaf relatives of the same generation.

Of the twenty-six families in which both parents are congenitally deaf and have hearing children only, there is none in which either parent has a deaf parent, so far as reported, twelve families in which both parents have deaf relatives of the same generation, eleven families in which one parent has deaf relatives of the same generation, and three families in which neither parent has deaf relatives of the same generation.

This illustration proves that the origin of an individual peculiarity has much to do with the question of its inheritance, and that we can not be sure that statistical data illustrate inheritance unless we can separate phenomena of ancestry from those of nurture.

Furthermore, in order to prove that children always revert to the mean or type of the race, and are on the average more mediocre than their parents, we must prove that this is the case when both parents have the same inherited peculiarity.

Galton shows that this is true of the stature of children both whose parents were tall or both short, but he has not shown that it is true when the peculiarity in the stature of both parents is the same inherited peculiarity. He points out that stature may be affected by diversity in the thickness of more than one hundred bodily parts, and it is plain that if the extra height of a tall father is due to a long femur for example, the chances are a hundred to one that the femur of the tall mother is normal and that her extra height is due to some other peculiarity—thick intervertebral bodies, for example.

There is statistical evidence from other sources to prove that if both parents have long femurs and have brothers and sisters with long femurs, the children, instead of reverting to mediocrity, may on the average be expected to have femurs very much above the mean, and that some of them may have them longer than either parent.

Many facts in our stock of information regarding domestic animals and cultivated plants show that hereditary peculiarities are often very persistent independently of selection, and the experience of all breeders shows that this tendency is greatly intensified when both parents have *the same* inherited peculiarity.

Not only is this the case, but it may be proved by many observations that the normal or type to which the average children of exceptional parents tend to revert may itself be rapidly modified.

In proof of this I refer to the following experiments in selection by Fritz Müller (Ein Zuchtungs-versuch an Mais. Kosmos, 1886, 2, i, p. 22):

Yellow corn is very variable in many respects. The number of rows of kernels on the cob is usually from eight to sixteen; cobs with ten or twelve rows being the most common, while one with eighteen or twenty rows is very seldom found. After searching through several hundred cobs Fr. Müller found one ear with eighteen rows, but none with more.

In 1867 he sowed, at different times, and in such a way as to prevent crossing, (1) seed from the cob with eighteen rows; (2) the seed from the finest sixteen-rowed ear; and (3) the seed from the finest fourteen-rowed ear. In 1868 he sowed (1) seed from a sixteen-rowed ear which had grown from seed from a sixteen-rowed ear; (2) seed from an eighteen-rowed ear from sixteen-rowed seed; and (3) seed from an eighteen-rowed ear from eighteen-rowed seed. In 1869 he sowed (1) seed from an eighteen-rowed ear with eighteen-rowed parents and grandparents; (2) seed from a twenty-rowed ear with eighteen-rowed parents and grandparents; and (3) seed from a twenty-two-rowed ear from seed from an eighteen-rowed ear produced from seed from a sixteen-rowed ear. The results are given in the accompanying table:

	1867.			1868.			1869.		
Number of rows on cob from which seed were taken.	14	16	18	16 16	16 18	18 18	18 18 18	18 18 20	16 18 22
Total number of cobs produced.	658	385	205	1,789	262	460	2,486	740	373
	Per c't.	Per c't.	Per c't.	Per c't.	Per c't.	Per c't.	Per c't.	Per c't.	Per c't.
8-rowed cobs	0·3	....	0·5	0·1	....	....	....	....	....
10-rowed cobs	14·4	3·0	1·0	1·4	0·8	0·2	0·1	....	....
12-rowed cobs	48·0	22·8	13·0	22·6	14·5	7·8	6·1	6·1	2·7
14 rowed cobs	35·6	48·6	37·8	48·5	46·7	35·4	37·3	28·5	25·3
16-rowed cobs	3·2	18·7	34·5	22·2	23·7	33·8	33·5	41·6	41·8
18-rowed cobs	0·5	6·8	12·6	4·9	12·3	18·2	18·6	20·2	24·1
20-rowed cobs	....	0·1	0·3	0·3	1·2	4·4	3·9	2·8	4·8
22-rowed cobs	....	....	0·3	....	0·8	0·2	0·5	0·8	1·0
26-rowed cobs	....	....	....	....	....	....	....	....	0·5
Average	12·61	14·08	14·9	14·15	14·39	15·52	15·57	15·70	16·15

It will be seen from this table that the number of ears with few rows decreases very rapidly in plants grown from seed taken from ears with many rows, and that the greater the number of rows on the ear from which the seed is taken the smaller is the number of ears produced with a small number of rows. It is also plain that, as the number of rows on the ear from which the seed was taken increases, the number of ears produced with a large number of rows increases, and that we have in each case a very considerable number of ears which equal their parents and a few which excel them, even when the parent seeds are far beyond the maximum for all ordinary corn. Fritz Müller says he has never, under ordinary conditions, except in three instances, found an ear with more than eighteen rows, and Darwin puts the maximum at twenty rows; yet we have among the children of seed from a twenty-two-rowed ear no less than 4·8 per cent, or eighteen ears out of 373 with twenty rows, and one ear out of 373 with twenty-six rows, and it will also be seen that the number of children which equal their parents increases in each case in each successive generation.

Thus the seed planted in 1867 from an eighteen-rowed ear produced 12·6 per cent of eighteen-rowed children. The eighteen-rowed ear planted in 1868 from an eighteen-rowed parent produced 18·2 per cent of eighteen-rowed children, and the eighteen-rowed seed planted in 1869 from eighteen-rowed parents and grandparents produced 18·6 per cent of eighteen-rowed children. The series is 12·6 per cent, 18·2 per cent, and 18·6 per cent.

The rapid change which took place in the "type" after only three years of selection is well shown by the following table, which gives the dominant number of rows at each sowing, and also the percentage of ears which had this number:

1867, 12 rows.........	48	per cent.	1868, 14 rows........	35·4	per cent.
1867, 14 "	48·6	"	1869, 14 "	37·3	"
1868, 14 "	48·5	"	1869, 16 "	41·6	"
1867, 14 "	37·8	"	1869, 16 "	41·8	"

The minimum for the third generation is equal to the mean for the first; the mean for the third generation, sixteen rows, is very near the maximum for ordinary corn, and the maximum for the third generation is far beyond the maximum for the grandparents, and much beyond the maximum for the parents.

No one can dispute the well-known fact that this sort of *pedigree selection* for a single point quickly grows less and less effective, and soon reaches a maximum; but this is no proof of any "principle of organic stability," or anything else except the truth that long ages of natural selection have made the organism such a unit or co-ordinated whole that no great and continuous change in one feature is possible, unless it is accompanied by general or constitutional change.

We must not forget, in addition, that, in a state of Nature, selection is neither for one feature, nor is it pedigree selection, or breeding from the fittest.

It is the extermination of the unfit, and unfitness may come from the imperfect co-ordination of the whole, or from defect in any quality whatever.

It is undoubtedly true that many of our domesticated races can be proved to have arisen as "sports," and that no great change of type can be effected, *by the methods of the breeder*, without sports; but there seem to be both evidence and theoretical ground for holding that, in this particular, artificial selection furnishes no measure of natural selection.

It seems to me that, notwithstanding the great value of Galton's data, they fail to prove that the "principle of organic stability" owes its existence to anything except past selection; that regression to mediocrity occurs when *ancestry* is studied uncomplicated by *nurture*; that the "mid-parent" is anything else than the actual parent; that "sports" are fundamentally different from the ordinary differences between individuals; or that natural selection is restricted to the preservation of sports.

Our tendency to believe that a type is something more real and substantial than the transitory phenomena which exhibit it is deeply rooted in our minds.

As the very nature of this belief renders disproof of it impossible, we can feel little surprise at its appearance and reappearance time after time in the history of thought, although science is based upon the well-warranted opinion that, whether types are real or unreal, we know them only as generalizations or abstractions constructed by our minds out of our experience of the orderly sequence of phenomena.

In zoölogy and botany the conception of species is unquestionably valid and justifiable, and as its most obvious characteristic is its persistency, as contrasted with the fleeting procession of evanescent individuals, we can not wonder at the vitality of the belief that specific types of life are more real than the individual animals, although Darwin's work has done away with whatever evidence may at one time have seemed to support this belief.

To the further question, whether specific types are inherent in living matter or external and objective to it, Darwin answers that they are both; that they are inherent, insomuch as all their data, or "events," are properties of the physical basis of life; but that they are external, inasmuch as the agreement of the "events" with the "law of frequency of error" is the effect of the environment.

Biology is not a closed science, and Darwin's view of the matter is not proved; possibly it is not provable; but its great value is in the proof that there is no shadow of evidence for any other view.

When embryologists talk about the doctrine of evolution in embryology as antagonistic to the doctrine of epigenesis; when biologists seek for the origin of species in "laws of variation" which are not the outcome of selection; when they talk about a "principle of organic stability" which does not owe its origin to the same agency—it seems to me that they fail to grasp the significance of Darwin's work, and that they are wandering from the only path in which we can have any well-grounded hope for progress—the path which takes its departure from that conception of specific types which leads us to seek for the origin of the "events" which exhibit the type in the physical properties of living matter, and to seek in the order of Nature external to the organism for the origin of the "law of error," which forms a type out of these events.

EXERCISE AS A REMEDY.*

By HENRY LING TAYLOR, M. D.

EXERCISE is not a remedy which in some mysterious way may prove beneficial in disordered conditions of the system, still less a specific in any given disease, but it may be made the means of producing gentle or powerful effects of a definite kind, which vary with its form, intensity, duration, time of application, method of administration, and the condition of the patient. The problem presented to the physician in a given case is not merely the prescription of exercise, but rather such proportioning and contrasting of the muscular activity to periods of rest that the total result shall be beneficial; here, as always, the patient is to be treated rather than the disease. Exercise employed systematically and with discrimination is of the highest value in the prevention of debility and disease, and also in he treatment of certain chronic affections. In many acute and some chronic diseases exercise is positively and actively injurious, and it is always liable to prove so when employed without due regard to its physiological effects. Though most of the useful effects of exercise can be obtained under skilled supervision with little or no apparatus, its practical importance is ignored in hospitals, but little recognized in asylums and imperfectly appreciated in private practice. The neglect of exercise as a therapeutic resource is traceable to failure to appreciate the indications for its employment, and perhaps

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still more to lack of precision in its application. While its proper prescription is undoubtedly more difficult than that of drugs, no drug is capable of producing effects at all comparable, and the care and attention devoted to its intelligent application by physician and patient are well repaid. It is a practical point of the first importance that individuals differ enormously—according to constitution, temperament, training, and previous habits—as to the amount of exercise that will be required to produce a given result. While those who have been trained may require severe or laborious exercise to produce physiological effects, the writer has met with individuals free from disease in whom the gentlest passive movements, lasting the fraction of a minute, would produce decided subsequent stiffness and constitutional disturbance. As it is just these sensitive and undisciplined people who may be most benefited by properly adapted exercise, it is evident that the kind and amount required must not be gauged by any absolute standard but by the reactive powers of the individual. Like some drugs, exercise may produce different and even opposite effects, according to the dosage and consequent intensity of action. Slow rhythmical passive movements are decidedly calming, while moderately active movements are stimulating to mental action. A careful distinction should be made between primary and remote effects. Exercise has also its synergists, antagonists, and incompatibles, its acute and chronic toxic effects, and their antidotes. The synergists of exercise are fresh air, a nourishing diet, sufficient rest, an unstrained and cheerful mind, and temperate and regular habits; moderate cold and possibly certain tonic drugs are a help to exercise. Exercise is antagonized by the opposite of the above-mentioned, and by toxic substances in the blood. Some interesting facts have recently been observed as to the effect of the use of tobacco in checking growth and the developing effect of exercise. From measurements of the one hundred and eighty-seven men of the class of 1891, Yale, Dr. J. W. Seaver found that the non-users of tobacco gained in weight during the college course 10·4 per cent more than the regular users, and 6·6 per cent more than the occasional users of tobacco. In height the non-users increased twenty-four per cent more than the regular users and twelve per cent more than the occasional users. In increase of chest girth the non-users had an advantage of 26·7 per cent and twenty-two per cent, and an increase of lung capacity of 77·5 per cent and forty-nine per cent respectively. These facts in regard to the dwarfing effects of tobacco are corroborated by observations on the class of 1891, Amherst, made by Dr. Edward Hitchcock. He found that in weight the non-smokers increased during their course twenty-four per cent more than the smokers; in increase in height they surpassed them thirty-seven per cent;

in gain of chest girth, forty-two per cent; and in gain of lung capacity, seventy-five per cent. It is probable that alcohol and other poisons have similar effects.

Exercise of the skeletal muscles is contraindicated in hæmorrhage, fever, inflammation, certain toxæmias, and serious injuries. Pain is an uncertain indication; if it result from inflammation or local injury, exercise is contraindicated, otherwise not necessarily. In acute local inflammation exercise is very injurious, since it increases the local congestion. Severe or sudden exertion should not be permitted in cases of aneurism, atheromatous arteries, cardiac vegetations or extreme cardiac weakness, but systematic training may be beneficial in the latter condition. Severe exertion should also be avoided soon after eating and in states of great physical and mental fatigue. Nothing will break down the system more quickly than the combination of mental worry or strain with physical prostration, though gentle exercises are often of value in resting the brain by bringing new centers into play, and thus effecting a better distribution of cerebral activity. It is futile to add to the burden of individuals already overworked, and the proper remedy in such cases is the reduction or proper proportioning of their total work, better hygiene, and provision for adequate periods of rest, repose, and recreation, which are the efficient antidotes for the toxic effects of excessive exercise. Well-chosen exercise may often be made to minister to mental poise, and thus to restful effects. It has been pointed out that the individual patient usually needs not exercise or rest exclusively, but exercise and rest in the proper proportions and in the proper order. The beneficial effects of treatment may often be enhanced by placing the two in sharp contrast. Exercise produces a better impression on a background of rest, and rest on a background of exercise; and particular attention should be paid to securing variety of action by contrasting one set of exercises with others involving different groups of muscles, or the same groups in a different manner. The level road may be the harder to travel in the long run. Neither its specific effect in any named disease, still less the piling up of enormous masses of muscle, is the therapeutic object of exercise, but the production of definite local or general physiological effects. Increased muscular power is usually an incidental result, but marked remedial effects are often produced with very moderate muscular development. The too dominant idea of "gymnastics" should not make us lose sight of the vast therapeutic importance of the nervous reactions associated with muscular movements, and of the systematic culture and training of the involuntary neuromuscular apparatus, which certainly depends in large degree on the activity of the skeletal muscles, but is often best elicited by massage, passive movements, hydrotherapy, and hygiene; all these involve exercise in a fundamental sense, and are of great therapeutic utility, even in febrile states, where exercise of the skeletal muscles is absolutely contraindicated.

The professional and domestic occupations, recreations, and sports have been noticed in their relation to the hygiene of exercise, and it is desirable that these means, which are within the reach of such large numbers of people, should be more often utilized therapeutically. For this purpose it should be remembered that many exercises have a preponderating effect on certain organs.

"Rowing tells on the breathing organs; the work of dumbbells, and of other exercises where muscles are moved without progression of the body, tells most on the muscles themselves; and long pedestrian feats, with climbing, tell on the nervous system. In cycling, as in running, it is the heart and circulation that first give demonstrative evidence of important change of action" (Richardson).

Housework, chores, gardening, walking, climbing, cycling, running, swimming, and many other sports give just the kind of exercise that is indicated in certain conditions, due regard being had to the physiological effects of varying dosage. Oertel has shown how the simple exercise of walking may be adapted to sufferers from cardiac debility by prescribing the distance and speed, and the number and length of the rests, on definite paths graduated according to their slope. His interesting and original work has not only given a new direction to the treatment of certain cardiac affections, but is destined to have an important influence in establishing accuracy in the prescription of exercise. Whoever has studied the map of the environs of Reichenhall, Bavaria, prepared by Oertel for the application of his method, will acquire a vivid idea of what precision of dosing in exercise means. In this map the different paths suitable for the work are marked in four different colors, to indicate those that are nearly level, those slightly sloping, moderately sloping, and steep, and figures are placed along each route to show the space that should be traversed in each quarter hour. The locality itself is prepared for its remedial use by placing benches for resting at suitable distances, and by marking on certain trees near the path circles, colored to correspond with the map, to indicate the difficulty of that particular section. By systematic practice on the easier paths the heart and system are progressively trained and strengthened. Intelligent analysis may do the same work for cycling, horseback riding, and many other familiar exercises. In this way the dosage is practically reduced to a definite number of kilogrammetres in a given time, and a step has been taken in placing the prescription of exercise upon a scientific basis.

Recreations and sports have the inestimable advantage of being taken in the open air and being interesting to those who take them—two factors whose absence in any form of therapeutic exercise is with difficulty atoned for. Athletics, though sharing in these advantages, are not well adapted to most therapeutic purposes, on account of their excesses, indefinite dosage, and lack of variety, each contestant being a specialist in one or a few forms of exercise. There remain for consideration the formal exercises of drill of various kinds, gymnastics, Swedish exercises, including passive and mechanical movements, and massage, which is elsewhere treated of in this work.

As the primary purpose of military, fire, and other drills is not therapeutic, they are not well suited to the treatment of disease, though they share in the beneficial effects of systematic exercise. The manual of arms is not adapted to young children, being too formal and too strenuous; the writer has seen cases of lateral curvature, knock-knees, nervousness, and debility in young boys which had apparently been aggravated if not produced by military drill.

Modern gymnastics has been largely shaped with reference to military purposes, and, while gymnastic exercises, if well selected and proportioned, do promote muscular development and physical grace and vigor, they are easily carried to an extreme, and instances are not rare where they have broken down the constitution, instead of building it up. Feats of skill train the nerve centers more than the muscles, and once the trick is acquired, their value as exercise is slight. Feats of strength often put an injurious strain upon the organism, with no corresponding benefit. The arm appears to be the object of all the exercises of modern gymnastics (Legrange); breasting and other movements which throw the suspension or support of the body upon the arms and shoulders give them unsuitable work, and result in disproportionate development of the muscles of the shoulder girdle, often associated with a rounded back, and little or no increased power of ventilation, since all such feats are performed with a chest fixed and constricted by muscular effort. The gymnastics of the modern gymnasium are in marked contrast with the athletic exercises of the Greeks, with whom the striving for physical perfection amounted to a passion. Their exercises were running, wrestling, boxing, fencing, and throwing the discus, taken in the open air, without apparatus, and exercising the body throughout, and especially in the fundamental associated movements of the trunk and limbs. The defects of ordinary gymnastics have been felt by those interested in physical culture, and have been partly obviated by the introduction of free movements, like running, jumping, and wrestling, and partly by the use of resistance machines, usually constructions of levers, pulleys, and weights, designed to exercise special groups of muscles, as in the Sargent system of apparatus. These reward effort, however, with depressing monotony, are devoid of most of the beneficial general effects of exercise, and appear to the writer to lack the elements of a coherent system.

The old gymnastic idea, in the endeavor to accomplish certain feats and to pile up large masses of muscle, ignored the intimate co-operation between muscle and nerve, and the delicate balance between co-operating and modifying muscular groups necessary to build up a clear-sighted, well-balanced mind, in perfect and harmonious but largely unconscious mastery of the bodily movements. The wise teacher and physician have small interest in gymnastic feats, but direct muscular activity into those channels best suited to promote harmonious mental and bodily development and adjustment.

With the Swedish system of exercises, devised by Ling and elaborated by his pupils, totally different ground is reached. Peter Henrik Ling was a fencing master, who became interested in exercise as a stimulus to development and as a remedy from observing its beneficial effects on his own health. He never took a medical degree, but developed remedial exercises into a system, which remains to-day as the basis of the most valuable procedures in therapeutic kinesiology. He also devised systems of educational, military, and æsthetic exercises. These exercises are based on the physiological actions of the different muscle groups and their relations to each other, and consist in free voluntary movements executed by the patient in different positions and in a determined order. The remedial movements include, in addition, passive movements executed by a manipulator, and assistive and resistive movements, in which the operator opposes resistance to the movements of the patient, or *vice versa*. To these are added the various manipulations of massage.

The Swedish therapeutic exercises emphasize strongly the local effect of movements, and hence have been called localized movements, and are largely used for specific local purposes. They proceed from the simple to the complex, aiming to establish correct fundamental attitudes and relations, and to invigorate and develop deficient parts through exercises adapted to the particular condition and situation. The value of gentle and passive exercise in conditions of debility, and of the systematic progressive adaptation of the exercise to the strength of the patient, is recognized and practiced.

The Swedish system avoids the abnormal development of special parts and the gratuitous feats of ordinary gymnastics, and produces normally acting viscera, a graceful carriage, and good muscular and mental control. One school of the Swedes, led by

Zander, has in the last thirty years developed a system of mechanical movements, both active and passive, given by means of apparatus. In these the resistance and amount of motion can be graduated to the patient's needs, and the personal element of the operator is eliminated. Each system fulfills certain indications, and neither can wholly supplant the other. If the Swedish school had given us nothing more than passive movements in therapeutics, our debt would have been great. The extraordinary prominence in recent years of massage as a remedial agent, in so far as it is justified by results, rests largely on the employment with it of passive movements. These enable the patient to obtain many of the benefits of exercise without effort and without undue fatigue, and can be employed in thousands of cases when active exercises are contraindicated or impracticable. Through passive exercises may be obtained the local effects of exercise on the circulation, easing of cardiac action or its gentle stimulation, mental discipline, or mental sedation, as in the soothing effects of rocking or swaying movements on infants; in a word, the more harmonious distribution of nervous and vascular activity.

It is well to remember Ling's adage that every movement properly performed is a respiratory exercise, and it is probable that respiratory development may be best attained through climbing, running, and similar exercises by those who are strong enough and energetic enough to take them. Those who most need them, however, are neither strong nor energetic, and it is often impossible to get patients to practice the purely respiratory exercises with sufficient care and persistence. In such cases, where more thorough pulmonary ventilation and respiratory power are required, passive respiratory movements, manually or mechanically given, often serve a useful purpose.

There is no more promising field for the therapeutic application of exercise than in the treatment of the insane and mentally unbalanced and defective. The elder Seguin has shown that the idiotic brain could be most effectively reached and developed through neuromuscular training, especially of the hand, and the value of manual employments, industrial training, and social life has been to some extent recognized in provision for the epileptic, idiotic, insane, and criminal. The striking and oft-quoted results obtained by Dr. Wey in the physical training of vicious and stupid criminals at the Elmira Reformatory by means of improved diet and systematic bathing, massage, drill, and gymnastics, mark an era in the treatment of the defective classes. A large proportion of previously incorrigibly dull and vicious individuals submitted to a few months of this treatment improved remarkably in physical and mental condition. It is safe to say that better provision will be made in future in our public institutions for the proper application of exercise in its various forms of manual training, sports, drill, gymnastics, and special exercises.

As exercise is a fundamental factor in the development and culture of the mind, it can be used to modify mental states, and has most important general and special applications in many nervous diseases. The repetition of rather gentle monotonous movements, especially of the automatic or passive kind, tends to allay mental excitement and nervous irritability. If the excitement is of the active insistent type, more vigorous exercise of duration to the point of fatigue may be beneficial, but should be semi-automatic, like walking, cycling, or rowing. These principles find a useful application in the treatment of insomnia. If the patient is dull and apathetic, with sluggish circulation and nutrition, exercises involving quickness and skill—that is, a more lively mental co-operation, like fencing, tennis, or boxing—should be used. In other cases the brain may need to be progressively trained through manual employments. The finer and more delicately adjusted the movements the less their value as muscular exercise, and the more the nerve centers are called into play. Writing, sewing knitting, playing on instruments, and in general the use of the hands mainly are valuable as mental training, but lack the beneficial general effects of vigorous exercise of the more fundamental groups. From its action as a cerebral sedative or tonic, exercise may be used as a means of influencing certain definite areas in the centers, in order to soothe, to stimulate, or to distribute and proportion mental action; and certain exercises may be abstained from to deprive certain areas of stimulation. We know no drug that acts mainly on the arm centers or mainly on the leg centers, but we can with certainty bring either of these centers into action by prescribing indicated exercises. In an important group of neuroses due to the excessive repetition of certain fine movements, usually of the accessory kind, involving accurate co-ordination, such as writer's, telegrapher's, and piano-player's cramp, and similar troubles, characterized by local pain and inco-ordination, usually associated with extreme mental anxiety, the hurtful practice should be stopped and massage and more general exercises involving more fundamental groups substituted. In another class of cases—the bedfast neurasthenics—the nutrition must first be built up by seclusion and systematic feeding, and the neuromuscular system, both voluntary and involuntary, aroused and strengthened by bathing, massage, and passive movements. Patients that would be injured at first by attempts at active movements will thrive on gentle passive movements of the arms and legs, and will soon be actively co-operating. When sufficiently advanced they can be taught to walk, and before they can do much at this they can take with great benefit some forms of passive mechanical movements, given after the Swedish system with power machinery, and which cause them to execute walking movements, respiratory movements, and trunk flexions while reclining, and with a minimum of effort and fatigue. Neurasthenics less severely affected can take such movements from the start, and they are indicated where the effects of exercise in equalizing the circulation and nervous activity, developing respiratory capacity and the supply of oxygen, increasing peristaltic and hepatic action, and nutrition, are desired for patients who are physically too delicate or who have too little energy or persistence to be able to get much benefit from exercise where vigorous volitional cooperation is involved. When the latter can be successfully prescribed the patient is well on the way to recovery.

Exercises of endurance, like cycling, rowing, and running, pushed to the point of considerable fatigue, are the most effective aids to continence, since the procreative impulse is the expression of a surplus of energy, and is abated if enough energy is regularly used up through muscular work.

As the larger number of functional disorders of the digestive system, such as dyspepsia and constipation, are the result either of the habitual neglect of muscular exercise or else of exercise taken under conditions of hurry, nervous tension, or fatigue, it is clear that the regulation of exercise and habits of life mnst be urgently indicated. In conditions of atony the patient must be trained to a variety of exercises, especially those involving the waist, abdomen, and trunk, among which the more active ones may be gradually introduced. In the cases due to debility from nerve tire, exercises requiring much skill should not be chosen, since these involve increased demands on the higher nerve centers. As there is usually sluggishness of the abdominal circulation, those exercises should be selected which will act on the abdominal organs through the muscles of the waist and trunk and upon respiration. Among the best of these is riding, which, moreover, affords just enough variety of scene and interest in the control of the horse to turn the current of an incessantly active brain into new and more restful channels. Riding may be as accurately dosed as walking, and may range from very gentle to exceedingly severe exercise, according to the gait, training, and disposition of the horse, the muscular development, temperament, and expertness of the rider, and the character of the ride. Changing from one mount to another also gives more variety of exercise than always riding the same horse. Abdominal massage is sometimes useful in constipation, as are also the arm, leg, and trunk movements of the Swedes or of the gymnasium, and walking, running, leaping, tennis, and other sports have their uses.

Whatever form of exercise is used, absolute regularity in attending to the calls of Nature must be observed.

Disorders of nutrition are powerfully affected by exercise, through the voluntary and involuntary muscles as well as through the nerve centers. Respiratory exercises and the exercises stimulating respiration and circulation are beneficial in anæmia, as are also the scientific application of massage and cold water to promote tissue interchange. By quickening oxygenation, the circulation, and the nutritive processes, moderate systematic exercise causes thin and poorly nourished people to gain in weight as well as in vigor.

In most wasting and febrile diseases, toxæmias and inflammations, the strength of the patient is needed to combat the circulating poison, heal the local lesions, and keep the vital processes going, and for these reasons, as well as on account of cardiac debility, muscular exercise is contraindicated, in some instances even during convalescence. Heart failure after diphtheria from changing from the recumbent to the sitting posture, and serious and even fatal relapse following too early sitting up after typhoid fever, are notable instances in point. Exercise of the unstriped muscles by friction and bathing may, notwithstanding, be extremely useful. It is noteworthy that under the supporting treatment afforded by cold bathing with friction much greater liberty is allowable. Not only do the patients bear well the lifting into and out of the tub, but some eminent physicians do not hesitate to let their typhoid patients sit up to adjust compresses to the body, to step into the tub, and even to walk to it with some assistance.

Exercise in the open air is of the greatest utility in the prophylaxis of phthisis. After the disease is developed exercise must be used with more caution, and in such a way as not to put great demands upon the vital powers of the patient. Moderate exercise out of doors and gentle respiratory exercises may be made beneficial, especially if directed to their gentle tonic effect and toward the better aëration of the pulmonary tissue.

There is a large class, especially among women, who habitually neglect exercise and lay up large amounts of reserve material in the shape of fat, which becomes burdensome by its bulk, and injurious by impeding the action of the organs in whose substance or vicinity it has been deposited. These people are not always large eaters, but having accumulated a physiological surplus, they have never been able to oxidize it. Exercise of endurance and respiratory exercises are well adapted to aid in burning up this surplus and to improve the health. It may, in addition, be necessary to reduce the ingestive fluids and fat-forming foods.

For those who habitually ingest too much rich and nitrogenous food and take too little exercise, whether suffering from typical gout or not, the systematic use of the muscles, together with a less hearty diet, is of the greatest value. It should be remembered, however, that when gout is developed, severe or unaccustomed exercise may precipitate an attack; systematically and judiciously employed in the intervals, exercise will tend to ameliorate the condition and prevent the recurrence of attacks. In diabetes, another disorder of imperfect metabolism, it has not been sufficiently appreciated that the surplus of sugar may be largely oxidized through carefully prescribed exercise. Walking is the most convenient form, and the amount should be graduated according to the patient's capacity and training. The aversion of the diabetic to exertion may be overcome by allowing limited amounts of bread as a reward for each mile walked. Those who have tried this plan find a decided advantage over a stricter diet and insufficient exercise.

The relation of exercise to the treatment of cardiac and circulatory affections has entered on a new phase since Oertel's original work. The dominant idea had been hitherto to relieve a weak or damaged heart of strain by avoiding exercise. Oertel teaches that the work of the staggering or flagging heart may be cut down by reducing the amount of ingested fluids, and the heart trained and strengthened by graduated daily exercise in walking on level and sloping paths. The results reported confirm the value of the method, and it is hardly too much to say that by accurately dosing and systematically applying this common exercise to meet the need of individual patients he has not only given the profession a valuable remedy, but a new point of view in the treatment of these serious affections. Oertel's cases are largely those of cardiac debility from imperfect nutrition of the heart and system, evidenced by fatty deposits in or about the heart, and not rarely elsewhere. This condition is usually the result of a too inactive muscular life, and in Germany is often associated with the ingestion of large quantities of beer, so that the ill-nourished heart has an increased amount of fluid to pump. In such cases a large reduction of ingested fluids is a necessity while attempting to invigorate the heart by graduated and divided doses, at first small, of walking and climbing exercise. Where valvular disease, with or without dilatation, presents similar indications, a similar course may be followed, but such prescriptions must be made with accurate discrimination and analysis of the actual state and needs of the economy.

THE STORY OF A MONKEY.

By M. J. DYBOWSKI.

WE were on the third hour of our march, one morning; it was nearly nine o'clock, and the sun was already getting burning hot, when, turning one of the green capes which the forest sends out in the sea that washes its base, we perceived the gay tricolor flapping near a hut. It was the port of Nyanga (in the Congo country). We had completed a hard day's work on the previous evening. The great forest, composed of spiny palms and interlacing lianas, drove us continually to the edge of the raging sea; a leaden sun darted its burning rays upon us, and the reflection from the fine sand threw a blinding light into our faces, which we could only endure by half closing our eyes. We were broken up as much by this toilsome march as by the all-enveloping heat, which in spite of all the precautions we could take, with helmet and dress of light linen, produced at last that kind of insolation which is shown by the fever that reigns normally in this country, and which a trifle will arouse. A thing that rendered this march still more difficult was that the sea washing into the lagoons that stretched along the shore made their water brackish, so that we could only get a little fresh water in the evening by stretching out our India-rubber coats to catch the drops from a shower that came up.

The sight of the French flag refreshed our strength, and we walked more rapidly to reach it the sooner, and take a little rest that we greatly needed. The port of Nyanga was held by a brigadier of customs, M. Lambert, who gave us the privilege of his house with a sincere cordiality. It was decided that we should remain there two or three days and make some excursions in the neighborhood.

Not far from the house was a little straw hut used as a kitchen, to which our host went to give his orders. I followed him, and saw in it, in one corner, tied to one of the posts, a pretty monkey, which as we came nearer to it uttered low cries and stretched its hands toward us. I was struck with the beauty of the creature and asked why it was there. I was told that it had been three years at the post, and that it usually lived at large; but that it was sometimes necessary to tie it, on account of the mischief it would not fail to commit when it was allowed to run where it would.

As I took so much interest in it, it was tied to the veranda. We soon became the best of friends. It was very pleasant and familiar. It allowed itself to be caressed, and responded to the advances that were made to it with cries of satisfaction. It played like a cat, getting on our back and climbing up our legs and arms to our shoulder.

The animal charmed me by the gentleness of its manners from the beginning, but I was still more attracted to it by curiosity as to the species to which it belonged. Having no manual of descriptions by which to identify it, I was not able, at first, to refer it to any common type. But I considered that I was concerned with a rare, if not new, species of *Cercopithecus*.

The chief officer at Nyanga thought much of the gentle monkey, which he had had for some time, and which entertained him in his idle moments in the extreme solitude in which he lived. Yet, with the kindness I usually receive from the officers of the countries in which I travel, he offered to give it to me; and I confess that the animal was so scientifically interesting that I did not allow him to repeat the offer. When we left the port, two days afterward, I carried the interesting creature with me, and in recollection of the place where it had lived so long, I named it Nyanga.

From this time on, Nyanga formed part of our caravan. She was tied, of course, with a cord fixed to a little harness which was put upon her. By day the foreman of the caravan carried her on his shoulders, and at night she was tied to one of the posts of the tent. The best of care was taken of her.

Every one brought her a part of his meal, or some of the fruit found in the bush. In a few days she became perfectly at home with us. She allowed herself to be handled and caressed, and accompanied her graceful motions with low guttural cries expressive of her enjoyment.

When we afterward arrived at Letté Cama, our menagerie had been increased by several other monkeys; but these less familiar ones were confined in cages. Nyanga alone continued to enjoy a half-liberty. We shortly gave her a companion, a young monkey of the same species. Nyanga adopted it, hugging it closely during the night as they slept on a box in the tent.

One day when I was hunting in the forest around our camp some monkeys I had heard howling in the branches, one of my men met me and called to me to stop hunting, for Nyanga had escaped, and I might shoot her. I returned hastily to the camp and learned there that our pet, doubtless tired of being always captive, had gnawed her cord in two and fled into the woods. Baba, the Senegalian charged with the care of the menagerie, had gone on the track of Nyanga, who had not got very far away, but had climbed to the top of one of the great trees.

She was called to in vain; she had no thought of coming back, and seemed wild with joy at being able to leap freely from branch to branch, to run to the ends of the limbs and make them bend, and to pick the wild fruits, or catch some insect which she could crush for her amusement. To our appeals Nyanga answered only by cries of joy, as if to let us know she was doing very well where she was. My Senegalian sergeant had gone to a neighboring village to engage some pirogues with which we might cross the lagoon in continuance of our journey. He might

M. Dybowski's Little Congo Monkey.
(From a photograph by M. J. Ducom, taken in the Jardin des Plantes, Paris.)

return at any moment, and it would be impossible for us to wait indefinitely till our monkey should be willing to be caught. It would probably return at night to the camp, but it would be a whole day lost, and a complication added to our march to wait for that. I was perplexed which alternative to choose—whether to abandon the monkey or lose our time, perhaps for no good—for there was no certainty that Nyanga might not meet some companion and follow him without thinking any more of us. From time to time we heard her calls, which the natives knew so well. They call this species the king of monkeys, for they believe that when its voice is heard all the monkeys in the wood keep silent.

But Baba, the Senegalian, provoked that one of the monkeys given him to take care of should have escaped, made every effort to catch the runaway. He had climbed an enormous tree with a trunk so large that it could not be scaled except by gymnastic efforts of which the blacks alone, who are almost as agile as the monkeys, are capable. He was away at the top, close against a branch, motionless, and hardly distinguishable from it. He had taken with him a light pole at the end of which was fixed a cord with a slip knot, and he hoped that he could get near enough to the monkey to take it in his snare. With a patience of which we whites would be incapable, he waited for the favorable moment. He had been there nearly three hours without moving, when all at once we heard him crying out from the branches, "Nyanga is caught!" It was true. Baba had waited till the monkey in her gambols had got upon a large branch that hung directly over the lake, had urged her gradually to the slender extremities of the bough; and there the animal had been forced to let herself be approached, for her only means of escape was to jump from a height of forty or fifty metres into the lake on the bank of which we were encamped. This adventure cost Nyanga the loss of all her liberty. In order to prevent her escaping again she was shut up like any common monkey in a cage, and was not let out from it except when we were camped at a post.

After this long lapse of about a month, which was required for the return from these distant regions, Nyanga, with twenty companions of various species which we had picked up on the way, took the express to Paris, and entered the Museum of Natural History, where she became the object of special attentions.

M. Milne-Edwards, on examining the animal, recognized in it a species still very rare, of which the British Museum has three skins from the island of Fernando Po. Bennett made a new species of it, which he describes as *Cercopithecus pogonias*. The specimen we brought is therefore the first that has come to Europe alive. Fortunately, I killed an adult male of this species in my African hunts, so that the French galleries also possess a stuffed specimen of it.

The *Cercopithecus pogonias* is a type reaching the full dimensions of the genus—that is, adult individuals measure from about forty-five to fifty centimetres in height. Their tail is very long, reaching eighty centimetres. The skin is gray—almost black—upon the back, passes with a lighter tint on the flanks, and is changed into a bright red on the chest, abdomen, and inside of the limbs. The face is furnished with full, light gray whiskers on the cheeks, and a very peculiar aspect is given to it by two broad white rays that extend from the superciliary arches to the top of the head, and unite with the tuft of black hairs to form a forelock on top of the forehead. Two bands of the same dark color occupy the sides of the face. Captivity did not take away her charming manners from Nyanga. She came to us joyously and let us caress her, and we could let her out of the cage then without danger of her running away. But the amiable animal had just escaped the greatest danger.

Her skin is so beautiful, she takes care of it with such pains that she is in as fine condition as if she were living free in the forests of the Congo; so that a person, whom I will not be so unkind as to name, found her so well kept that he proposed nothing less than to kill her, in order to put her stuffed skin in the cases. Fortunately, this idea was not carried out; and it is not likely that the learned director of the museum would ever consent to listen to it.—*Translated for the Popular Science Monthly from La Nature.*

NORMAL AND HEIGHTENED SUGGESTIBILITY.

By Prof. WILLIAM ROMAINE NEWBOLD.

THERE is perhaps no question so perplexing to a worker in a relatively new field as that which arises with reference to his terminology. Not only must he be influenced by considerations of euphony and etymological correctness, but he must also be on his guard against using words the connotations of which would tend to lead both himself and his reader astray in their practical inferences. It is, for example, true that a quart of alcohol acts as a poison, but it does not follow that we should use an ounce of alcohol as we would an ounce of strychnine. It may be eminently proper to apply a bad name to a dog under certain conditions, but it does not follow that the dog should be forthwith hanged.

"Suggestion" and "suggestibility" are words which usage compels us to employ, and, as their connotations are apt to mislead us, I shall find it necessary to preface my account with a brief analysis of their various meanings.

In dealing with any mental state, we have to consider (1) its character, (2) its conditions and causes, (3) its effects. The word "suggestion" properly denotes either an agency which produces a mental state, or the state so produced, and in the latter use it connotes the notion of the agency. Its most common meaning, however, is still narrower, and is limited to mental states springing directly or indirectly from physical stimuli, especially from words.

The effects of mental states, to which I called attention in my second article, were long ignored in psychology. The first to obtain clear recognition was the property of producing ideas, and this has become famous as "the law of association." The motor effects of mental states have been more recently noted, and the study of such effects is now rapidly becoming the fashion in current psychology, much as the study of association came into vogue in England a century ago or thereabouts. Now, the study of association has been prosecuted for the most part by the psychologist's watching the flow of his own ideas, but the effects of mental states upon movements—what Prof. Baldwin calls dynamogeny—has hitherto been studied chiefly by noting the motor effects of ideas and sensations suggested from without by words or physical stimuli of other kinds. Hence the word "suggestion" has come to include among its connotations not only the notion of the cause but also that of the effect—especially the motor effect—of the suggested state, and in the derivative "suggestibility" the original meaning is almost lost; it does not mean "a condition in which mental states may be more readily initiated by suitable causes," but, "a condition in which mental states, however initiated, tend to work out their proper results more readily than usual." From this usage, which is nowadays the most common, is derived a still broader one which I shall not scruple to employ. By an individual's suggestibility we denote the fact that in him every mental state tends to work out definite results of its own. In this sense we are all suggestible. The word corresponds to dynamogeny, save that the latter term has reference to the motor tendencies only of the state, while suggestibility includes its tendency to development, its associative and metabolic tendencies as well. The condition commonly known as suggestibility, in which the results of the individual state are more easily traced than usual, I would strictly term "heightened suggestibility," but for the sake of brevity it may be allowable to call it also simply suggestibility; the context will usually show what degree of suggestibility we are talking of.

Suggestions may be subdivided with reference to their origin into suggestions from without, due to impressions received through the senses, and suggestions from within, arising from some pre-existing thought. These are usually termed auto-suggestions and hetero-suggestions. Both words are barbarous hybrids, but the former at least is too deeply fixed in usage to be displaced. The distinction is sometimes of importance, since many patients who are very suggestible from within are not at all so from without, and *vice versa*. Yet it is difficult to draw any sharp line of demarcation between the two classes, and in the account which I shall give of suggestion I shall confine myself to the latter. I may have occasion to recur to suggestions from within in a later paper. I shall also limit myself to the discussion of the tendency to development and the associative and motor tendencies of mental states, omitting for the present their effects upon the metabolic processes. Thus the chief phenomena which I shall pass in review are, (1) the development of a suggested idea into a "sensory" hallucination, (2) the expansion of a suggested idea into a complete dream by evocation of associated ideas, (3) the production of bodily movements by means of suggested sensations or ideas.

As I have already said, it is not easy to observe that one is one's self suggestible. One's present consciousness contains at all times such a mass of subnascent, nascent, and vivid states that it is impossible to trace the effects of any one group, yet occasionally one can catch a state on the wing, as it were, and note its effects. Some years ago, I came home about ten o'clock one sunny morning, deeply absorbed in thought; of the latter part of my walk I had no clear memories, but I came to myself to find myself standing in the sunlight, holding a lighted match aloft in my right hand, apparently looking for a gasjet. I always carried in a certain pocket my keys and a matchbox; the sight of the door had prompted me to thrust my hand into my pocket, but I had no clear thought of the latchkey of which I was in search. Had I had, the mere fact that my hand happened to come in contact with the matchbox would have produced no result. As it was, the feeling of the matchbox found no obstacle to its working out its own results—my hand closed on the box, withdrew and opened it, took out a match and struck it, and this organized motor series was wrecked merely by the physical impossibility of lighting a gasburner where there was none to light, and not by the interference of inconsistent mental elements. Such phenomena are familiar to us all, but we rarely take pains to analyze them in detail, otherwise the precisely similar phenomena of hypnotic suggestion would not excite so much astonishment.

A large proportion of our acts are thus suggested by sense-impressions. Another large proportion is under the direct control of thoughts almost as simple, but the guiding thought is often so faint and phantomlike that it escapes attention. I was sitting once in a railway train on my way to Philadelphia; in the corner in front of me was an umbrella. I lifted my right hand, extended it, then let it fall. When I say that "I" did this I am not speaking with precision. "I" was at the time occupied with an entirely different train of thought, and the lifting and dropping of my hand struck "me" as something so strange that I fell to looking about in the dark nooks and crannies of my mind to find the culprit thought. Fortunately, I was in time. I had been looking out of the window, and the lowering clouds had suggested rain, walking the streets, getting wet; my hand reached out for the umbrella with some dim notion of taking off its cover and making ready for the rain. Then arose a vague, unformed thought which, if it had become articulate, would have taken some such form as, "Two hours yet before I get there": the hand was arrested half extended, and fell. The whole of this little comedy was enacted in an out-of-the-way corner of my mind, while "I," the thinking self, was absorbed in a train of abstract thought, and probably both the actors would have escaped notice and been straightway forgotten had it not been for the inconsistency of their motor results.

Every object of perception and thought is a center of innumerable diverging suggestions. Not all of these are of equal strength, and the manner in which any given object will affect a given individual will vary with his education, his habits, and his present mood. Many physical objects have, besides the lines of motor suggestion which they share with others, certain special lines peculiar to themselves. Of these perhaps the most important is the *use* of the object. Thus, of all the things which I could possibly do with a dagger, stabbing is to me by far the most attractive, and I find it very attractive indeed. I can not handle a dagger without feeling a marked propensity to strike the point into anything that comes handy. Many other objects are similarly suggestive. A gentleman, while visiting a friend of mine, was asked to examine a fine rifle which his friend had recently acquired. He loaded it, poised it, lifted it to his shoulder, took aim, remarking in a joking tone, "Suppose I fire?" "Do," said his friend—and he did. Happily, the ball contented itself with plowing its way through a cherry bookcase and four or five books, and no lives were lost. When asked why he did such a reckless thing, he could only say that he did not know—he did not intend to do it. To my mind there is nothing surprising about it. The rifle, to a man fond of shooting but without much experience, is instinct with dangerous suggestions. Ordinarily the immensely preponderating mass of inhibiting ideas keeps even the most reckless well within the danger line. But when the rifle was loaded, cocked, and aimed, and the finger on the trigger, a great mass of ideal and sensational suggestions were excited to the highest pitch and all converged upon the delicate muscles of the forefinger. Still, the inhibitory suggestions of time and place would, under most circumstances, have been sufficient to counteract all these; probably the command, "Do," re-enforced the latter at the very moment that it distracted attention from the former, and the slight advantage thus given to the weaker of the two systems of forces was sufficient to contract the finger and bring about the catastrophe.

The spontaneous phenomena which the Germans call *Massenpsychosen*—a word denoting a state of mind shared by a mass of people at once—are nothing more than Nature's experiments in suggestibility conducted on a large scale for our benefit. The panic is a familiar illustration. The terrifying suggestion which each man could easily brave alone becomes so intensified in being reflected upon him from a thousand frightened faces that he gives way and becomes for the time being an unreasoning, struggling animal. During every great strike such phenomena are common. A crowd gathers, the spirit of disorder is abroad, and the soberest of citizens feels his fingers fairly itching for mischief. A stone is thrown, another, and then another, and in a few moments every man is vying with his neighbor to see how much damage he can do. In these cases the frequently repeated suggestions given by the words, and still more by the deeds, of others overcome the results of years of training in orderly habits, and when the excitement has subsided many a participant in the late riot may fall to wondering "what in the world possessed him." The colloquial phrase, like many another, enshrines a truth. He was indeed possessed—not by any evil spirit, to be sure, but by myriads of delicate physical impulses, which, streaming in through eye and ear, prompted him with almost irresistible force to violence.

The so-called "contagion of crime" is somewhat analogous. There are at all times in the community "weak brethren" who, while not criminals, are drawn like moths to the flame by the fascination of a great crime. The Whitechapel murders and the assassination of Mr. Harrison, late Mayor of Chicago, are illustrations fresh in our minds. In each case a crop of dangerous "cranks" was brought to light, who, without the suggestion, might never have fallen into the hands of the police.

Turning now from these illustrations of suggestibility in general to the conditions under which it is heightened, the first phenomena to arrest attention are those of childhood. The consciousness of a newborn baby must be very unlike anything that we can picture. It contains perhaps sensations of pain and touch something like those with which we are familiar, but differing from them in lacking all localization and reference to an outer world. It is only by slow degrees that sight and hearing are developed, and we can never hope to know the various stages through which the raw material delivered to consciousness by the developing organs of sense must pass before it becomes anything like what we call sense-experience. Yet, however dim, confused, and rudimentary the baby's consciousness may be, the ingoing nerve currents produce more or less definite movements, and, as consciousness becomes more highly evolved, not merely do the impressions of sense produce movements, but the ideas also, or copies of those impressions, acquire control over the body. The later history of volition merely records the steps by which the inner control, through its gradually increasing complexity, comes to supersede the outer. In the earlier years of life the child may almost be said to be a slave to his environment. His conduct is controlled for the most part either by what he actually sees and hears or by his most recent memories and immediate anticipations. The remote past and the distant future affect him but little: he is a creature of the present. Consequently, one can see the motor effects of sensations and ideas more directly in children than in the adult. At first definite responses are limited to a few reflexes. Sucking, winking, crying, swallowing, clutching, and one or two more, constitute the capital with which the child begins life. Besides these we find a mass of random movements out of which all later forms are evolved. At a somewhat later period the child enters upon the imitative stage, to which so much attention has been attracted of late; no sooner does he see an act performed than he attempts to do it himself. Of the mental and physiological conditions which lie at the basis of imitation we know very little. It probably marks a period in which the visible appearances of the grosser bodily movements are entering into associative union with those thoughts of how the movements feel when performed which are the immediate psychical antecedents of the movements which they represent. "Naughtiness," in children passing through this stage, is frequently nothing more than sheer inability to overcome the imperative suggestions of the environment by the relatively feeble thoughts which its parents' commands suggest. For children, example is indeed better than precept.

As the child grows older and his mind becomes more richly stored with memories, as his hereditary instincts come to view, and his increasing power of imagination enables him to picture the future more distinctly, he is little by little emancipated from his slavery to the present. Yet in many children marked suggestibility persists to a quite late period. In the normal adult the store of memories has become so rich and the power of anticipating the future so great that the primitive suggestibility seems almost to have disappeared. The man's conduct is no longer mainly controlled by this or by that suggestion of his environment, but springs naturally from the steady stream of thoughts and purposes that fill his mind. No suggestion can enter his mind without running the risk of encountering a mass of ideas which either are antagonistic to it or overcome it by sheer weight of numbers. Furthermore, most persons who closely watch their mental life can detect in it that at present mysterious activity of the "self" to which I alluded in my first article. We must conceive it as in some way originated by and dependent upon our past experience, and in it we see, as I have elsewhere expressed it, the present conscious representative of the net resultant of our past experience, brought to bear upon the nascent mental state. Its function in our life may be compared to that of the rudder on the ship: it serves to hold us steadily to the course already laid out, and makes our present and our future symmetrical with our past.

It is evident, then, that, if we would restore primitive suggestibility in an adult, we must either break up the consciousness of self, or weaken its power of control. If we can do that, we have removed from the path of the suggested state the most formidable possible impediment to its free progress and development. But to give it full liberty we must abolish or enfeeble all other sensations and ideas as well. These would be, from the psychological point of view, the conditions of heightened suggestibility.

In many cases it is, unfortunately, impossible to get any evidence as to the mental condition of the patient, but such evidence as we have goes to support this hypothesis. The hypnotized patient, if asked what he is thinking about usually says, "Nothing." Sometimes you find that he is dreaming and will tell his dreams, but, like other dreams, they are readily guided or dissipated by the least sensory suggestion. In the few cases in which the patient remembers his experiences upon awaking, he says he felt drowsy, dull, or weak. One of my patients told me that it seemed to him as if the motor suggestions I gave him were executed by his body, mechanically, without his own concurrence. He did not feel disposed to resist, but, when he did, he either found himself helpless, or could overcome the suggestion by the most strenuous resistance only.

But the suggestibility thus produced differs widely from that observed in children. The consciousness of the child is so rudimentary in character that complex thoughts can not be awakened in it by any means; its suggestibility, therefore, is limited to the performance of relatively simple acts. But in the complex brain of the adult, with its myriad ramifications, the range of suggestibility, when once it is established, is far greater and its phenomena more striking. In language we possess an instrument which, although intangible, is as much physical as an axe, a saw, or a knife, and with it, as with an adjustable stamp, we can impress upon the still sensitive brain what modifications we will. Once started, they work out their proper results with almost fatal precision.

Turning now from the theory underlying these phenomena to the actual facts, we may say that heightened suggestibility is found under three chief groups of circumstances. First, it is found in sleep occasionally, and more frequently in the states akin to sleep termed hypnotic. Second, it is sometimes found as one of the symptoms produced by certain drugs. As we suppose these symptoms to be due to poisons circulating in the blood, the type is termed toxæmic suggestibility, from two Greek words meaning blood poison. In the last place, heightened suggestibility is found as a spontaneous phenomenon for which no reason can be given. This is called idiopathic suggestibility.

Of these three forms, hypnotic suggestibility is the best known and for many reasons the most interesting. Dreams, as I have already pointed out (February number), are largely due to suggestions given in sleep. A higher degree of suggestibility is sometimes found in normal sleep. A friend of mine told me that, when a boy, he had a schoolmate who became highly suggestible whenever he was slightly disturbed in sleep. Without awaking, he would become partly conscious and would do everything, no matter how preposterous, which the mischievous ingenuity of the boys could suggest. In hypnotic states suggestibility is so constantly found that some propose to regard it as an essential characteristic. Let me give a few illustrations of its varying forms. T—— B—— is a laborer, twenty-three years of age, neurotic, intemperate, easily hypnotized. His muscles are entirely at my command. I can stiffen a finger or an arm by a word so that he can not bend it. I can even contract one set of muscles while leaving the opposite set under his control. I bring his hands together, place the tips of his fingers in contact, and tell him he can not separate them. The systems of muscles necessary to hold them together are strongly innervated, while those that pull them apart are left under his control; he struggles in vain to part them, and his struggles are such as could not be easily imitated voluntarily. I can control his sensations in the same way. I can abolish his sensations of pain, of touch, of sight, and of hearing. I tell him he will feel in his right hand what I do to his left; I then put a lighted match to his left hand and it remains at rest, while the right jerks violently about in its efforts to escape from the fire. I tell him he is blind, and he is—deaf, and he can hear nothing. I tell him he can not see or hear such a man, and he acts as if he were unconscious of his presence. I can create hallucinations of all the senses also.

The limitations of suggestibility are even more interesting. R—— is a college graduate and is now a student of divinity.

When hypnotized, he passes into a light sleep, remains vaguely conscious of his surroundings, and remembers all that happens. The smaller muscles, as those of the eyelids, lips, and fingers, are entirely under my control, but the larger groups only in part. I can affect all his senses to some degree except that of hearing. The sense of sight is also refractory, and, although I can obliterate it, it is only for a few moments. I lean over him, look him in the eyes, and say, "I am getting dim—you can not see me clearly—now I am fading out altogether—I am gone—you are blind." "No," he says, "I see you still." He tells me afterward that I did grow faint and for a moment vanished, but almost instantly reappeared in brighter colors than before. I put a chair before him and say: "There is Mr. S——. You see him clearly—he is looking at you." "No," is the reply, "I do not see him; he is not there." I repeat it over and over again, but without effect. I try again. We are in Prof. F——'s lecture room, and R—— is sitting in the large chair on the platform. "There," I say, "in front of you, is Prof. F——." R—— denies it, denies it several times, and then suddenly admits it. When I press him to tell me exactly what he sees, I find that he fancies himself sitting in the body of the room where he usually sits during lectures, and sees Prof. F—— standing on the platform in an attitude he frequently adopts. In other words, R—— is dreaming with his eyes open, and his dream is determined by my command, he himself supplying for the dream of Prof. F—— a suitable associative setting. At another time I told R—— to reflect upon the name "Henry Jones," and put in his hand a pencil. After some time the hand fell to twitching and then swiftly wrote "Henry." "What are you doing?" I ask. "Thinking of that name." "What is your hand doing?" "Nothing." "What did it do a moment ago?" "It moved." "Did you move it?" "No." "What did it move for?" "I don't know." No questioning on my part could elicit any consciousness of the writing. In other words, the touch suggestion given by contact with the pencil had re-enforced the motor tendencies of the thought, and the thought had literally written itself.

I have not myself seen any cases of toxæmic suggestibility, but many are reported in the literature of the subject. For example, Dr. Janet describes a patient suffering from alcoholic delirium who was suggestible in the highest degree. Dr. Carpenter quotes from Dr. Moreau a description of the effects of hasheesh, than which nothing could better describe the augmentation in the developmental and associative tendencies of the suggested states. "We become the sport of impressions of the most opposite kind; the continuity of our ideas may be broken by the slightest cause. We are turned, to use a common expression, by every wind. By a word or gesture our thoughts may be successively directed to a multitude of different objects, with a rapidity and a lucidity which are truly marvelous. Fear becomes terror; courage is developed into rashness which nothing checks; the most unfounded doubt or suspicion becomes a certainty. *The mind has a tendency to exaggerate everything*." So, also, De Quincey, of the effects of opium: "Whatsoever I happened to call up and trace by a voluntary act upon the darkness, was very apt to transfer itself to my dreams. Whatsoever things I did but think of in the darkness, immediately shaped themselves into phantoms of the eye; and, by a process apparently no less inevitable, when once thus traced in faint and visionary colors, like writings in sympathetic ink, they were drawn out, by the fierce chemistry of my dreams, into insufferable splendor that fretted my heart." In the delirium of fever and in the coma of ether and nitrous oxide suggestibility is sometimes noted, but it is not a common phenomenon, and more information is much needed.

Idiopathic suggestibility has been reported by many observers, but I shall limit myself to the description of one case which has fallen within my own ken. Florrie is a little girl aged twelve. Her father is a blacksmith in good health but not robust. Her mother is a work-worn woman, slow of speech and slower of wit, and is easily hypnotized. Florrie is a quiet child, has suffered from frequent and violent headaches, and is very forgetful. In all other respects she is quite normal. She was hypnotized some time ago by a traveling showman. Of her condition before that time there is no record, but since then she has been markedly suggestible. A command forcibly uttered, once, twice, or thrice, is sufficient to displace her upper consciousness and throw her into a dreamlike state in which she executes nearly all suggestions. A typical experience with her will serve as an illustration. I had been lecturing in an amphitheater crowded with students, and she had been waiting outside. The patients I had already shown aroused a great deal of laughter, and when I went for her I found her panic-stricken, sobbing bitterly: she would not go, no, she would *not* go before all those men—she was afraid. I said to her in a low tone: "Florrie, of whom are you afraid? Are you afraid of me?" "No." "Of your mother?" "No." "Well, there is no one else here." After much persuasion I got her to look out. "There," said I, triumphantly, pointing to a crowd of physicians and nurses, "don't you see that bare wall? There is no one here but us three." Her tears were dried at once. I led her into the amphitheater and said, pointing to the rows upon rows of men, "Don't you see, Florrie, there is nothing here but empty benches and ourselves?" She saw nothing save what I told her to see, was perfectly cheerful and happy, entirely at her ease, and absolutely subject to my commands. She seemed to be quite normal, and she acted out the dreams I suggested to her with a grace that any actress might envy. I told her there was a plate of strawberries on the table. "Oh," said she, "what beautiful berries! May I have one?" She began eating them, and took the stem off each imaginary berry with a precision that almost made an observer believe that his own eyes were at fault, and that the berries were really there. "Are they sweet?" said I. "Oh, yes." "Rather odd, in February, isn't it?" said I. "I would have thought they would be sour." As she ate the next berry she made a wry face. "Dear me!" she said, "it is as sour as sour can be." At another time I told her I had two bouquets for her, and wished her to choose the one she liked best. I gave her with my right hand a real bouquet—with my left, nothing. She took both, smelled each in turn, exclaimed over their beauty, and finally returned to me the *real* bouquet, saying the other was much the prettier.

I might cover pages with such illustrations, but one is as instructive as a thousand could be. This child was not "hypnotized," yet she was in a "secondary state" or dream. I was never able to determine precisely how much of the real, visible, tangible world entered into her dreams apart from what I deliberately suggested to her to see, but my impression was she saw and felt as the rest of us do unless my suggestions were inconsistent with the testimony of her senses—in that case the suggestion triumphed. The suggested dreams were remarkably permanent. If she were told there was a parrot or cat in the room, she would continue to see it until it was abolished in the same way. Once or twice she refused suggestions that I gave her. For example, when I told her she was a princess, she acted the part very well; but when I told her she was a horse and was pulling a cart, she said she was not, and no amount of insistence on my part could make her see that cart. Once I tried to "hypnotize" her—i. e., I told her I would put her to sleep—and she went to sleep so soundly that I had great ado to get her awake again. So also after suggesting dreams to her, it was not possible to restore her at once to her normal condition, although if left to herself she slowly returned to it. I always took pains to abolish all the hallucinations I had given her, and she would then seem quite normal, but upon questioning her afterward I always found that her memory did not begin until perhaps a half hour after she had left me, and the attempt to elicit recollections of the forgotten period by leading questions always resulted in throwing her into a similar secondary state. Yet there was no connection between her secondary states; in one she never recollected what had happened in another, and no suggestion could make her remember. Nor was I ever able to produce posthypnotic suggestions, although I frequently tried to do so. I wished very much to relieve her headaches in this way, but could produce no effect upon them whatever. In other words, she failed to present many of the most characteristic phenomena of hypnosis. I think, perhaps, I should say that my attention was called to this little girl's case by her physician, and although in all the experiments that we made upon her we kept a sharp lookout for any indication of evil results, we were never able to detect any. Her waking dreams did not seem to be more injurious than other dreams.

One may justly ask how one can guard against simulation in such cases. I do not think the possibility can be altogether excluded, and in this case I was at first very suspicious. But after a good deal of careful observation one forms a pretty clear opinion, based upon many slight indications. My chief reason for thinking that the phenomena in her case were genuine was that taken as a whole they differed widely from the type of hypnosis she had seen in the public shows she had attended, which would naturally have given the model for her to imitate, and agreed very closely with rare cases reported by other observers.

THE COMING OF THE RAINS IN GUIANA.

By JAMES RODWAY.

WE are nearing the end of November, and the rains have come. For three months no more than one or two passing showers have fallen, and every tree and shrub in our gardens has done its best to accommodate itself to the changed conditions. During the rains of May, June, and July they grew rampant, the climbers extending themselves in every direction for long distances. Then came a severe check. The burning sun poured down on the parched earth at the beginning of September and caused most of the trees to flag and hang limp. Some of the more delicate plants in the garden had their leaves burned at the edges and for a time they looked unsightly. Some commenced to drop their leaves preparatory to a partial rest, but these were few; the majority braced up, as it were, and soon adapted themselves to the altered situation. The change was characterized at first by a wealth of flowers, but these quickly disappeared, until hardly a blossom could be seen. As the foliage grew less dense, the young fruit became conspicuous, and very soon guavas began to ripen and mangoes to set. Now also the mammee apple, which matures its fruit only once a year, felt the influence of the sun and came to perfection.

As month after month passed, the leaves fell until the canopy was almost bare, and in one or two cases toward the end of the dry weather the trees became denuded for a few days, or, in the case of the fiddlewood and silk cotton tree, several weeks. Those trees which never become quite bare dropped leaf after leaf until when the proper time came the young foliage pushed off the few leaves that remained and took their place.

Now comes the rain. The heat has been more oppressive than usual, and the sun is often obscured by thick clouds. Distant thunder is heard, and to the west and south the black clouds are lowering. Now and again great splashes of rain fall suddenly and as suddenly cease. Walking along a straight road, you see a mist apparently rising half a mile away, and when you come to the spot find that the rain has well soaked the road for a short distance. Then you may see a similar mist over a cane field, and notice that it is rolling steadily toward you. Listening, you hear a clattering, as if a regiment of cavalry was galloping along the road, and in a few seconds look for shelter against the big drops. It comes, wets you to the skin, and passes on up or down the road, leaving you very uncomfortable, but brightening up the vegetation and rousing the birds from their siesta.

These are the preliminary skirmishes, as it were. The rains have not yet come—only their vanguard. Presently they will be down in force to soak the parched earth and make every tree and shrub rejoice and blossom.

During the drought, animal life has been almost quiescent. Butterflies, moths, and beetles have been dormant as chrysalids. The foliage has hardened and lost its luscious taste; it would be therefore undesirable that larvæ should be hatched at such a time. Ants have been busy as usual, however; their nests may be seen in the dry ground everywhere. Frogs hide themselves in cracks of the earth or crawl into the mud at the bottom of the almost dry canals. Spiders, centipeds, scorpions, and cockroaches go outside the house only to come back when the ground is sodden. A few flowers come up on the roadsides as the dense thicket of sour grass becomes less rampant, but toward the end of the season the parapets look almost bare.

Yesterday a heavy downpour closed the cracks in the dry ground and flooded some of the ants' nests in the garden. To-day a regiment of great black ants is marching up the sides of the open gallery, and here and there one is running over the floor. Three quarters of an inch long, these creatures look rather formidable, but they are not vicious, nor is their nip painful. Out in the garden, however, a swarm of red fire ants is moving house, and if you happen to tread on the procession the mistake is very soon brought to your notice by sundry pricks and instillations of venom on your lower extremities. Then there are the tree ants, who make little nests the size of walnuts and keep flocks and herds of scale insects on the under surfaces of the leaves. For months their live stock has consisted mainly of hard scale insects; now they are busy fostering the young of these and bringing forward species of a softer nature. Some of these stock-breeders build their small nests about the roots of plants and thus escape the flood, while those who nest in the bushes seem to have gone a step further in their development.

At this time also the small black ants are everywhere. They come into the rooms and get upon our dining table, even though its legs are placed in pans of kerosene oil. A chair will provide a suitable gangway, or they will even run over your clothes as you sit at dinner. They even get into our beds, and we wake up at night to find hundreds of these tiny creatures crawling over us and giving vicious bites here and there. Then the baby cries in the next room, and its nurse wakes up to find the little pests running over its face and sucking the moisture from its eyelids. The child wakes up and rubs the part with his fist, to be rewarded with sundry bites on his delicate skin. Or perhaps one of them has got into his ear, and the child screams with all his might; then the mother or nurse has much ado with a syringe and oil before silence is again restored.

Now come the cockroaches. Not that they have ever been entirely wanting, but as long as the weather was dry they could hide under heaps of dead leaves or about the roots of trees in the garden. Routed from these snug quarters, they appear in great numbers, flying into the open sitting rooms, and perhaps making a lady scream out with disgust as one of them sprawls on her dress. Their object is to hide themselves as soon as possible, no matter where, and female drapery is very convenient. Like the ants, these stinking creatures invade our bedrooms, and a new-comer is warned not to sleep with his mouth open, for he might wake to find one exploring the cavity. Those who have lived in the tropics for any length of time can hardly escape tasting the cockroach. Now and then they run over our dishes and leave their taste and smell behind, while occasionally one gets into the flour barrel and spoils your cake or pudding. We have seen bits of their carcasses in our bread, and have had to reject a roll altogether from such a cause.

Now that the ground is well soaked, the wood ants or termites begin to swarm. They fly for a little while, but quickly get rid of their wings, to crawl into the chinks and crannies of the floor, between the covers of books, and in fact everywhere. They litter the tables with their cast-off wings, and if not looked after will do serious damage in a few days. Furniture is bored with holes, books are excavated to provide nests, and the very house itself becomes ultimately little more than a home for wood ants. The boards appear to be uninjured, but you can almost put your finger through them on account of the numerous channels and excavations of these apparently helpless little creatures.

The hardback—a black, chaferlike beetle—is very conspicuous after the rains have drenched the ground. They pass their larval stage in the earth and are driven forth in myriads. Not so disgusting as the cockroaches, they are yet very troublesome. They fly to the lights in your sitting room and drop upon your book as you are reading, or inside your collar. As for the ladies, they seem to be peculiarly open to such crawlers, as they have so much drapery, but the creoles take hardbacks almost as a matter of course. We remember, however, one occasion at an evening entertainment when these beetles spoiled half the pleasure of the female part of the audience. They came in literally by thousands, and, flying in their blundering way at the gaslights, fell upon the people below. Evening dress was worn by the ladies, and this made the matter so much the worse. Some shuddered as they felt them crawling over their bare necks, and there was a continual movement of the hands to pick them off. When we state that the beetles were swept up next morning by pailfuls, some idea can be formed of their number.

Moths also appear in great numbers at this time. The flowers open, and those that are nocturnal perfume the air, bringing the insects to your garden. The white flowers shine in the darkness, but not so brightly as your gaslights, and it follows that many a sphinx comes in and commits suicide. Smaller insects also appear, so that what with one and another a table under the lamp is littered with hundreds of the dead and dying before you go to bed.

As these come indoors, some of their enemies follow. Centipeds, scorpions, and spiders leave the garden and look for the luscious cockroach in his new quarters. Web-making spiders are not very conspicuous, but those which hunt—veritable beasts of prey—lurk in every corner. To see one of them spring upon a cockroach is as interesting, perhaps, as the attack of a tiger upon an ox. And, when the spider has taken all he wants, the ants come and carry off the remainder. There they go, marching up the wall, a hundred tiny creatures carrying between them the monster corpse, probably weighing more than a thousand of its bearers. We have often wondered at such a sight, and thought of the difficulty of carrying a heavy weight under such circumstances.

Under the ground floor our cat had kittened, but we did not know of the fact until the first great downpour of the season. Waiting under cover until the rain abated, we saw puss come out bearing a little, half-drowned creature in her mouth, which she carried to a dry place. A torrent came pouring down the gutter immediately above the entrance to her lair, but the anxious mother passed through this to bring a second and then a third kitten, until all her family were rescued from the flood.

Not only are nocturnal insects roused by the rains, but the butterflies also come forth from their chrysalids. We have an *Aristolochia picta* climbing up the gallery which has been seriously checked by the continual attacks of one particular species. It is a handsome creature, with black wings edged with yellow. As the rains fall, the plant puts out new shoots, and almost immediately the leaves and stems are dotted with yellow eggs. The butterflies come into the open gallery sometimes three or four at a time, and refuse to be driven off until they have done their work. In two or three days the caterpillars are at work, and with all our attention the plant is often quite denuded.

The frogs come forth from their hiding places as the canals become filled, with their rejoicing croak and hubble-bubble. Toward evening another species chirps and makes up to some extent for the absence of singing birds: in fact, it has been called the Demerara nightingale. After nightfall fireflies swarm over the marshy places, twinkling like myriads of stars, and they sail here and there in search of prey; for, of course, the gnats and midges and mosquitoes are at hand in such places. They also come into the house occasionally, but not in great numbers.

We have read of fireflies glancing through myrtle boughs and lighting up the dark arches of the forest, but rarely indeed do we see them among bushes, and never in the virgin forest. Their prey can not be found in such places. Over a marshy spot, however, they dart by thousands, each for an instant shining forth and as quickly hiding its light. Here, also, mosquitoes swarm, to pounce upon the unlucky wanderer who goes "mooning" about after dark.

In our garden the ferns are suddenly infested with caterpillars. The young and succulent fronds are delicate morsels, and as the rain brings them forth their enemies come to the front. Yonder pretty specimen of *Adiantum farleyense* was pushing out three delicate croziers yesterday; now they are nothing but bare stalks, while the fat green larva which has done the mischief hides behind one of them. Snails also appear from you know not where, to get a share of the succulent young shoots, and grasshoppers follow to almost denude a plant of leaves during the night.

Under the arc lights on the street are scattered hundreds of beetles, and round them hover great batlike sphinges, impatient to destroy themselves. Prevented from getting inside the globes, they dash themselves against the barrier, to fall or go off at a tangent. As you stroll along in the moonlight, the odors of a thousand flowers are wafted from the neighboring gardens, and the buzz and hum of insect life show that other living things are attracted by the efforts of the flowers. Yonder is a white convolvulus, its flowers showing up against the dark foliage like little moons. It does not emit any perfume, for its size and color alone make it conspicuous. Here is an avenue of fiddlewood trees, the flowers of which can not be seen, but the almost overpowering odor they emit is quite as effectual as the color of the convolvulus.

You would like to classify these odors. Some are very grateful, others cloying. There is the jasmin type, which, when excessively strong, is sickly. Then comes the West Indian mignonette, which is not unpleasant at a distance, but which is almost nasty in a room. The most grateful to our sense of smell appears to be an odor in which there is something spicy—this never cloys. On a damp evening all these come at intervals, now as light zephyrs and anon in overpowering bursts of perfume. Then there are odors too delicate for appreciation by our gross organs, which nevertheless attract insects from long distances. As the flowers open, the visitors appear, to linger round for an hour or two perhaps in the morning and then vanish until the same time next day.

Why do particular species of butterflies and moths confine themselves to one plant? Our plague, the butterfly above mentioned, comes to lay its eggs on or near the *Aristolochia*, but on no other plant. A day or two ago we found its larvæ on some seedlings about two inches high, and there is one plant which vainly attempts to push out new shoots, for as soon as a green leaf appears it is eaten. But the insect does not always lay its eggs on the leaves or stalks of the plant, but rather chooses a railing of the gallery or a portion of the latticework, always, however, in the immediate neighborhood of the food plant. Is not this the act of a reasoning being rather than hereditary instinct?

The effect of the rainfall on our magnificent vegetation is wonderful. What immense quantities of water are stored in the great herbaceous plants of the tropics—the banana, maranta, and the treelike papaw! All these are softer-wooded than many of the delicate plants of other climes which grow only to a few inches above the ground. With such a wealth of light and moisture, everything rises toward the sun. Daisies and primroses would be smothered; there is no room for them except up in the trees among the epiphytes. Your gardens, fields, and even woods are but miniature representatives of ours—only comparable to the contents of a box of Dutch toys. Grasses often rise above our heads, and the cousins of your *Compositæ* become tall shrubs. There are no *Ranunculaceæ*, *Primulaceæ*, or *Umbelliferæ*, and the violets are almost trees. Nothing but rampant grasses and sedges in the meadows, a few coarse, weedy flowers on the roadside, a wealth of vegetation in the canals, and everything else bushes and trees. No delicate plant hugs the ground for warmth, but all shoot upward, only requiring the heavy rains to enable them to rise higher and higher.

THE ANCIENT ISLANDERS OF CALIFORNIA.

By Prof. C. F. HOLDER.

DURING the past summer several attempts were made to thoroughly investigate the shell heaps, kitchen middens, and graves of the islands of Santa Catalina and San Clemente, off the coast of southern California. One of these parties, organized by Mr. J. Neale Plumb, of New York, in the short time at their command made some interesting finds.

The two islands are respectively twenty-two and forty miles off shore, each about twenty-two miles in length. Santa Catalina is

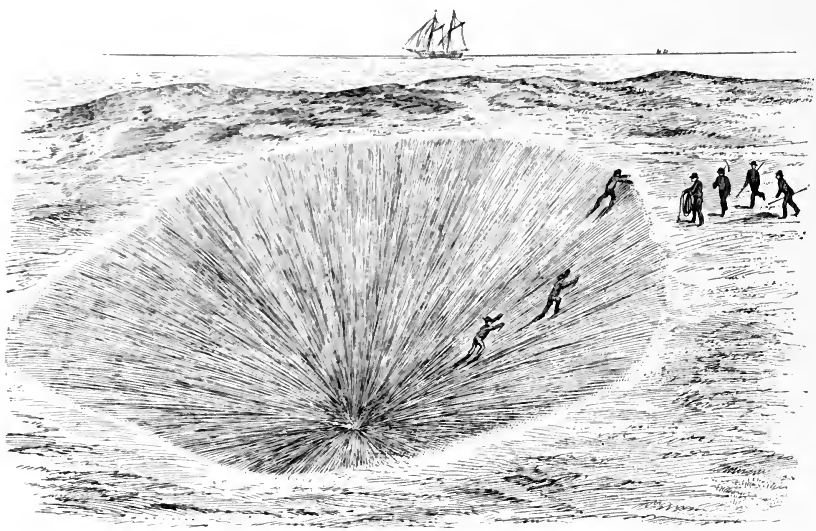

Fig. 1.—Gigantic Natural Sandpit at San Clemente Island.

a mountain range, with peaks twenty-five hundred or three thousand feet in height, with a climate that makes it a most desirable spot the year round, as the summer is delightful and in winter the island is a garden in the sea. San Clemente rises to a height of one thousand or twelve hundred feet at places, but is flat on top, as though swept by the winds.

Both islands were inhabited when discovered by Cabrillo in 1542, and undoubtedly for ages supported a large and vigorous population of savage seafarers who were skilled in all the rude arts of the fisherman and the sea.

How long these islands have been occupied, and who were the original settlers, are questions difficult to answer; but on Santa

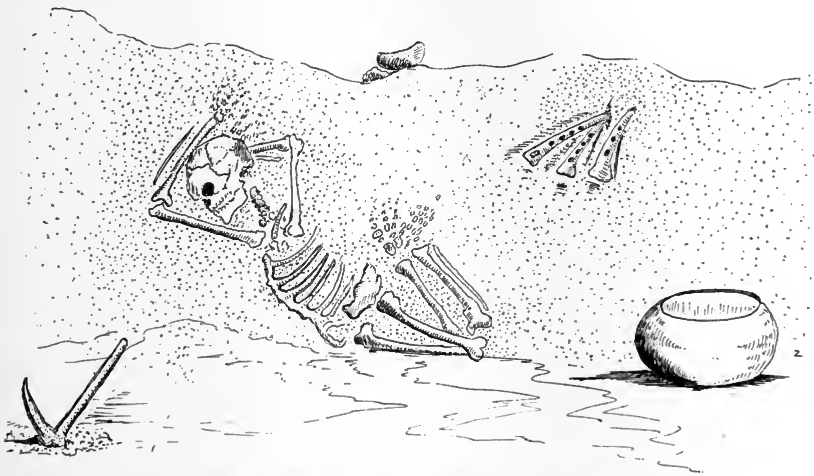

FIG. 2.—SKELETON FOUND AT SAN CLEMENTE ISLAND, CALIFORNIA.

Catalina the writer has identified a number of residence sites, shell mounds, caves, and tumuli, all of which show evidence of ancient occupation.

On the island of San Clemente we began work on the north end, at what is known as the Isthmus. Here for several hundred acres the sand has covered the soil and is gradually flowing up over the island, driven by the wind. For some reason this appears to have been a favorite location for the aborigines, as in every direction traces of previous occupation were found; but as the sand has been blowing for centuries, a greater portion of the material has been covered by it. The evidence was in the shape of shell mounds—piles of abalones, brought from the ocean, half a mile distant; heaps of the bones of fishes, seals, and various animals, among which were found stone implements, well-molded scraping stones, grinders and broken mortars.

A day was spent in digging in these sand dunes with poor success, but the following morning, on the west shore of the island, another sand stretch was discovered which had evidently been occupied for years. In one place we found human bones uncovered by the sand, in such numbers that the impression was given that here was an old battlefield where bodies had been left as they fell. As far as the eye could see down the coast the sand dunes extended, and everywhere were the telltale fragments of shell and abalone.

In the space of the present article it is impossible to more than call attention to a few of the finds made, illustrating the everyday history of these unknown people. The sand in places was littered with fragments of stone vessels which had been broken probably by some vandal. Some of these jars weighed nearly twenty pounds, others more, and were of all sizes, from small vessels, intended as paint or color jars, to vessels which would hold several quarts of water. Here were discoidal stones exactly like those taken from the kitchen middens of Europe, flint arrow and spear heads, beads of shell and bone, scrapers and awls of bone, and rings and other ornaments cut from the pearly abalone.

The most interesting find was made in the center of the dune, where, in sinking a trench, a skeleton was found in so peculiar a

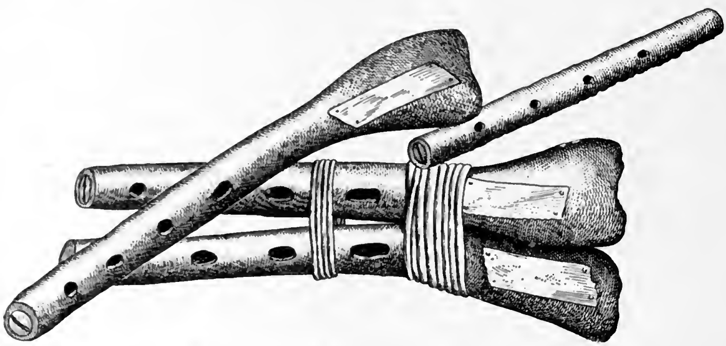

Fig. 3.—Musical Instruments, Double and Single, Inlaid with Pearl taken from Sands of San Clemente, by C. F. Holder, August, 1895.

position that the entire party gathered about and aided in the excavation. It was lying on its face, the head to the east, the arms raised over the head as though the man had fallen on his knees, or had been buried in a bent position. The bones were of a deep tan color, and about them was not the slightest vestige of clothing. The sand was carefully worked out, and after an hour's labor the skeleton was seen in perfect relief against it. Then began the detachment of the bones, each one being taken out separately and carefully laid aside to dry; in this way the perfect skeleton was secured.

Of many skeletons discovered by the writer on these islands, this was the first with which some of the possessions of the native had not been buried; as a rule, mortars and pestles, beads, weapons, and other property of the deceased were buried with him.

When the skeleton was almost exposed, an interesting find was made about five feet behind it. When first found it was supposed to be another skeleton, but careful digging with a knife in the soft sand soon resulted in the uncovering of three musical instruments, or flutes, showing that evidently the musician of the tribe had been discovered. They were the leg bones of the deer, found on the mainland forty miles away, and were evidently highly treasured by the owner, as they were ornamented with pearly iridescent plates cut from the haliotis. The flutes, which are now in Mr. Plumb's collection at Islip, Long Island, were about eight inches in length, perforated with four or five finger holes, while the largest end was covered with asphaltum, into which was set the square or oblong piece of pearl, evidently selected for its beauty and luster.

Fig. 4.—Pearl Ornaments.

These quaint instruments had been placed at the feet of the body evidently, as they were just on a level with it. It is not impossible that some stone vessels had been buried over the skeleton, as numbers of broken fragments were found here. Near by a large shell was discovered at the surface filled with shell beads, and a short distance away a skeleton partly burned, the bones mixed up among charred wood, fish bones, etc. Beneath it were several discoidal stones, and a curious object resembling a bell-clapper, probably a polishing implement of some kind.

The entire region was undoubtedly either a vast burying ground or had been a village site covered in the intervening years by the drifting sand that was ever creeping up the cañons.

As to the age of these remains, no estimate could be made, but everything pointed to an early period in the history of the island. San Clemente is subjected to winds, has a poor water supply, and does not present the attractive features found at Santa Catalina, now a famous watering place. The latter island evidently had a larger population. During the past ten years the writer has located at least twenty ancient town sites or camps on Santa Catalina, and found stone implements on many of them, ranging from mortars and pestles to discoidal stones, and various objects of stone, wood, shell, and bone. One location is of especial interest, being an ancient olla manufactory, where the natives from time immemorial made soapstone vessels and objects of various kinds. Here are the old olla marks, showing where the mortars had been broken off; and

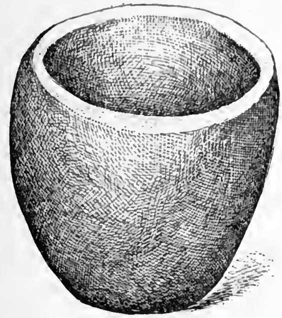

Fig. 5.—Stone Jar from the Sand Beds.

where the site was originally located the remains of the vessels were found.

These two islands are virtual archæological treasure houses which, when thoroughly examined, will undoubtedly produce many interesting finds.

ACCLIMATIZATION.

By WILLIAM Z. RIPLEY,
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THERE is no question of greater significance for European civilization than the one which concerns the possibility of its extension over that major part of the earth which is yet the home of barbarism or savagery. The rapid increase of the Aryan populations is more and more forcing it to the forefront as a great economic problem. No longer is it merely a scientific and abstract problem of secondary importance as contributory to the theories of the unity or plurality of the human race.* It has to-day become a matter of peculiar significance for the present generation of men, and the old abstractions, which did so much to confuse its students, are laid aside.† The substantial unity of the species having become an accepted fact along with the doctrine of evolution, the migration and consequent acclimatization of the various branches of the parent stock follow as a matter of course.

The modern problem plainly stated is this: First, can a single generation of European emigrants live? and, secondly, living, can they perpetuate their kind in the equatorial regions of the earth? Finally, if the Aryan race is able permanently so to sustain itself, will it still be able to preserve its peculiar civilization in these lands; or must it revert to the barbarian stage of modern slavery—of a servile native population, which alone in those climates can work and live? An area of fertile lands six times as great as that cultivated by the people of Europe to-day stands waiting to absorb its surplus population.‡ But its point of saturation

* Revue mensuelle de l'École d'Anthropologie, i, p. 129; Virchow, in Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, 1885, p. 202.

† The French distinction between "acclimatement" and "acclimatation" is practically an illustration of these two phases of the question. *Vide* Bulletin de la Société d'Anthropologie, Paris, v, p. 781. Our National Department of Agriculture has become so impressed with the importance of this matter that special investigations are being prosecuted, and a climatological journal is promised.

‡ In Proceedings of the Royal Geographical Society, January, 1891, p. 27, are maps, reproduced from a paper by Mr. Ravenstein before the British Association for the Advancement of Science at Leeds, of lands open for settlement. *Vide* also map in Transactions of the Seventh International Congress of Demography and Hygiene, x, opp. p. 163, of lands im-

will obviously soon be reached if traders and superintendents of native labor are the only colonists who can live there. Moreover, the problem of acclimatization has a great political importance; for if any one of these European nations be possessed of a special physiological immunity in face of the perils of tropical colonization, the balance of power may be seriously disturbed. Or a great menace to the feeble attempts of Europeans to colonize the tropics may exist in the surpassing aptitude of the great Mongol horde, which is perhaps the most gifted race of all in its power of accommodation to new climatic conditions.* Africa, Polynesia, and all parts of the earth have now been divided among the nations of Europe. What will they be able to do with them, now that the explorer has finished his work? † Because the problem pertains to the sciences of physiology and of anthropology, in no wise lessens its concrete importance for the economist and the statesman.

Before we are in a position to measure even approximately the influence of a change of climate upon the human body and its functions, a number of subordinate confusing factors must be eliminated. Neglect to observe this rule vitiates much of the testimony of observers in the field. In the first place, a change of residence in itself always tends to upset the regular habits of the soldier or the colonist. The temperate youth in England becomes a heavy drinker in the barracks of India; and the Portuguese and Spanish races, predisposed to the use of light wines—ready even to give up the habit if need be—suffer from the disorders incident to alcoholism far less than the English. ‡ Inflammation of the liver is indigenous to the tropics; and yet the ofttimes sixfold deadliness of hepatitis among English soldiers in India, compared with the mortality among the native troops from the same disease, is probably due more to the consumption of alcoholic drinks than to the influence of the climate.# To this fact is also

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possible of colonization by the Teutonic people. In Petermann's Mittheilungen, xxxviii, 1, p. 8, and Ausland, 1891, p. 481, the present extension of the "plantation" stage of culture is shown by maps.

* This theme is ably discussed by Prof. Ratzel in Kolonization, Breslau, 1876. It forms the groundwork of the pessimistic plaint in Pearson's National Life and Character. *Vide* also Dilke, Problems of Greater Britain.

† This was the great question before the International Geographical Congress at London in August, 1895.

‡ Dr. Montano, pp. 428 and 437, and St. Vel, p. 41, insist upon the necessity of abstemiousness. *Vide* also C. Stolz, Das Leben des Europäers in den Tropenländern, in Mittheilungen der ost-schweizerischen geographischen-commerziellen Gesellschaft in St. Gallen, 1888. The abuses of this habit are sympathetically portrayed by Kipling in the Mulvaney stories.

Davidson, *op. cit.*, i, p. 455.

due a certain immunity of the wives and children of soldiers in this regard. A moderate amount of alcoholic stimulant undoubtedly has a beneficent action.* Dr. Clarke even asserts that light wine is an indispensable part of a hygienic diet; † but the abuse of the drinking habit is a factor in the comparative immunities of all races in the tropics not to be neglected.

Alcoholism and sexual immorality go hand in hand. Newly acquired vicious habits, unknown amid the restraints of home life, would speedily cause physical prostration in any climate. An engineer in Algeria testifies that "a Sunday will put more men in the hospital than three days in the hot sun." ‡ One of the most subtle physiological effects of a tropical climate is a surexcitation of the sexual organs,# which in the presence of a native servile and morally undeveloped population often leads to excesses even at a tender age. ‖ The elimination of this factor becomes especially important in dealing with the crossing of races and the effects of climate upon fecundity. It is invariably true that the mulatto—a social as well as an ethnic hybrid—suffers from a loss of caste which exposes this class to many temptations. The effect of this upon morbidity can not but be very great in face of the peculiarly weakened physical resistance.^ Among the imported and liberated negroes in the West Indies, indeed, immorality rises to a climax almost sufficient to outweigh every other consideration. ◊

The influence of national habits in the choice of food is a third element to be eliminated. One of the immediate effects of a tropical climate is a stimulation of the appetite, ‡ which too often leads to overindulgence. On the other hand, it seems to be rather the kind than the quality of food which is the decisive factor. Dr. Felkin advises an increase in the daily allowance, provided it be of the right sort. ↕ In this regard the Teutonic nations are especially handicapped in competition with the Mediterranean peoples. The English and Germans insist upon their usual allowance of meat, where the Spaniards or Italians are content with

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* Science, 1891, p. 3. † Journal of the Royal Statistical Society, xix, p. 75.

‡ De Quatrefages, The Human Species, p. 236. # *Vide* Jousset, *op. cit.*, p. 229.

‖ *Vide* interesting letters from Dutch physicians in the East Indies in Verhandlungen der Berliner Gesellschaft für Anthropologie, 1886, p. 90.

^ Revue d'Anthropologie, second series, v, p. 47.

◊ Publications of the American Statistical Association, June, 1895, p. 195 *seq.*

‡ Jousset, *op. cit.*, p. 211; St. Vel., p. 29.

↕ The physiological effects of diet are discussed in Proceedings of the British Association for the Advancement of Science, 1889, p. 787. *Vide* also Archiv für Anthropologie, xxiii, p. 467. Foster (Elements of Physiology, p. 843) agrees with Dr. Felkin. The caution of the best authorities in making positive assertions is in sharp contrast with the statements of Buckle and earlier writers.

cereals or lighter food. The Chinese are especially favored in accommodation to a new tropical climate by reason of their simple diet of rice.

More important even than food, as a correction to be applied, is the effect of daily habits of life and of profession upon the physiological processes.*

An indolent life always and everywhere tends to superinduce a multitude of disorders. De Quatrefages has pointed out that in the West Indies the wealthy and idle creoles, and not the "petit blancs," swell the death-rate of the white population above the average.† Gentle and regular exercise, then, must be accounted one of the most important hygienic precautions to be observed. Worse than lack of exercise, however, is overexertion, especially if it be coupled with exposure to the hot sun or to miasmatic exhalations. Statistics for the Jewish race, confining all its activities to shops in the towns, must be corrected, therefore, for this circumstance, before they are compared with statistics for the Germans, who as colonists take up the ever-deadly cultivation of the soil. The Boers, who thrive as herders, would undoubtedly suffer were they to stir up the soil as husbandmen.‡ Most favored of all is that nationality which is seafaring by nature. The apparently high vitality of the Italians and Maltese in Algeria is in part because they are mainly sailors and fishermen.# In consonance with this principle is the relative immunity, already cited, of the wives and children of soldiers in India.‖ Slavery also always produces a terrific death-rate which vitiates all comparison between the statistics for the white and the negro.^ It should be noted, moreover, that such an institution exercises a selective choice upon the negro; for the survivors of such severe treatment will generally be a picked lot, which ought to exhibit vitality to a marked degree, all the weaklings having been removed.◊ Racial comparisons are also invalidated by the fact that hygiene and sanitation are generally confined to the European populations, so that, other things being equal, a higher death-rate among the natives would be most natural.

In any scientific discussion of the effect of climate upon the human body the racial element must always be considered; and

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* Archiv für Anthropologie, xxiii, p. 467. † *Op. cit.*, p. 236.

‡ Verhandlungen der Berliner Gesellschaft für Anthropologie, 1885, p. 258.

\# Jousset, *op. cit.*, p. 291.

‖ *Vide* also Verhandlungen der Berliner Gesellschaft für Anthropologie, 1886, p. 90. In some cases the mortality of adult women is higher, as in the island of St. Louis. Revue d'Anthropologie, new series, v, p. 30 *et seq.* ^ De Quatrefages, *op. cit*, p. 234.

◊ The bearing of this in Algeria is discussed in Revue d'Anthropologie, second series, v, pp. 47, 54.

correction must be made for ethnic peculiarities before any definite conclusions become possible.*

Three diseases are peculiar to the white race and to civilization—namely, consumption, syphilis, and alcoholism;† there being marked differences in the predisposition of each of the barbarous races for them, which often vary inversely with the degree of civilization they have attained; so that their widely varying liability to contract these diseases becomes an important consideration in the ingrafting of any degree of culture or of artificial life upon the native inhabitants of a colonial possession.

The Aryan race in its liability to consumption stands midway between the Mongol and the negro, climatic conditions being equal. The immunity of the Ural-Altaic stock in this respect is very remarkable. The Kirghis of the steppes, exposed to the severest climatic changes, are rarely affected with it,‡ and the pure Turanian stock is almost exempt from its ravages.# This may be one reason why the Chinese are able to colonize in many places even in the tropics where the negro can not live, since it is well known that a tropical climate is fatal to all persons with a consumptive tendency.‖ The Chinese succeed in Guiana, where the white can not live;^ and they thrive from Mamiatchin, where the mean temperature is below freezing, to Singapore on the equator.◊ That their immunity from phthisis is due in large measure to race, and not to climatic circumstances, seems to be indicated by the results of ethnic intermixture. The Japanese apparently derive a liability to it from their Malay blood, which not even their Turanian descent can counteract.‡ The Malays, a mixed race, seem to lack vitality in many other respects as well, in all

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* Dr. Bordier, of the École d'Anthropologie at Paris, is perhaps the best authority upon this subject. A fine outline will be found in Revue d'Anthropologie, i, p. 76; ii, p. 135; iv, p. 236; and v, p. 30. *Vide* also Dr. Montano in Bulletin de la Société de Géographie, Paris, 1878, p. 444; and Bulletin de la Société d'Anthropologie, 1881, p. 733. In Germany Dr. Buchner has discussed it in Correspondenzblatt der deutschen Gesellschaft für Anthropologie, xviii, p. 17; and more popularly in Sammlung gemeinverständlicher wissenschaftlichen Vorträge, 1886, No. 42. Dr. Ashmead, in Science for 1892, has raised some interesting points.

† Whether nervous affections belong to this category is a matter of present controversy. *Vide* Science, December 16 and 30, 1892. Suicide as an ethnic disease is ably discussed by Morselli in his treatise on Suicide.

‡ Revue d'Anthropologie, third series, i, p. 77.

Ibid., new series, iv, p. 236.

‖ Jousset, *op. cit.*, p. 300.

^ Bordier, Colonisation Scientifique, p. 472.

◊ Peschel, Races of Man, p. 77. The mortality table given in Quatrefages *op. cit.*, p. 235, seems to contradict this. *Cf.* Revue d'Anthropologie, new series, i, p. 76 *et seq.*, where tables of mortality are given.

‡ Revue d'Anthropologie, new series, iv, p. 237; and in Bulletin de la Société d'Anthropologie, 1881, p. 733.

of which the Japanese share to some extent. Their liability to consumption seems to be akin to that *penchant* for alcoholism, which is lacking among the Chinese because of the national opium habit.

The negro even in the tropics is especially subject to all affections of the lungs, a fact which constitutes a serious bar to his wide extension over what has been designated by Dr. Fuchs the catarrhal zone, in contradistinction to the dysenteric zone of the tropics.* The black races have in general less fully developed chests † and less respiratory power ‡ than the European race. They perspire less freely,# and their skin is thicker, or at least more dense, so that oxygenation by the lungs alone is more necessary. They are consequently exceedingly sensitive to atmospheric changes, and are severely handicapped in any migration for this reason. ‖ Almost invariably, where the European succumbs to bilious or intestinal disorders, the negro falls a victim to diseases of the lungs even in the tropics. An interesting case is instanced △ of a caravan in Senegal, composed of ninety-five negroes and ninety Europeans, in which the average mortality for each of the two contingents was exactly equal for two years. Yet only one of the whites was affected with disease of the lungs, while five of the eleven negroes who died succumbed to diseases of this class. Similar to the effect of change of climate upon the negro in inducing respiratory derangement is the influence exerted by altitude, which will be discussed in another place.

Dr. Ashmead has suggested an interesting reason for the predisposition of the negro for consumption—namely, that the broad, open nostril of the race is unfitted to perform the necessary service of warming the air before its entrance into the lungs. ◊ Leptorrhinism, he asserts, is due to natural selection, which has fixed upon that form of nose as most suitable to the temperate zone; and the negro, deprived of this advantage, suffers from disease of the

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* Dr. Rey, *op. cit.*, has fully discussed this.

† Jousset, p. 85.

‡ Ibid., p. 88. The same point is startlingly proved by the statistics of the civil war in the reports of the Sanitary Commission and of the Provost Marshal General, and in the recent reports of the Surgeon General of the Army as for 1895.

\# Ibid., p. 111.

‖ Dr. Buchner, in Correspondenzblatt der deutschen Gesellschaft für Anthropologie, xviii, p. 17, distinguishes *ektogenen* (from the environment, such as malaria) from *endogenen* diseases (from within, such as tuberculosis). The white race, he avers, is most liable to the former, the negro to the latter. Certain facts seem to lend slight color to this generalization, as, for example, the immunity of the negro from septicæmia. (*Vide* example on p. 669 *infra.*) Spencer notes this peculiarity of primitive peoples in Principles of Sociology, i, p. 49.

△ Revue d'Anthropologie, v, p. 95. Other examples might be multiplied indefinitely.

◊ Science, March 31, 1893.

lungs at once he is transferred to that part of the earth. It is not inconceivable that this may indeed serve as a partial explanation, but how, then, can we account for the equally open nostril of the Turanian stock so immune from consumption? Or how can this theory be made to square with the predisposition of the Polynesian for the same class of diseases, especially when the leptorrhinism of this latter race is taken into account?* At all events, this element of race must be reckoned with in every comparison of the statistics of different localities.

In the geographical distribution of diseases there is no more uncertain factor than the ethnic peculiarities of syphilis. It can therefore never be neglected in any project for acclimatization by crossing with the natives, since its relation to fertility is so important. Probably brought by the Aryan race to America † and to New Guinea, ‡ and by it disseminated in Polynesia, this disease seems to be as yet unknown in Central Africa to any extent.# In fact, it dies out naturally in the interior of that continent even when introduced, while it kills the American aborigines at sight. ‖ From this dread disease the Chinese are especially exempt; for if contracted, it speedily becomes benign, in marked contrast to the Japanese, who betray their Malay blood in this respect.△ Everywhere syphilis follows the Malay stock even in crossing with other races, like the negroid, which by nature is immune, as has been said. In Madagascar, where five sixths of a certain population was infected, Hirsch declares that the Malagasy (negroid) element is quite free from it, the Hovas (Malay cross) having it in the severest form. ◊

It will at once appear that these ethnic peculiarities of syphilis are of the greatest importance, therefore, since this disease is likely to prevail among exactly those classes in a colonial population where ethnic crossing would be most likely to occur. Intermixture as a remedy for acclimatization would consequently be much more difficult of application in the East Indies or in South America than in Cochin China or the Congo Valley; for

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* The extermination of this race by diseases of this character is suggested by De Quatrefages. *Vide* also Revue d'Anthropologie, new series, i, p. 76 *et seq.*

† Revue d'Anthropologie, i, p. 76; and Hirsch, *op. cit.*, ii, pp. 67 and 74; although denied by Boudin.

‡ Revue d'Anthropologie, second series, vi, p. 497.

Lombard, *op. cit.*, iv, p. 485; and Hirsch, ii, p. 77. This immunity has not persisted in America, however, so that syphilis is frightfully prevalent; shown, for instance, in medical officers' reports of the Freedman's Bureau, etc.

‖ Livingstone, Travels, p. 128; and Hirsch, ii, p. 82.

△ Revue d'Anthropologie, new series, iv, p. 236 *et seq.*; Bulletin de la Société d'Anthropologie, 1867, p. 543; and 1881, p. 733.

◊ *Op. cit.*, ii, p. 77; Revue d'Anthropologie, second series, v, pp. 54 *et seq.*

where this malady strikes down the first cross—the mulatto or the half-breed—all further assimilation of the races is at an end.

The list of ethnic diseases might be greatly extended, but enough has perhaps been said to indicate the importance of eliminating it before entering upon the discussion of acclimatization *per se*. The predisposition of the negro for elephantiasis * and tetanus,† his sole liability to the sleeping sickness, so severe that in some localities the black is utterly useless as a soldier, ‡ his immunity from cancer # and his liability to skin diseases in general, ‖ together with his immunity from yellow fever and bilious disorders, are well-recognized facts in anthropology. The Mongolian type appears to be likewise free from inflammatory diseases,^ and oftentimes from cholera to some extent; ◊ as well as from beriberi, which is so peculiar to the Malay stock that it may be traced in the Japanese *kak ké*. ‡ The Polynesians are immune from scarlet fever, ‡ and it is said that the Japanese can not even be inoculated with it. ‡ This again is an illustration of the same persistence of pathological predispositions, since the partial affinity of the Japanese to the Polynesian race is well established. Modern investigation is bringing out similar examples of the constancy of racial diseases among the modern peoples of Europe. Dr. Chibret affirms that the Celtic type is immune from "trachoma," or epidemic granular conjunctivitis, which has often seriously ravaged the rest of Europe.** Spreading in the Belgian army, it passed over the Walloons; and in the central plateau of France attacking strangers alone; it passed over southern Bavaria, even when contracted by a Celt, speedily becoming benign. The only exception to this racial immunity is that of the Piedmontese, otherwise it never extends above the two hundred metre Celtic boundary. ††

* De Quatrefages, p. 426. Instanced by all writers.

† Revue d'Anthropologie, new series, iv, p. 236.

‡ Hirsch, iii, p. 595; Bulletin de la Société de Géographie, Paris, 1878, p. 444.

Not universal, however. Bulletin de la Société d'Anthropologie, 1879, p. 390. The frequency of tumors among negroes in the United States is a peculiar fact.

‖ Clarke, *op. cit.*, p. 67.

^ Revue d'Anthropologie, new series, iv, p. 236.

◊ Cf. tables in ibid., new series, i, pp. 76 *et seq.* Contrast with table in De Quatrefages, p. 235.

‡ Ibid., third series, iv, p. 206. Dr. Ashmead has tried to prove it is a result of unsanitary environment (Science, November 8, 1892).

‡ Ibid., second series, v, p. 30.

‡ Science, April 21, 1892, p. 343.

** Comptes rendus du deuxième Congrès international des Sciences médicales, Berlin, 1891. Curiously, however, Dr. H. H. Haskell, of the Massachusetts Eye and Ear Infirmary, informs me that the disease is especially common in America among the poorer classes of Irish extraction. It is generally ascribed to unhealthy conditions of life.

†† The geographical distribution of *caries* also indicates an ethnic predisposition. *Vide* Map, Bulletin de la Société d'Anthropologie, Paris, 1867, p. 100; also 1868, p. 138; and

Always, in accounting for such a phenomenon, two factors are to be considered—race and environment. Hence, in our study of climatic circumstances the first must be carefully eliminated before proceeding to study the second.

Finally, the effects of ethnic intermarriage or crossing must in every case be taken into account. It is present as a complication in almost all colonial populations, and is by far the most subtle and difficult of all eliminations to be made. Notwithstanding the objection that accommodation to climate by intermarriage is in reality not acclimatization at all, but the formation of an entirely new type, the two are continually confused; and crossing with native stocks is persistently brought forward as a mode and policy of action. As an element in colonization, and a devious means of avoiding the necessity of acclimatization, it arises to complicate the situation. Intermarriage is said to be the secret of Spanish and Portuguese success; * in Mexico this has apparently been the case,† as well as in the Philippines. ‡ Dr. Bordier states that the Spanish and southern French are more prolific than others in marriage with negroes; # and concludes that the only hope for the future of French colonization in Cochin China lies in such crossing with the natives. ‖ The efficacy of this remedy is to-day accepted quite generally by anthropologists. Topinard agrees with Ten Kate that half-breeds resist climatic changes better than pure whites,^ and other authorities concede the same. ◊ Desmartis has even proposed to inoculate the British troops in India with Hindu blood as a preventive of tropical disorders. ‡

Mémoirs de l'Académie de Médecine, Paris, xxix, 1878. It formed the basis of an interesting discussion at the meeting of the Association française pour l'Avancement des Sciences. *Vide* Bulletin for 1878, p. 803. Sormani, Chervin, and Lagneau have also treated of it in their respective publications.

* Revue d'Anthropologie, N. S., iii, p. 265. Dr. Felkin finds the success of south Europeans in their element of Semitic blood (Scottish Geographical Magazine, ii, p. 652).

† Ibid., v, p. 318.

‡ Bulletin of the American Geographical Society, 1883, No. 2.

\# Colonisation Scientifique, p. 285. An example is also given in Revue d'Anthropologie, second series, viii, p. 190.

‖ Ibid., p. 397.

^ Elements d'Anthropologie, p. 204. The Hudson Bay Company refused for many years to employ trappers with white wives, partly because they desired to increase the supply of half-breeds (Political Science Quarterly, ii, p. 139).

◊ Proceedings of the British Association for the Advancement of Science, xxix, p. 178. "Bertillon's principle" is accepted by Landowsky in the Bulletin of the French Association for the Advancement of Science, 1878, p. 817. In Revue d'Anthropologie, second series, viii, p. 190, is a statistical account of crossing in Algeria on a meager basis, seeking to prove that French crosses with natives are more prolific than those with Germans.

‡ Proceedings of the British Association for the Advancement of Science, 1861, p. 143.

On the other hand, a cross between races is too often apt to be a weakling, sharing in the pathological predispositions of each of its parent stocks, while enjoying but imperfectly their several immunities, as we have seen.

Mulattoes in any climate are liable to lack vitality, and especially, unless a continual supply of white blood is kept up, they tend to degenerate.* Dr. Gould notices this lack of vitality among mulattoes as very marked in the Union army.† For this reason intermixture is by many regarded as a doubtful remedy.‡ Neither the Malay nor the Japanese mixed races have the vitality of the Chinese.# Jousset affirms that in many cases crossing increases the liability to attacks of fever.‖ In Guiana the negroes thrive, but the mulattoes suffer from the climate.^ Berenger-Ferand states that the mulatto in Senegal so far degenerates as to become infertile after three generations;◊ and Westermarck, while acknowledging that many statements of this kind are exaggerated, inclines to the view that crossing may be unfavorable to fertility.‡ Be this as it may, it is certain that mulattoes are pathologically intermediate between the white and the negro; they rarely have yellow fever, and are less liable to malaria (paludism) than the Europeans; and they are not predisposed to bilious disorders. But they have all the diseases to which the negro is alone liable—namely, elephantiasis leprosy, phthisis, and even the dreaded sleeping sickness (*mal de sommeil*).‡ Finally, it may be added that many of the most successful examples of acclimatization have occurred where there has been a complete

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* Dr. S. B. Hunt showed by measurements during the civil war that the brain weight of the mulatto, with less than half white blood, is below that of the pure negro (Quarterly Journal of Psychological Medicine, New York, 1867).

† Military and Anthropological Statistics of American Soldiers, 1869, p. 319.

‡ Dr. Ricoux, in Annales de Demographie, vi, p. 5, says it can never be a permanent remedy in Algeria. *Vide* also Revue d'Anthropologie, second series, v, pp. 54, 79. Ibid., pp. 85 *et seq.*, contains full details on the relation of the sexes in South America.

Walther (Revue d'Anthropologie, new series, i, p. 76) gives, for example, the following rates of mortality from cholera in Guadaloupe in 1865: Chinese, 2·7 per cent; negro, 3·44; Hindu, 3·87; European, 4·31; mulatto, 6·32. The particularly high vitality of the Chinese is as marked as the weakness of the half-breed; Dr. Brinton (Races and Peoples, p. 284) corroborates this fully.

Revue d'Anthropologie, new series, iv, p. 236. *Vide* also remarks on racial pathology *infra.*

‖ *Op. cit.*, p. 150. Its effects are discussed on pp. 154 *et seq.*

^ Revue d'Anthropologie, ibid.

◊ Parturition is held by Pruner Bey to be peculiarly difficult among hybrids (Études sur le Bassin, p. 13, Paris, 1855). *Vide* also Revue d'Anthropologie, second series, ii, p. 577, and Pösche, Die Arier, p. 10.

‡ History of Human Marriage, pp. 284, 287.

‡ Bordier, Colonisation Scientifique, p. 285, and Berenger-Ferand, *op. cit.*; also Revue d'Anthropologie, new series, v, p. 30.

absence of crossing, as among the Jews * in the Bourbon Islands, † with the Boers in South Africa, ‡ and in many parts of South America.#

The physical elements of climate, ranged in the order of their importance, are humidity, heat, and lack of variety.

Heat by itself, when unaccompanied by excessive humidity, does not seriously affect human health except when unduly extended. ‖ The ranges of temperature to which the human body may become accustomed are very broad, so that the limitations to the dispersion of the race seem to be set by the food supply rather than the degree of heat or cold.^ All authorities agree, therefore, that the regions where acclimatization is most difficult are to be found in the areas of excessive humidity, or, roughly, where there is the maximum rainfall. ◊ For this reason the successful examples adduced in favor of the view that acclimatization in the tropics is possible, should always be examined in the light of this consideration.

A traveler in northern Africa has noted this in his observation, that "where there is water and something can grow, there the climate is murderous; where the climate is healthy, there is no water and nothing can grow." ‡ In this sense, the boasted acclimatization of the French in Algeria is merely accommodation to one element of climate, after all. With this limitation it will be generally conceded that the success of the French in their African possessions along the Mediterranean is assured. ↕ The mortality of soldiers and sailors in Algeria was seventy-seven

* The Jews prosper in South America (Montano, p. 445) and in Egypt (Verhandlungen der Berliner Gesellschaft für Anthropologie, 1885, p. 258), and elsewhere (Jousset, p. 292); while even in the uttermost parts of Russia they increase faster than the natives (Wallace, *op. cit.*). Their cosmopolitan character, first pointed out by Boudin, is generally accepted by anthropologists (Revue d'Anthropologie, new series, i, p. 76). Dr. Felkin suggests that Semitic blood always helps in acclimatization (Scottish Geographical Magazine, vi, p. 652).

† Quatrefages, p 236.

‡ Wallace, *op. cit.*

Ibid.

‖ Jousset, p. 37; Ratzel, Anthropo-geographie, i, p. 308; Virchow in Verhandlungen der Berliner Gesellschaft für Anthropologie, 1885, p. 208.

^ Ratzel, *op. cit.*, p. 300, traces out the climatic limits of human life in detail. *Vide* also Science, January 27, 1893.

◊ A comparison of Hahn's map of the extension of the plantation system in Petermann, Geographische Mittheilungen, xxxviii, No. 1, p. 8, with a map of the distribution of rainfall in Berghaus's Physicalischer Hand Atlas will illustrate this relation.

‡ Quoted from a scathing article by Max Nordau, Rabies Africana, in Asiatic Quarterly Review, second series, ii, p. 76.

↕ General references are Berthelon, "De la Vitalité des Races du Nord dans les Pays chauds," and the statistics given by M. Bertherand (Paris, 1882). *Vide* also Landowsky in Bulletin de l'Association française pour l'Avancement des Sciences, Paris, 1878, p. 817.

pro mille from 1837 to 1848, so that Boudin, Bertillon, and Knox doubted if the French could ever colonize there. At the present time the birth-rate even exceeds that in France itself;* and the death-rate is but little above the normal.† In Tunis also the birth-rate was 35·6 *pro mille* in 1890–'92, greatly exceeding the ruling death-rate of 25·7 per thousand.‡ In America it is in the uplands of Mexico, Peru, and Bolivia, or along the arid coast of the Pacific, and not in the real tropical climate of Brazil, where the Spaniards have succeeded most fully. They have also done well in Cuba, to be sure, but the cases are entirely dissimilar. And to reason, from the French success in Algeria, that the same would ensue in the Congo basin, in Madagascar, or in Cochin China is totally to misconceive the real limitations of a tropical climate.# The relative difficulties to be encountered in these several cases may be roughly indicated by the mortality of soldiers. In Cochin China it is almost exactly double that in Tunis;‖ and this is, roughly speaking, a measure of the difference between a mere torrid climate as distinguished from one which is very humid as well as hot, for humidity means that malaria is superadded to all the other difficulties inherent in climate alone.

The heat in a tropical climate becomes important but indirectly, because it is the cause of humidity and generally accompanies it. In the temperate regions humidity goes with cool weather except in the dog days, while within the tropics heat prevails just when radiation through perspiration is most retarded by moisture in the atmosphere. This, in combination with the enforced lack of exercise and its attendant excretion, forms the double cause of physiologic disturbances. The blood is not properly purified and anæmia ensues, if the more immediate effects do not manifest themselves in intestinal disorders.

Everything which conduces to give a variety to the climate of the tropics affords relief. The alternating sea and land breezes of islands make them more amenable to European civilization.^ Especially when these islands are volcanic or mountainous is the strength of these tempering elements increased. This, in fact, is

* Levasseur, La Population française, iii, p. 43; and De Quatrefages, p. 229.

† Revue d'Anthropologie, third series, iv, p. 346.

‡ Étude statistique sur la Colonie de Tunisie, Tunis, 1894; reviewed in L'Anthropologie, v, p. 731.

Vide Ravenstein in Proceedings of the Royal Geographical Society, January, 1891, pp. 30 *et seq.* Dr. Felkin has not always been clear on this (Scottish Geographical Magazine, ii, p. 649). Refrigeration may do something as a palliative, but it deals with the lesser factor. *Vide* address by President Galton before the Anthropological Institute, London, 1887.

‖ Revue d'Anthropologie, third series, iv, p. 346.

^ *Vide* Jousset, p. 50.

the only alleviating circumstance in Jamaica, where the fierce sea breezes by day, reversing at night, have made life for the English possible. Singapore owes its prosperity to the fact that it is the only place in the East Indies where malaria is completely unknown. Similarly, wherever there are alternating seasons of heat and cold, the chance of acclimatization becomes greater.* Hence one advantage of the climate of plateaus in the tropics, since both daily and seasonal variations are very great. Even in the major part of the African plateau, however, the elevation can not overset the monotony of the tropical climate, the seasonal variations ranging much lower than ours, while the mean temperature is fifty per cent higher.†

Altitude, while giving at least temporary relief to the white race,‡ seems to exert a peculiarly baneful effect upon the negro and the Indian. Dr. Spruce gives an interesting example# of great economic distress produced by it in South America. Coffee grows in the zone from four thousand to six thousand feet, and the demand for native labor is very great. Indians coming from above die of dysentery, while if they come from the coast they succumb to respiratory diseases, so that the planters are severely hampered. It is said in our Southern States that the negro can not go from the hill country to the plains without great physiologic disturbance.‖ Jousset declares that the elevation of three thousand to forty-five hundred feet proves fatal to the negro in Africa.^ This, of course, is due in part to the greater sensitiveness of all primitive peoples to climatic changes, and partly due to lack of hygiene. But that the negro by nature really lacks a power of accommodation, even in the tropics, in this respect is conceded by most observers;◊ for by change of habitat he loses the immuni-

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* Jousset, p. 62. An interesting table to illustrate this in Cuba is given from Ramon de la Segra in Revue d'Anthropologie, new series, i, p. 76 (although the relief in winter to the white, becomes correspondingly fatal to the negro). Lombard's Atlas, Maps 2 and 3, shows the effect of seasons in Europe.

† This was fully discussed in the Proceedings of the Seventh International Congress of Demography and Hygiene, p. 155, in London. Drs. Felkin and Markham took a hopeful view of the Central African region. Ravenstein declared Matabeleland alone to satisfy the conditions (Proceedings of the Royal Geographical Society, January, 1891, p. 31). Jousset, p. 341, asserts that an elevation of three thousand to forty-five hundred feet will make acclimatization everywhere possible in the tropics.

‡ Jousset, p. 57, as well as p. 434. *Vide* also Dr. Montano, p. 434. Topinard, Anthropologie, p. 392, analyzes Bertillon's views in this regard.

\# Wallace, *op. cit.*

‖ An interesting letter in the Nation, October 12, 1893. *Vide* also Revue d'Anthropologie, new series, v, p. 30.

^ *Op. cit.*, p. 341.

◊ *Vide* discussion in the Bulletin de la Société d'Anthropologie, i, p. 528; Hunt, *op. cit.*, p. 131; Jousset, p. 148; Ratzel, i, p. 304. Cf. the case of Apaches in Alabama given in the Publications of the American Statistical Society, September, 1893.

ties he once enjoyed, and does not thereby gain any new ones.* A project to import twenty thousand negroes from Alabama and Mississippi into the State of Durango in Mexico has been definitely abandoned, after the payment of over one hundred thousand dollars for freight charges alone. The land companies will introduce Chinamen instead, and the outlook is correspondingly brighter. Every experiment but demonstrates more clearly that the negro is useless as a colonist, even for reintroduction into the tropics. †

EDUCATIONAL VALUES IN THE ELEMENTARY SCHOOL.

By Prof. M. V. O'SHEA.

It is perhaps safe to say, without attempting to enter into the question in detail, that there has scarcely ever been a time when intelligent people have not been concerned about what their children should be taught in the schools. Leaving the attitude of bygone ages out of view, it is apparent to a careful observer that in our own time and country there is marked interest manifested in the question, What materials of instruction are of greatest value to be employed in elementary education? The last quarter century has witnessed many and important changes in the curricula of the elementary school; new subjects have been introduced and old ones dropped, or less time and emphasis put upon them. The recent appearance of two of the most important educational documents of modern times, ‡ both considering in the main the relative worth of branches of instruction; and the rapid growth of book and periodical literature dealing with the same problem, are indications of the importance which is being attached to this matter by all educators. Our educational gatherings, too, in every part of the country are largely given over to the discussion of this old but yet very new question; and not only teachers, but parents and statesmen take sides in the debates, some maintaining that the classic three R's furnish superior material for the scholastic training of childhood, while others believe that the many new subjects of history, literature, science, music, and art are better adapted to prepare our youth for the circumstances they will encounter when they leave the school-

* Jousset, p. 279. Waitz and others agree that the negro returning to Africa from America becomes liable to fevers from which his predecessors were immune.

† *Vide* letter in Boston Transcript, dated Mexico, August 11, 1895.

‡ The Report of the Committee of Ten, 1893; and the Report of the Committee of Fifteen, 1895.

room. So there are taking place in the educational arena warm contests between the champions of conservatism and those of radicalism; between those who cling to the things of the past as adequate for the exigencies of the present, and those who feel that the complexity of our modern life demands somewhat different training in the schools, and who realize that contributions from recent scientific investigation along various lines have given us many valuable ways and means for improving and extending the work of the schoolroom that could not have been known or appreciated a century ago. Perhaps in no matter of public interest, all things considered, is there such ferment of ideas as in elementary education; and one potent cause of this disturbance is our changing standards of educational values.

Whatever things are contributing to alter the opinions of people as to the comparative values of various materials of instruction, there are at least two or three agencies whose influence may be clearly and easily traced. In the first place, modern psychological inquiry is leading toward a very different view of the mind and the mode of its development from that which has been held in previous times. This is not so much to be wondered at, though, for psychology, while a very old subject is a very new science, at least in its applications to the choosing of educational materials and the determination of educational processes; and some of the theories advocated a hundred years ago by eminent teachers show that the knowledge of mental activities in those days was extremely meager and formal, as perhaps those who follow us a century hence will be able to say of our present notions. One view commonly held at that time, and which seems to have determined school work ever since, maintained that the mind is composed of parts, each of which may accumulate general power by exercise in any special direction, in some such manner as we believe the muscles of the body grow and develop for future use in all sorts of ways by being disciplined in the gymnasium in youth. Now, it seems evident that, referring to physical things, the employment of the muscular system upon *any* kind of work develops a capacity which may be of service, at least in a measure, in *all* kinds of work. A young man, for example, who has passed his youth upon a farm engaged in manual labor is generally a more promising candidate for the football eleven or the crew when he enters college than is an individual whose early life has been spent in intellectual pursuits, or amid the idlenesses and luxuries of the city. A crew in preparation for a race, to illustrate further, spend a portion of the training period in running, believing that the strength and endurance accumulated in this way may be advantageously used in the final great effort, which will require activity of a different kind from that necessitated by the training. But it is not needful to multiply examples; the proposition will be granted to be true, in a general way at any rate, although it has been pointed out by many * that it does not hold absolutely, in the sense that the power developed by one special line of work can be used as well to perform other kinds as the particular kind by which the power is accumulated. That is, to illustrate, a blacksmith can not use his strength so advantageously in farming or carpentry as in making horseshoes, or performing other kinds of labor common to the forge and anvil.

This reference to physical things is important for us here only in illustration of certain theories that have been, and are still perhaps, extensively held concerning the development of the mind, and that have been largely influential in determining the material and method of elementary education. Reasoning from analogy, which seems to have been the principal method followed by early psychologists, it would appear that exercising any part or faculty of the mind in a given direction would create a power in the part exercised that could be employed with equal advantage in all directions. Thus if memory were employed in recalling and retaining any kind of facts—whether in language, in science, in mathematics, or in history—there would result a general power which in later life could be profitably used to remember anything and everything that was desired. It would follow, then, that if a pupil should master the vocabulary of a language so that it could be recalled readily, he would because of the power thus generated more easily remember legal matters after he left the school if he became a lawyer, medical matters if he became a physician, commercial matters if he became a merchant, or theological matters if he became a minister of the gospel. In the same way, and perhaps in a more serious sense even, if a pupil should pass some time in reasoning upon any kind of material in the schoolroom, he would thereby be prepared to reason accurately and readily upon all sorts of things after he left the school, just to the degree that he reasoned accurately and keenly upon the special thing in the school. The conclusion rushes upon us that if you wish men and women to be reflective beings, judging wisely upon all matters with which they may be concerned in daily life, you should require boys and girls to reason much in school; and that kind of material of instruction should be chosen that gives the greatest opportunity for the exercise of the ratiocinative faculty. Until recently—perhaps we ought to include our own time—this material was supposed to have been most largely comprised in mathematics; and as reason has been regarded as the highest faculty

* For example, by Prof. Hinsdale, in the Educational Review for September, 1894.

of the mind, the ability to exercise which keenly and readily was the thing most to be coveted in life, it was a natural result that mathematics should have formed the backbone of school studies. And since we are still in that period when reasoning is regarded by most people as the highest attribute of man, we of necessity must have arithmetic as the most important subject in the elementary school curriculum.

It will not be possible within the limits imposed upon us here to examine in detail the theories of this "faculty" psychology: it will suffice to say, although perhaps in a dogmatic manner, that in our own day students of the mind are breaking away from these old notions, and establishing what seems to be a much more rational and simple system of psychology; and following upon this there must come a different appraisal of educational materials, and a consequent change in the subjects taught in our schools. To be very brief, one important general conception of modern educational psychology is that the mind is a unit, and develops as a unity. As an inference from this it can be seen that the material of instruction in the school must be chosen with a view to train the whole individual—his perceiving, remembering, imagining, judging, and reasoning faculties, so called, and not any one of them singled out from all the others. And not only must this material train one intellectually as a unity, but it must affect him emotionally and volitionally as well—that is, it must develop character. We have had in the past, as every one knows, a kind of educational philosophy which declared that there should be one subject to train one faculty, another subject another faculty, and so on throughout the list of faculties and subjects; and there should also and particularly be special material to cultivate the emotions and furnish proper incentives to the will. The error of this sort of thing must be plainly apparent to any one who will study the problem concretely, by observing and interpreting the activities of his own mind, and looking into the various types of mind in his environment. If one will become introspective for a little time he will see that his perceptions are not divorced from his memory and reason along the lines that he is perceiving; and he will also discover that what he perceives, remembers, or reflects upon has its effect upon his emotions and will in leading him to some sort of action, immediate or in the future. One never sees a physician who is keen and ready in his perceptions of things relating to the practice of medicine who can not and does not remember, reason, and imagine equally well in regard to those matters; nor is his character, his personality free from the shaping influences of his system of thought. The same may, of course, be said of the lawyer, the merchant, or any other type of individual. The truthful view of the case seems to be that perception, memory, imagination, and reasoning are phases of one process, and they can not be separated from each other except by logical procedure; nor can the intellect be considered apart from the emotions and will. There is no virtue either in this separation except for the mere purpose of analysis, for in daily life these faculties are never divorced in their activities from each other; and in training the individual in school, educational psychology declares it to be a serious mistake to try to separate one faculty from the others and train it by the use of some special material.

The workings of this old analytic and analogical psychology are especially apparent in its teaching that the exercise of the mind in any direction generates a capacity which may be used equally well in all directions. The very statement of this doctrine would seem to show its falsity, but yet belief in it has practically determined the subjects taught in our schools for the last three centuries. No one, upon reflection, would maintain that an extended study of mathematics would prepare a man for the practice of medicine so well as would the special study of physiology and the effect of medicinal agencies upon the human system. Nor would such mathematical discipline be the very best thing to prepare for the profession of law, or theology, or any other business which does not directly call into play a large body of mathematical knowledge. Common-sense philosophy long ago concluded, and thoroughly believes now, that one who is to be engaged in the practice of some art should wisely acquire all the knowledge possible relating thereto; and it esteems this of far greater account than to be concerned in getting some foreign matter for the sake of whatever discipline this will give. Thus one who is to become an architect could spend his time to greater advantage in familiarizing himself with those things that relate to the successful conduct of his business, than he could to study profoundly into chemistry, botany, or theology in the belief that the general power gained by such mental gymnastics would make him more expert in architectural matters; and the illustration may be multiplied at pleasure.

To carry our point a step further, it must be obvious to any one who has thought about the matter that what an individual studies, and what he thereby gets to know, determines almost entirely what he can get to know in the future; not along general lines either, but in special directions. The mathematician, for example, is enabled by the abundance of his learning in geometry and calculus to appreciate and interpret further mathematical facts; but he is by no means empowered, by virtue of his mathematics merely, to be a competent or appreciative judge of historical, legal, psychological, or linguistic matters. It has become a truism in the public mind that a mere specialist grows more narrow every day of his life, and there seems to be plenty of evidence in one's environment to give rise to such speculation. The argument in favor of liberal culture before a man takes up his specialty is based upon a recognition of the fact that knowledge of one kind only predetermines a man to be able to appreciate and interpret things of a similar nature, and these merely. There are two reasons for this, as one can readily see from a little study of humanity around him. In the first place, what a man knows determines what he is interested in; and common-sense philosophy has often declared that people are essentially selfish, because they are interested only in their own kinds of business, their own pursuits, their own specialties, and they lack that many-sided interest which is necessary for any title to unselfishness. The lawyer feels little interest in what the medical fraternity are doing, and perhaps will never be seen at a medical lecture; the scholar, pure and simple, troubles himself little about questions of government, and is a very insignificant warrior indeed in the political camp. The mechanic reads theology or listens to a theological sermon with the greatest difficulty. But each of these types has the deepest interest for readings, lectures, and everything else that relate to his own specialty, or to the thing he is most familiar with. It sometimes happens, it is true, that a poet may be interested in psychology or theology, but this is the case only when he is already well versed upon these subjects; and other apparent exceptions to the general rule may probably be explained in the same way.

The second point in proof of this law, that what one knows determines what he can get to know, is that, psychologically speaking, ideas create the ability to appreciate and interpret other ideas of a similar nature. This also may be abundantly illustrated by the circumstances of daily life. A man very widely read in history may be unable to understand a lecture upon biology, mechanics, or any subject unrelated to history. The general power which he has accumulated in his historical researches can not be applied to the ready and easy mastery of all sorts of things, as the old psychology stoutly maintained. Again, one who has pursued mathematical studies to great length is not thereby qualified to become a statesman; the power which may be generated by the study of mathematics is not transferable immediately to the solution of social problems. Educational psychology, then, may be said to declare in a very broad way that ideas create capacity for the reception of ideas of similar kind, but that there is practically no such thing as the acquisition of general power by the mastery of special subject-matter. In explanation of this *practically*, it should be said that any kind of intellectual activity, no matter what it be, tends to create habits that may be carried into all kinds of study or business. One who has patiently, day after day and year after year, solved arithmetical or algebraic problems in the school, has by such exercise acquired habits of careful reflection and weighing of evidence that will lead him to dwell with somewhat the same care upon all matters that are brought to his attention; but unless he has sufficient data upon these new matters his reflections, of course, will come to but little. The practical conclusion is, and the one of importance in education, that study along any line limits excellence in perceiving, remembering, imagining, or reasoning to matters along this same line.

Applying this principle to the work of the schoolroom, we see that no subject should be studied merely for the discipline it may be supposed to give. The old theory that the school should cultivate the senses, the memory, and the reasoning powers of pupils, means nothing as a matter of pure discipline; in the light of modern psychology we must understand that the only way to secure this cultivation is in special directions determined by the peculiar nature of the material upon which the mind is exercised. Assuming, then (for it will not be deemed necessary to argue the matter here), that one ideal of our civilization is to have an individual understand himself in relation to his natural environment, so that he may be able to adapt himself to natural laws and turn them to the promotion of his own happiness and welfare, it follows that the study of natural law, the method of adapting one's self to it, and the industries that are based upon an adequate comprehension of it, should form an important part of school work; and it is some such argument that has introduced Nature-study into many elementary schools, giving it a prominent place there. In like manner, if it is desirable for one to be able to adjust himself in the best way possible to his social environment, he should study the organization of society, and the ethical and material conditions upon which his own and others' welfare and advancement depend. These considerations have been at the bottom of changes in the school curriculum, and are now at work in the endeavor to introduce still further improvements, as many educators think.

At all events, the old idea of formal discipline is gradually losing the breath of life, and we can think no better of it than that the sooner it releases its hold upon those who make school curricula, the sooner will the material of instruction be more nearly adapted to prepare the individual for his needs in after life. Whatever may be said in favor of the study of any branch for its disciplinary value, because of the good habits which are formed in its pursuit, may be said with equal force of those subjects which have direct worth in giving the pupil knowledge that will be of service to him outside the schoolroom, for these also will create habits of attention, reflection, and industry equally well. Thus, in the study of history, literature, or science, habits of careful observation and reflection may be formed with as great readiness and surety as in the study of algebra, English grammar, Latin, or Greek. And, moreover, the conditions for accurate observation and reasoning in science or in the conduct of society are somewhat different, as every one will admit, from what they are in Greek, Latin, or arithmetic; and if the purpose is to lead the pupil ultimately to observe keenly and accurately and interpret readily and serviceably facts of Nature or the phenomena of social intercourse, then the more he has to do of this in the school the more will he become familiar with right methods for future activity. On the other hand, if the object is to make the pupil keen in the appreciation of linguistic matters, then, of course, he must study language; and we might speak in a similar way of any special subject.

We have, therefore, this broad conception, that study along special lines does not create general but only special power. There follows a second principle of equal importance in determining the relative value of materials of instruction; but this, like the one just considered, has not yet received universal recognition among teachers. It has been maintained from aforetime that arithmetic, grammar, spelling, and the mechanical side of reading, writing, and the art subjects should receive particular attention because of the paramount necessity that the pupil should be master of these things before he leaves the school, in order to be able to make any progress in his learning thereafter; and there has always accompanied this first argument another, close of kin, that these branches afford opportunity for excellent discipline of the mind. Enough has already been said perhaps to indicate that the idea of pure discipline (or, as Prof. Hinsdale calls it, "the dogma of formal discipline"*) is not founded upon good philosophy; it remains to examine briefly this second position which many teachers, with their faces always turned toward the setting sun, declare with fervor to be impregnable. A survey of the subjects in the elementary school curriculum will show that they fall naturally into three great classes, usually styled (1) the real or content subjects, including history, literature, geography, and Nature-study or science; (2) the form or symbolic subjects, including language, grammar, arithmetic, and the mechanical side of reading, writing, music, and art; (3) the industrial or "psycho-manual" subjects, including manual training, sewing, and cookery. It has been held hitherto that the elemen-

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* Educational Review, September, 1894.

tary school should be concerned very little if at all with the real or content subjects, because these could not be studied with profit until a considerable body of symbols had been acquired, by the ready use of which a pupil would be enabled to talk, read, write, spell, draw, and cipher in the expression of what he gained from his investigations; and, moreover, is it not impossible for one to study history, literature, or science until he has mastered a vocabulary that will enable him to intelligently comprehend what he is trying to study about? That is to say, must he not first study words so that through them as symbols he may finally get to know about the realities symbolized? It is doubtless familiar to every one who has looked into the matter that there has been a reversing of this doctrine in many places of late years, and the aim is now to acquire familiarity with symbols through the things which they represent. It has become a truism of modern educational psychology that a symbol is learned with great difficulty and with little serviceableness unless it be connected with the thing or thought it is to symbolize; it is learned only after great effort, because, in the first place, it possesses no characteristic in itself but that of form, and in the case of words and figures very simple forms at that, which increases the difficulty of mastery. A mature person looking at the end of a pencil in the endeavor to fix it in the mind so that it may be identified in the future from similar pencils, would find the task well-nigh impossible, although it appears so entirely simple; but if the same effort be made in remembering a horse, or large and complex object of any kind, the problem is very much easier, because there are more evident characteristics to fix the thing in the mind, and by which it may be identified when it appears there again. Now, in the case of learning the symbolic subjects in the schoolroom, the ease of mastery depends upon every word and figure learned being connected with the thought or thing it symbolizes; the thought being previously aroused in the mind, and the symbol fused with it, as it were. Hence the maxim now frequently heard: First the thought, then the symbol. Psychological observation has shown also that the use of a symbol can become automatic in acquiring or expressing thought (which is the sole ultimate object in the teaching of the form subjects) only when that symbol has been connected a great many times in one act of thought with the thing it represents; and then whenever the symbol appears in the mind the thing symbolized will be automatically suggested. It is illustrated every day of our lives that when two or more things are perceived or experienced as connected with each other in time or space, one being thought of or experienced again, the other invariably accompanies it in the manner of the original appearance. Psychology has long recognized that contiguity is the essential principle of memory; and it is particularly applicable to the automatic memory, upon which, as already said in substance, the teaching of the symbolic subjects must depend. The object is to have thought spontaneously suggested by symbols, with no conscious attention upon the symbols themselves; and, of course, there is the co-ordinate purpose to acquire power to use the means of expression automatically to convey thought. Neither of these objects may be secured if the learning of forms is divorced from their constant use in the ready acquisition and clear conveyance of thought; which, when applied to the work of the schoolroom, means that the study of arithmetic, language, grammar, or the mechanics of reading, writing, and drawing, apart from their natural connections with the pursuit of the content subjects, history, literature, science, and geography is a mistake. Common sense maintains, in everyday life at least, that the mechanism necessary to the performance of any art may be most advantageously acquired through actual practice of the art; and one never learns the mechanics of bicycle-riding, baseball-playing, typewriting, and similar arts before he begins to ride the bicycle, play ball, or use the typewriter; but he acquires skill in doing these things by applying himself to their execution at the outset. A child at its mother's knee learns to talk by talking, and to walk by walking, rather than in either case to acquire beforehand the theory and mechanics of each in the hope to apply them some time later in life. But common sense, which has always been slow in carrying its philosophy of the activities of daily life into the work of the schoolroom, is just now beginning it seems to appreciate in a way that what is true concerning the mastery of the mechanics of doing things in daily life applies also to the formal subjects of education, in the sense that they may be most serviceably acquired in an incidental manner, while using them continually to acquire and express thought aroused by the study of real things. It is, no doubt, necessary to have much drill upon these formal things to make their use automatic; but this drill must follow and depend upon the use of the symbolic subjects in the study of the real subjects at any time rather than to aim at mastering a body of forms which may be applied at some future period.

From the foregoing (and there are other arguments, such as the greater interest which the pupil will have in the study of the formal subjects when they are thus connected with the real subjects, which can not be entered into here) it may be concluded that the formal branches of instruction acquire a value from their connection with the study of content subject-matter; and taught by themselves they are, comparatively speaking, empty and valueless. What has been said of the symbolic studies may be said also, without repeating arguments here, of the psycho-manual or industrial subjects: they, too, must be concerned with the expression, and hence with the deepening and intensifying of thought gained from the pursuit of history, literature, and science. Thus when the pupil studies about the industries in his environment and gains an impression of the activities of the mechanic, farmer, seamstress, and so on, he makes his ideas effective and lasting by imitating these activities himself. But to require him to learn the rules and mechanism of these industries before having an opportunity to perform them is to create an indifference or distaste for them all because of the formality and emptiness of such work. In drawing, too, the object should be to have the pupil express what has been gained from the study of some real object, or to illustrate some scene from history or literature; and when the mere grammar of drawing is learned before putting it to any use, not only interest but effectiveness in the work is lost.

Other matters should be considered in a complete and thorough analysis of educational values in elementary education; but from what it has been possible to say here it may be concluded that in the arrangement of the elementary school curriculum the central place should be given to the real or content studies—literature, history, geography, and science—and all other subjects must follow and depend upon them in the acquisition and expression of thought gained from their pursuit. As to whether the literary or the scientific subjects should receive greater emphasis there seems not to be so great agreement among psychologists and educators; although the ideal of the development of moral character in our schools, so frequently spoken of nowadays by teachers, would seem to argue the superiority of those studies that have a moral content—that is, those that deal with moral matters. Educational psychology points out a danger people are liable to fall into in thinking that because the material of instruction used treats of moral questions the result upon the character of the pupil must of necessity be moral. If this were true it would follow that the learning of moral subject-matter, as literature and history, would constitute adequate means for the training of exemplary men and women. In somewhat the same way it was once thought by religious teachers, and may be yet in some places, that the study of the catechism would cause an individual to become religious. But a little observation of types in one's environment will show that these theories do not hold absolutely, at any rate. If it necessarily follows that the study of history produces an estimable moral character, then we should find historians to be exemplary above all other men, and statesmen to be infinitely more than politicians. Taking things literally, we should expect all those individuals whose calling leads them to study history more or less, as the lawyer, the politician, historical teachers, and others to be distinguished for their morality above the scientist, the mathematician, or any one else in the community; but if this be so, it has not yet impressed itself upon the public mind. The more just view to take of this question is (to be dogmatic for the sake of brevity) that those activities which tend to become habitual are the ones that determine character; and an individual may study profoundly about charity, for instance, without ever exercising that quality himself; while, on the other hand, one may be little familiar with the literature of benevolence, but an exemplary person in its practice. Although it seems eminently true that our thoughts tend to get worked out into appropriate activities, yet we make a serious mistake when we conclude that those ideas which we get from books are uppermost in our minds when we are inspired to action; rather those impressions that have already become deepened and fixed through previous expressions are the ones that get mastery when we are about to act. This does not imply that literature and history have not great moral culture value when rightly used to furnish incentives and models for moral activities that become actually realized in the pupil's life—in the child immediately under the guidance of the teacher, in the older person at a more remote period perhaps. But at the same time it should be understood that character in a true sense includes the whole of personality, and a defect in any part is essentially a moral defect; so that what one can and does do, in a material sense, is as important to be looked after in elementary education as how he may think or feel in a bookish sense. These considerations alone (and there are other important arguments that might be advanced) indicate that, so far as values are concerned, the study of science, and of the various industries that may be understood and improved upon only by a comprehension of its laws, should hold a place in the elementary school co-ordinate with that of literature and history. One may not dogmatize here, though, considering the present state of our knowledge upon the most effective means for training moral character; and it is to be sincerely hoped that we may ere long be in possession of further contributions along this line from psychologists and educators.

Cutting telegraph wires is, according to Mr. P. V. Luke, of the British-Indian Chitral Expedition, a favorite amusement with frontier tribes. They find the wire useful. Sometimes, too, they convert the hollow iron posts of which the telegraph poles are made into guns, by lapping them round with wire; and they cut the wire up for bullets.

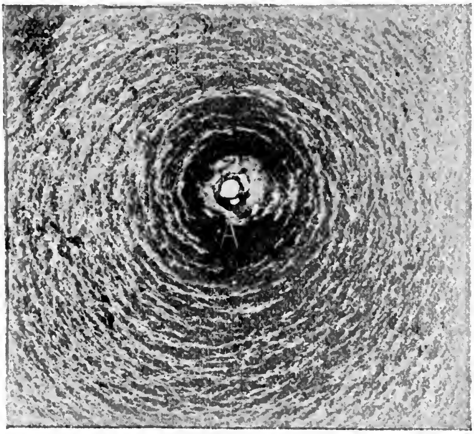
THE VELOCITY OF ELECTRICITY.

By GIFFORD LE CLEAR.

THE determination of the velocity of electricity has been the ambition of many physicists; yet at present it is generally conceded that the velocity may be anywhere from the fraction of an inch per hour to millions of miles per second.

By the popular use of the words "current of electricity" we have grown to think of a fluid flowing through a wire, yet we do not know that there *is* any such fluid, and consequently we can hardly say that it has a velocity. However, the attempt was made, some years ago, to find the velocity of electricity, considering it as a fluid, by finding the time taken for a signal sent from the Harvard Observatory, Cambridge, to reach St. Louis. The distance between the two places was known, and the gentlemen who conducted the experiment easily found what they supposed was the velocity of electricity by dividing the distance by the time. To understand why this velocity is not really the velocity of electricity, as well as to understand the direction in which physical research is now directed, we must consider what we really do know about electricity.

When the two poles of a battery are connected by a wire we say a current of electricity is flowing through the wire. The evidences of the so-called current are two: in the first place, the wire is heated; and in the second, a magnetic force is set up in the neighborhood of the wire. It is this magnetic force that interests us, and we must get as clear an idea of it as possible. We find by experiment that in the neighborhood of the wire a compass needle is turned from its customary north-and-south position. The force which so turns the needle we call the magnetic force, and the direction in which the north end of the needle is pulled we call the direction of the magnetic force.



The adjacent figure is from a photograph of iron filings spread over a plate through which a wire is thrust, perpendicular to the plate. A current is passing through the wire whose cross-section we see at A. The filings arrange themselves in the direction of the magnetic force, which we see to be in concentric circles around the wire. According to theory, this magnetic force extends to an indefinite distance. Near the wire the force is very strong, but grows weaker, losing strength with distance until it finally becomes imperceptible. Before we connected the wire to our battery this force did not exist. Where did it come into existence first—near the wire or far from the wire—or did it come suddenly everywhere at once? The late Dr. Hertz performed some wonderful experiments in this connection, in which he showed that the magnetic force comes into existence first near the wire and then makes its appearance a little farther off, and so on till all the surrounding space is filled with the force. Dr. Hertz's experiments seem to indicate, moreover, that the rate at which this magnetic force travels out from the wire is perfectly definite; in a word, that it travels with the velocity of light. You can picture this to yourself by imagining the wire suddenly to emit light just as we connect it to the battery; then the light and the magnetic force will both reach any point at which you may place your eye at exactly the same time.

This is the theory, and a very interesting one it is, but it does not stop here, for not only does this magnetic force travel with the velocity of light, but it has been proved by experiment that it can be reflected, refracted, and brought to a focus.

Many observers are now engaged in reproducing and extending Dr. Hertz's experiments, and many brilliant results are to be expected.

Now, to see why the velocity determined between Cambridge and St. Louis was not the velocity of electricity, we must go back to some fundamental principles which at first sight seem to have no connection with the question.

Just as a current of electricity produces magnetic force around the wire carrying the current, so does magnetic force around a wire produce a current of electricity, no matter how the magnetic force may be produced; but, whereas the current produces a magnetic force that lasts as long as the current flows, the magnetic force produces a current only while the force is growing, so to speak—while it is being made. If, now, we have a wire, *a*, so arranged that a current of electricity may be sent through it from a battery by pressing a key, and another wire, *b*, parallel to *a*, connected with an instrument for detecting a current of electricity, when we press the key we shall get magnetic force around *a*, extending as it grows to *b*. While this magnetic force is growing, we find there is a current through *b* in the opposite direction to the current through *a*. Now let us move *b* up closer to *a*. We get, of course, the same effect, only the current in *b* is stronger than before, because the magnetic force is stronger the nearer we get to *a*. Finally, let *b* touch *a*. We have then really only one wire, since the wires touch and form one conductor. Of course, now the magnetic force can not send a current through our wire, as it did through *b*, in the opposite direction to the current from the battery; but it tries to do so, opposing the current from the battery. Consequently, the current that the battery gives is very weak for a short time, but only for a short time, because this opposing current lasts only while this magnetic force is growing. This phenomenon evidently holds for every wire through which we try to start a current.

The instruments used in the experiments between Cambridge and St. Louis could not work unless the current from the battery had reached its full strength, so that the time the experimenters found between the sending of the signal and its receipt was not the time it took for electricity to pass from Cambridge to St. Louis, but was the time it took for the current they used *to grow to its full strength.*

We know that the strength of the magnetic force around a wire depends upon the size and form of the figures into which the wire is bent, and the time it takes for a current through the wire to reach its full strength depends upon the strength of the magnetic force. Therefore we should expect that, by using different instruments on which wire is wound in different forms and sizes, we ought to find that it takes different times to send a signal from one place to another. This has been tried and found true. In fact, it was in this way that it was first proved that the velocity found between Cambridge and St. Louis was not really the velocity of electricity.

It would seem, then, that in our search for connecting links between electricity and light we had better turn our attention to what goes on in the space around a wire carrying a "current" rather than to confine ourselves to what takes place *in* the wire.

THE Davenport Academy of Sciences is endeavoring to organize a systematic and thorough field work in archæology through the State of Iowa, with the expectation of ultimately publishing a final report on the subject. For that purpose it asks the co-operation of workers everywhere in the State in collecting the material necessary, hoping to accomplish the task in not less than five years. That the work may be intelligently done, it has sent out a "circular of suggestion," giving details of instruction as to methods of proceeding in examining mounds, earthworks, shell heaps, village sites, rock shelters, aboriginal workshops, cliff carvings and paintings. A combined summary of what has already been done in this work has been prepared by Prof. Frederick Starr, and is sent out by the academy.

SKETCH OF WILLIAM STARLING SULLIVANT.

"IN him we lose the most accomplished bryologist which this country has produced, and it can hardly be said that he leaves behind anywhere a superior." This is high praise, and its value is enhanced by its coming from Prof. Asa Gray, who certainly knew whereof he spoke.

William Starling Sullivant was born January 15, 1803, at the little village of Franklinton, then a frontier settlement in the midst of primitive forest, near the site of the present city of Columbus. He was the eldest of the four children of Lucas Sullivant, a Virginian, and Sarah (Starling), his wife. His father had been commissioned by the Government to survey a district in the Northwestern Territory lying in the center of what is now the State of Ohio, where he early purchased a large tract of land, bordering on the Scioto River, and near by, if not including, the site afterward chosen for the capital of the State.

The early life of William Sullivant was therefore that of the frontier, with its mixture of hardships and opportunities. At a time when the hominy mortar and the hand grater served to furnish coarse meal for bread, and grist mills were few and far apart, young William, mounted astride of a bag of wheat on one horse and leading another on which also was strapped a well-filled bag, was often sent on a journey along the blazed bridle-path through the forest to procure flour for the family. These expeditions frequently occupied two or three days' waiting for the grist, and necessitated sleeping in the mill wrapped in a blanket, where he was fortunate who had a pile of corn or wheat for his couch instead of the hard floor. But all this, together with the athletic sports of the frontier settlement, served to give him the fine physical development which was often remarked in his adult years. He was also one of the party on some of his father's shorter surveying expeditions, thus gaining knowledge that he was soon destined to put in practice.

He was sent to a private school in Kentucky, and, entering the Ohio University when that institution opened, received there the rudiments of a collegiate education. He was then transferred to Yale College, from which he was graduated in 1823. His father dying in the same year, he was obliged to give up the idea of studying a profession in order to take charge of the large family estate. The property consisted of lands, mills, etc., and demanded much and varied attention. The care of it required him to become a surveyor and a practical engineer, and to be much engaged in business for the greater part of his life. He became a member of the Ohio Stage Company, whose operations covered a wide field, and before the introduction of railroads afforded the best accommodations and facilities to the traveling public. He was one of the original stockholders and directors of the Clinton Bank, and for a time its president.

Mr. Sullivant was not one of those whose predilection for science appeared at an early age. He was nearly thirty years old, and his youngest brother, Joseph, was already somewhat proficient in botany, conchology, and ornithology, before his interest in natural history was aroused. He had married Miss Jane, daughter of Alexander K. Marshall, of Kentucky, and niece of Chief-Justice Marshall, and was living in his suburban residence in a rich floral district. His wife had died within a year after marriage, leaving him an infant daughter.

His first scientific observations were upon the birds. When his attention was directed to botany, by his brother Joseph, he took up the subject with the determination to acquire a thorough knowledge of it. "He collected and carefully studied," says Prof. Gray in the memoir already quoted from,* "the plants of the central part of Ohio, made neat sketches of the minuter parts of many of them, especially of the grasses and sedges, entered into communication with the leading botanists of the country, and in 1840 he published A Catalogue of Plants, Native or Naturalized, in the Vicinity of Columbus, Ohio (63 pages), to which he added a few pages of valuable notes. His only other direct publication in phanerogamous botany is a short article upon three new plants which he had discovered in that district, contributed to the American Journal of Science and Arts in the year 1842. The observations which he continued to make were communicated to his correspondents and friends, the authors of the Flora of North America, then in progress.

"As soon as the flowering plants of his district had ceased to afford him novelty, he turned to the mosses, in which he found abundant scientific occupation, of a kind well suited to his bent for patient and close observation, scrupulous accuracy, and nice discrimination. His first publication in his chosen department, the *Musci Alleghanienses,* was accompanied by the specimens themselves of mosses and *hepaticæ* collected in a botanical expedition through the Alleghany Mountains from Maryland to Georgia, in the summer of 1843, the writer of this notice being his companion. The specimens were not only critically determined, but exquisitely prepared and mounted, and with letterpress of great perfection; the whole forming two quarto volumes, which well deserve the encomium bestowed by Pritzel in his *Thesaurus.* It was not put on sale, but fifty copies were distributed

* Read before the National Academy of Sciences, April 22, 1875.

with a free hand among bryologists and others who would appreciate it.

"In 1846 Mr. Sullivant communicated to the American Academy the first part, and in 1849 the second part, of his Contributions to the Bryology and Hepaticology of North America, which appeared one in the third, the other in the fourth volume (new series) of the academy's Memoirs, each with five plates from the author's own admirable drawings. These plates were engraved at his own expense, and were generously given to the academy.

"When the second edition of Gray's Manual of the Botany of the Northern United States was in preparation, Mr. Sullivant was asked to contribute to it a compendious account of the *musci* and *hepaticæ* of the region, which he did, in the space of about one hundred pages, generously adding, at his sole charge, eight copperplates crowded with illustrations of the details of the genera; thus enhancing vastly the value of his friend's work, and laying a foundation for the general study of bryology in the United States, which then and thus began. So excellent are these illustrations, both in plan and execution, that Schimper, then the leading bryologist of the Old World, and a most competent judge, since he has published hundreds of figures in his *Bryologia Europæa*, not only adopted the same plan in his Synopsis of the European Mosses, but also the very figures themselves (a few of which were, however, originally his own), whenever they would serve his purpose, as was the case with most of them.

"A separate edition was published of this portion of the Manual under the title of The Musci and Hepaticæ of the United States East of the Mississippi River (New York, 1856, imperial octavo), upon thick paper, and with proof impressions directly from the copperplates. This exquisite volume was placed on sale at far less than its cost, and copies are now of great rarity and value. It was with regret that the author of the Manual omitted this cryptogamic portion from the ensuing editions, and only with the understanding that a separate *Species Muscorum*, or Manual for the Mosses of the whole United States, should replace it." This work Mr. Sullivant was about to prepare at the time of his death.

Mr. Sullivant married Miss Eliza G. Wheeler, of New York, a lady of rare accomplishments, who became a zealous and acute bryologist, and ably assisted her husband in his scientific work until her death, of cholera, in 1850 or 1851. Her botanical services were commemorated by Schimper in the name of the Ohio moss, *Hypnum Sullivantiæ*. Two daughters and a son were the fruit of this marriage.

In 1848 Mr. Sullivant secured the co-operation of the accomplished botanist Leo Lesquereux, by whose labors his undertakings were substantially promoted. A characteristic feature of his scientific work was the issuing of sets of specimens, mounted on leaves with printed labels, and bound into a volume having a title-page, index, etc. Specimens had accompanied Mr. Sullivant's text in the *Musci Alleghanienses,* and now, from the ample stores collected by him and Lesquereux, or otherwise acquired, fifty-six sets of about three hundred and sixty species each were made up, and all, except a few copies for gratuitous distribution, were placed on sale at less than cost, for the benefit of his esteemed associate. The title of the volume was Musci Boreali Americani quorum specimina exsiccati ediderunt W. S. Sullivant et L. Lesquereux; 1856. The value of the work insured the speedy sale of the edition. A similar but larger collection, containing between five and six hundred species, many of them recently gathered in California by Dr. Bolander, was issued in 1865. The sets were disposed of with the same unequaled liberality as before displayed. Still later, Mr. Sullivant aided his friend Mr. Austin both in the study of his material and in the publication of his *Musci Appalachiani.*

In his *Musci Cubenses,* which appeared in 1861, Mr. Sullivant named the species of Charles Wright's earlier acquisitions in Cuba and described the new ones. These mosses were also distributed in sets by the collector. His researches upon later and more extensive collections by Mr. Wright, in which many new species were indicated, were left in the form of notes and pencil sketches at his death. The same is true of an earlier collection, made by Fendler in Venezuela.

Mr. Sullivant was several times called upon to work up the mosses gathered by Government exploring expeditions. Thus the Bryology of Rodgers's United States North Pacific Exploring Expedition was early prepared for publication by him in the most elaborate manner. But, from causes over which he had no control, it has never been published, although brief characters of the principal new species have seen the light. The fact that Sullivant's exquisite drawings of these species were not promptly engraved and given to the scientific world is especially to be regretted.

In the case of the South Pacific Exploring Expedition, under Commodore Wilkes, the volume on the mosses was not published in his lifetime, but Mr. Sullivant issued a separate edition of his portion of it in 1859. It forms a sumptuous imperial folio, the letterpress having been made up into large pages, and printed on paper matching that used for the twenty-six plates. The fourth volume of the Pacific Railroad Reports contains Sullivant's descriptions of the mosses collected in Whipple's Exploration, occupying about a dozen pages, and accompanied by ten admirable plates of new species.

The *Icones Muscorum*, however, is Mr. Sullivant's crowning work. It was issued in 1864, and consists of "Figures and Descriptions of most of those Mosses peculiar to Eastern North America which have not been heretofore figured," forming an imperial octavo volume with one hundred and twenty-nine copperplates. "The letterpress and the plates," says Prof. Gray, "(upon which last alone several thousand dollars and immense pains were expended) are simply exquisite and wholly unrivaled; and the scientific character is acknowledged to be worthy of the setting." Most of the time which Mr. Sullivant could devote to science in the last few years of his life was given to the preparation of a second or supplementary volume of the *Icones*. The plates were finished, the descriptions partly written out, and it was to have been printed in the spring in which he died.

Mr. Sullivant was attacked with pneumonia in January, 1873, about the time of his seventieth birthday, and, although making a partial recovery, died from the effects of the disease on April 30th. He had married Caroline E. Sutton, who survived him. Four sons and two daughters were born to them.

He bequeathed all his bryological books and his exceedingly rich and important collections and preparations of mosses to the Gray Herbarium at Harvard University. The rest of his botanical library, his choice microscopes, and other collections, were left to the State Scientific and Agricultural College, then recently established at Columbus, and to the Starling Medical College, founded by his uncle, of which he was himself the senior trustee.

The American Academy of Arts and Sciences elected Mr. Sullivant to membership in 1845; he was also an associate of the other chief scientific societies of this country and of several in Europe. The honorary degree of Doctor of Laws was conferred upon him by Gambier College, while Torrey and Gray honored him early by bestowing the name *Sullivantia Ohionis* upon a rare and modest plant discovered by him in his native State, and belonging to the same order (saxifrages) with the currant, syringa, and hydrangea.

For nearly forty years Sullivant corresponded with Asa Gray, also collecting with him and co-operating in research whenever practicable. He is often mentioned in Gray's Letters. When Lesquereux, who had been Gray's curator at Cambridge, left him to go and assist the Western bryologist, Gray wrote in a letter to Torrey: "They will do up bryology at a great rate. Lesquereux says that the collection and library of Sullivant in muscology are '*magnifique, superbe*, the best he ever saw.'" Under date of December 6, 1857, Gray writes to W. J. Hooker: "Your first letter is now gone to Sullivant, because you speak of him so handsomely, and say that Mitten is instructed to prepare a set of mosses for him. A noble fellow is Sullivant, and deserves all you say of him and his works. The more you get to know of him the better you will like him." And when, in 1877, he gave to Mr. Burgess, since famous as a designer of yachts, a note of introduction to Charles Darwin, Gray wrote: "He has just married the daughter of my dear old friend the late Mr. Sullivant, who did for muscology in this country more than one man is likely ever to do again."

Prof. Gray said of him in the memoir already quoted, and which has supplied the facts for a large part of this article: "In personal appearance and carriage, no less than in all the traits of an unselfish and well-balanced character, Mr. Sullivant was a fine specimen of a man. He had excellent business talents, and was an exemplary citizen; he had a refined and sure taste, and was an accomplished draughtsman. But after having illustrated his earlier productions with his own pencil, he found that valuable time was to be gained by employing a trained artist. He discovered in Mr. A. Schrader a hopeful draughtsman, and he educated him to the work, with what excellent results the plates of the Icones and of his other works abundantly show. As an investigator he worked deliberately, slowly indeed and not continuously, but perseveringly. Having chosen his particular department, he gave himself undeviatingly to its advancement. His works have laid such a broad and complete foundation for the study of bryology in this country, and are of such recognized importance everywhere, that they must always be of classical authority; in fact, they are likely to remain for a long time unrivaled. Wherever mosses are studied his name will be honorably remembered; in this country it should long be remembered with peculiar gratitude."

The following extract from a letter written immediately after Sullivant's death to Mr. Joseph Sullivant by Leo Lesquereux will be interesting:

"In everything, as well you know, W. S. S. was most accurate. He was superficial in nothing. He worked his mosses slowly, coming again and again to a doubtful species, comparing authorities, repeating the most difficult anatomical preparations, till fully satisfied that his conclusions were warranted as far as botanical science could warrant them. The numerous species to which he has given his authority have therefore been admitted and recognized by the most eminent botanists of our time—Schimper, Müller, Lindberg, etc. More than ten years ago a very honorable account of his works as a bryologist was published in the *Botanische Zeitung* of Leipsic, which, for botany, is the highest European authority.

"Another remarkable trait of the character of your lamented brother was his perhaps too liberal disposition to work in science for the benefit of others, without credit for himself. Not only did he give his time to the determination of an immense number of specimens which were sent to him by students, or by so-called authors, etc., but often, without claiming his right of authority, he determined the species, prepared descriptions of the new ones, when he well knew that they would be published under the names of his applicants. He has thus fixed a far larger number than those which were published in his name. Even lately he examined a large collection of mosses in which his opinion was requested, prepared descriptions of new species, remarks on interesting ones, etc., and from this work a catalogue was made by the same applicant, the notes copied as well as his remarks, and thus the authorship was literally taken from him, and not even a word of credit was given for his work. Such absence of scientific honesty was not even resented by your brother, who merely alluded to it as a poor reward for hard work. A character as was his, without trace of envious or jealous feeling, marked by true kindness for everybody, by a ready disposition to acknowledge and help every effort for the advancement of his science of predilection, to recognize errors and to correct them without the slightest word of depreciation, could but excite admiration and love; and, indeed, your brother was truly and sincerely loved by the few who knew him well; for he was not open to everybody. A man of few words, he never talked of himself or his doings, and thus only those who had the privilege of being intimate with him would recognize his noble nature."

In a paper read at the recent International Geographical Congress, Mr. H. Yule Oldham, of the University of Cambridge, attached great value in the study of the history of geographical discovery to the mediæval manuscript maps or *portolani*. Usually made for practical purposes, by sailors, they were, as a rule, free from personal and political bias. A careful study of them gives valuable corroboration and often correction of information derived from ordinary documents. It was long customary to ascribe the discovery of the Madeiras and Azores to the fifteenth century, but they were found on maps of the fourteenth century. Similarly at a later period Cuba was shown to be an island at a time when, according to the ordinary historical documents, it was believed to be continental; and the Bermudas and other islands were shown on maps of earlier dates than those to which their discovery was ascribed. So often was cartographical information found to be ahead of historical records pointing to the results of otherwise unrecorded voyages, that additional interest and importance were lent to those maps which seemed to indicate the possibility of a pre-Columbian discovery of America.

PROFESSIONAL INSTITUTIONS.

XI.—PAINTER.

By HERBERT SPENCER.

PICTORIAL representation in its rudest forms not only precedes civilization but may be traced back to prehistoric man. The delineations of animals by incised lines on bones, discovered in the Dordogne and elsewhere, prove this. And certain wall-paintings found in caves variously distributed, show, in extant savage races or ancestors of them, some ability to represent things by lines and colors.

But if we pass over these stray facts, which lie out of relation to the development of pictorial art during civilization, and if we start with those beginnings of pictorial art which the uncivilized transmitted to the early civilized, we see that sculpture and painting were coeval. For, excluding as not pictorial that painting of the body by which savages try to make themselves feared or admired, we find painting first employed in completing the image of the dead man to be placed on his grave—a painting of the carved image such as served to make it a rude *simulacrum*. This was the first step in the evolution of painted figures of apotheosized chiefs and kings—painted statues of heroes and gods.

We shall the better appreciate this truth on remembering that the complete differentiation of sculpture from painting which now exists did not exist among early peoples. In ancient times all statues were colored: the aim being to produce something as like as possible to the being commemorated.

The already named images of dead New Zealand chiefs tattooed in imitation of their originals, illustrate primitive attempts to finish the representations of departed persons by surface-markings and colors; and the idols preserved in our museums—not painted only but with imitation eyes and teeth inserted—make clear this original union of the two arts.

Of evidence that the priests painted as well as carved these effigies, little is furnished by travelers. Bourke writes of the Apaches:—"All charms, idols, talismans, medicine hats, and other sacred regalia should be made, or at least blessed, by the medicine-men." But while the agency of the primitive priest in idol-painting must remain but partially proved, we get clear proof of priestly agency in the production of other colored representations of religious kinds. Describing certain pictographs in sand, Mr. Cushing says:—

"When, during my first sojourn with the Zuñi, I found this art practice in vogue among the tribal priest-magicians and members of cult societies, I named it dry or powder painting." The pictures produced "are supposed to be spiritually shadowed, so to say, or breathed upon by the gods or god-animals they represent, during the appealing incantations or calls of the rites. . . . Further light is thrown on this practice of the Zuñi in making use of these suppositively vivified paintings by their kindred practice of painting not only fetiches of stone, etc., and sometimes of larger idols, then of washing the paint off for use as above described, but also of *powder painting in relief;* that is, of modeling effigies in sand, sometimes huge in size, of hero or animal gods, sacramental mountains, etc., powder painting them in common with the rest of the pictures, and afterward removing the paint for medicinal or further ceremonial use."

But the clearest evidence is yielded by the Navajo Indians. Dr. Washington Matthews in a contribution on "The Mountain Chant, a Navajo Ceremony," says:—

"The men who do the greater part of the actual work of painting, under the guidance of the chanter, have been initiated [four times], but need not be skilled medicine men or even aspirants to the craft of the shaman. . . . The pictures are drawn according to an exact system. The shaman is frequently seen correcting the workmen and making them erase and revise their work. In certain well-defined instances the artist is allowed to indulge his individual fancy. This is the case with the gaudy embroidered pouches which the gods carry at the waist. Within reasonable bounds the artist may give his god just as handsome a pouch as he wishes. Some parts of the figures, on the other hand, are measured by palms and spans, and not a line of the sacred design can be varied." *

Unquestionably then pictorial art in its first stages was occupied with sacred subjects, and the priest, when not himself the executant, was the director of the executants.

The remains and records of early historic peoples yield evidences having like implications.

As shown already, there existed in America curious transitions between worshiping the actual dead man and worshiping an effigy

* Both great surprise and great satisfaction were given to me by these last sentences. When setting forth evidence furnished by the Egyptians, I was about to include a remembered statement (though unable to give the authority), that there are wall-paintings—I think in the tombs of the kings—where a superior is represented as correcting the drawings of subordinates, and was about to suggest that, judging from the intimate relation between the priesthood and the plastic arts, already iillustrated, this superior was probably a priest. And here I suddenly came upon a verifying fact supplied by a still earlier stage of culture: the priest is the director of pictorial representations when he is not the executant. Another important verification is yielded by these sentences. The essential parts of the representation are sacred in matter, and rigidly fixed in manner; but in certain non-essential, decorative parts the working artist is allowed play for his imagination. This tends to confirm the conclusion already drawn respecting Greek art. For while in a Greek temple the mode of representing the god was so fixed that change was sacrilege, the artist was allowed some scope in designing and executing the peripheral parts of the structure. He could exercise his imagination and skill on the sculptured figures of the pediment and metopes; and here his artistic genius developed.

of him—cases in which a figure was formed of portions of his body joined with artificial portions. The Nile Valley furnished other transitions. Concerning the Macrobrian Ethiopians, Herodotus tells the strange story that—

"When they have dried the body, either as the Egyptians do, or in some other way, they plaster it all over with gypsum, and paint it, making it as much as possible resemble real life; they then put round it a hollow column made of crystal."

And to this plastered, painted, and inclosed mummy they made offerings. The Egyptian usage diverged from this simply in the casing of the mummy and in the painting: the one being opaque and the other consequently external. For the carved and painted representation of a human figure on the outer mummy-case, was doubtless a conventionally-stereotyped representation of the occupant. And since, in all such cases, the ancestor-worship, now of private persons, now of major and minor potentates, was a religion, painting as thus employed was a religious art.

The leading subjects of Egyptian wall-paintings are worshiping and killing: the last being, indeed, but a form of the first; since pictures of victorious fights are either glorifications of the commemorated commanders or of the gods by whose aid they conquered, or both. In early societies sacrifice of enemies is religious sacrifice, as shown among the Hebrews by the behavior of Samuel to Agag. Hence the painting in these Egyptian frescoes is used for sacred purposes.

That in Ancient Egypt the priest was the primitive sculptor we have already seen; and the association of painting with sculpture was so close as to imply that he was also the primitive painter—either immediately or by proxy. For, seeing that, as Brugsch remarks, Egyptian art "is bound by fetters which the artist dared not loosen for fear of clashing with traditional directions and ancient usage," it results that the priests, being depositaries of the traditions, guided the hands of those who made painted representations when they did not themselves make them. But there is direct proof. Erman says:—"Under the Old Empire the high priest of Memphis was regarded as their chief, in fact he bore the title of 'chief leader of the artists,' and really exercised this office." In another passage describing the administration of the great temple of Amon he tells us that the Theban god had his own painters and his own sculptors; both being under the supervision of the second prophet. It may be that, as in the case of the Indians above named, these working painters had passed through some religious initiation and were semi-priestly.

In connection with this use of painting for sacred purposes in Egypt, I may add evidence furnished by an existing religion. Says Tennent concerning the Buddhists of Ceylon:—

"The labors of the sculptor and painter were combined in producing these images of Buddha, which are always colored in imitation of life, each tint of his complexion and hair being in religious conformity with divine authority, and the ceremony of 'painting of the eyes,' is always observed by devout Buddhists as a solemn festival."

It is interesting to remark that in its mural representations, Egypt shows us transitions from sculpture to painting, or, more strictly, from painted sculpture to painting proper. In the most sculpturesque kind the painted figures stood out from the general field and formed a bas-relief. In the intermediate kind, *relief-en-creux,* the surfaces of the painted figures did not rise above the general field, but their outlines were incised and their surfaces rendered convex. And then, finally, the incising and rounding being omitted, they became paintings.

By the Greeks also, painting was employed in making finished representations of the greater or smaller personages worshiped—now the statues in temples and now the figures on *stelæ* used to commemorate deceased relatives, which, cut out in relief, were, we may fairly infer, colored in common with other sculptured figures, just as were those on Etruscan sarcophagi. Of this inference there has recently been furnished a justification by the discovery of certain remains which, while they show the use of color in these memorials, show also the transition from raised colored figures to colored figures not raised. Explorations carried on in Cyprus by Mr. Arthur Smith, of the British Museum, have disclosed—

"a series of limestone stelæ or tombstones, on which is painted the figure of the person commemorated. The surface of the limestone is prepared with a white ground, on which the figure is painted in colors and in a manner which strongly recalls the frescoes of Pompeii."

The painting being here used in aid of ancestor-worship, is in that sense, religious. Very little evidence seems forthcoming concerning other early uses of painting among the Greeks. We read that before the Persian war, the application of painting "was almost limited to the decoration of sacred edifices, and a few other religious purposes, as coloring or imitating bas-reliefs, and in representations of religious rites on vases or otherwise." In harmony with this statement is the following from Winckelmann:—

"The reason of the slower growth of painting lies partly in the art itself, and partly in its use and application. Sculpture promoted the worship of the gods, and was in its turn promoted by it. But painting had no such advantage. It was, indeed, consecrated to the gods and temples; and some few of the latter, as that of Juno at Samos, were Pinacothecæ, or picture galleries; at Rome, likewise, paintings by the best masters were hung up in the temple of Peace, that is, in the upper rooms or arches. But paintings do not appear to have been, among the Greeks, an object of holy, undoubting reverence and adoration."

This relatively slow development of painting was due to its original subordination to sculpture. Independent development of it had scope only when by such steps as those above indicated it became separate; and, employed at first in temple-decoration, it gained this scope as sculpture did, in the ancillary and less sacred parts.

Partly because the Greek nature, and the relatively incoherent structure of the Greek nation, prevented the growth of an ecclesiastical hierarchy, with the normal developments arising from it, and partly—perhaps chiefly—because Greek civilization was in so large a measure influenced by the earlier civilizations adjacent to it, the further course of evolution in the art and practice of painting is broken. We can only say that the secularization became marked in the later stages of Grecian life. Though before the time of Zeuxis various painters had occupied themselves with such semi-secular subjects as battles and with other subjects completely secular, yet, generally executed as these were for the ancillary parts of temples, and being tinctured by that sentiment implied in the representation of great deeds achieved by ancestors, they still preserved traces of religious origin. This is, indeed, implied by the remark which Mr. Poynter quotes from Lucian, that Zeuxis cared not "to repeat the representations of gods, heroes, and battles, which were already hackneyed and familiar."

The first stages in the history of painting, and of those who practiced it, after the rise of Christianity, are confused by the influences of the pagan art at that time existing. It was only after this earliest Italian art, religious like other early art in nearly all its subjects, had been practically extinguished by barbarian invaders, that characteristic Christian art was initiated by introduction of the methods and usages which had been preserved and developed in Constantinople; and the art thus recommended, entirely devoted to sacred purposes, was entirely priestly in its executants. "From the monasteries of Constantinople, Thessalonica, and Mount Athos," says Mr. Poynter, "Greek artists and teachers passed into all the provinces of Southern Europe;" and thereafter, for a long period, the formal Byzantine style prevailed everywhere.

Of the scanty facts illustrating the subsequent relations between priest and painter in early Christian Europe, one is furnished by the ninth century.

Bogoris, the first Christian king of the Bulgarians, solicited the emperor Michael "for the services of a painter competent to decorate his palace," and the "emperor dispatched [the monk] Methodius to the Bulgarian Court."

The continuance of this connection is shown by the following passage from Eastlake's History:

"In the practice of the arts of design, as in the few refined pursuits which were cultivated or allowed during the darker ages, the monks were long independent of secular assistance. Not only the pictures, but the stained glass, the gold and silver chalices, the reliquaries, all that belonged to the decoration and service of the church, were designed, and sometimes entirely executed by them; and it was not till the thirteenth and fourteenth centuries, when the knowledge of the monastery began to be shared by the world at large, that painting in some degree emerged from this fostering though rigid tuition."

Along with the practice of painting went knowledge of the ancillary art, the preparation of colors. In a later passage Eastlake says:—

"Cennini, speaking of the mode of preparing a certain color, says that the receipt could easily be obtained, 'especially from the friars.'"

In another passage there is implied an early step in secularization.

"Colors and other materials, when not furnished by monks who retained the ancient habits of the cloister, were provided by the apothecary."

And further steps in the divergence of lay painters from clerical painters are implied by the statement of Laborde, quoted by Levasseur, to the effect that the illuminators of the thirteenth century had for the most part been monks, but that in the fourteenth and fifteenth laymen competed with them. Various painters in miniature and oil are mentioned. Painters continued to be illuminators as well; they also painted portraits and treated some sacred subjects.

Throughout early Christian art, devoted exclusively to sacred subjects, there was rigid adherence to authorized modes of representation, as in ancient pagan art—Egyptian or Greek. Over ecclesiastical paintings this control continued into the last century; as in Spain, where, under the title of *Pictor Christianus*, there was promulgated a sacro-pictorial law prescribing the composition of pictures in detail. Nay, such regulation continues still. M. Didron, who visited the churches and monasteries of Greece in 1839, says:—

"Ni le temps ni le lieu ne font rien à l'art grec; au XVIII^{e} siècle, le peintre moréote continue et calque le peintre vénitien du X^{e}, le peintre athonite du V^{e} ou VI^{e}. Le costume des personnages est partout et en tout temps le même, non-seulement pour la forme, mais pour la couleur, mais pour le dessin, mais jusque pour le nombre et l'épaisseur des plis. On ne saurait pousser plus loin l'exactitude traditionnelle, l'esclavage du passé."

And Sir Emerson Tennent, *à propos* of the parallelism between the rigid code conformed to by the monkish artists of the East and the code, equally rigid, conformed to by the Buddhists of Ceylon, quotes an illustrative incident concerning these priest-painters of Mount Athos, who manufacture pictures to pattern with "almost the rapidity of machinery." M. Didron wished to have a copy of the code of instructions "drawn up under ecclesiastical authority," but "the artist, when solicited by M. Didron to sell 'cette bible de son art,' naïvely refused, on the simple ground that 'en perdant son Guide, il perdait son art; il perdait ses yeux et ses mains.'"

Concerning later stages in the rise of the lay painter, it must suffice to say that from the time of Cimabue, who began to depart from the rigidly formal style of the priestly Byzantine artists, the lay element predominated. Amid a number of apparently non-clerical painters, only a few clerics are named; as Don Lorenzo, Fra Giovanni, Fra Philippo Lippi, Fra Bartolommeo. But meanwhile it is to be observed that these secular painters, probably at first, like the secular sculptors, assistants to the priests in their work, were occupied mainly and often exclusively with sacred subjects.

Along with this differentiation of the lay painter from the clerical painter there began a differentiation of lay painters from one another; and the facts show us a gradual beginning where imagination would have suggested only an abrupt beginning. As I learn from an academician, the first form of portrait (omitting some painted under a surviving classic influence in those earliest days before art was extinguished by the barbarians) was that of the donor of a sacred picture to a church or other ecclesiastical edifice, who was allowed to have himself represented in a corner of the picture on his knees with hands joined in supplication.

Something similar happened with another form of art. Landscapes made their first appearance as small and modest backgrounds to representations of sacred personages and incidents—backgrounds the composition of which displays an artificiality congruous with that of the figure-composition. In course of time this background assumed a greater importance, but still it long remained quite subordinate. After it had ceased to be a mere accompaniment, landscape-painting in its secularized form was but partially emancipated from figure-painting. When it grew into a recognized branch of art, the title "Landscape with figures," was still generally applicable; and down to our own day it has been thought needful to put in some living creatures. Only of late has landscape pure and simple, absolutely divorced from human life, become common.

Of course various classes and sub-classes of artists, broadly if not definitely marked off, are implied by these and other specialized kinds of paintings: some determined by the natures of the subjects treated and others by the natures of the materials used.

For form's sake it is requisite to say that here as always those units of a society who make themselves distinct by performing functions of a certain kind, presently, along with separation from the rest, begin to unite with one another. The specialized individuals form a specialized aggregate.

When in the Middle Ages the artists employed as assistants to priests for ecclesiastical decoration became a class, they grew into something like guilds. Levasseur, quoting Laborde, says they were hardly distinguished from artisans: like them they formed corporations under the name of *paintres, tailleurs d'ymaiges et voirriers.* In Italy during the fourteenth century a Brotherhood of Painters arose, which, taking for its patron St. Luke the Evangelist, had for its purpose, partly mutual instruction and partly mutual assistance and protection.

That in modern times the tendency to integration has been illustrated all know. It needs only further to remark that the growth of the chief art corporations has been followed by the growth of minor art corporations, some of them specialized by the kinds of art practiced; and also that embodiment of the profession is now aided by art periodicals, and especially by one, *The Artist,* devoted to professional culture and interests.

MENTION is made in Prof. Frederick Starr's Comparative Religion Notes, in the Biblical World, of the important place in the ceremonials of the Indian tribes of the Southwest occupied by curious pictures or mosaics made of sand. Different colored sands are procured by pounding up the various kinds of rocks. The designs are made by qualified persons, according to a prescribed method, after preparatory purification. Colors and designs are symbolical. In making them the sand taken in the hand is allowed to run out between the thumb and forefinger along the lines to be produced. The practice is found among various pueblo peoples and among the Navajos; and notice is made of similar observances among the Hindus and Parsees; and sand pictures are made as a street amusement in Japan.

THE London Spectator gathers from a number of letters it has received that "a great many cultivated people *like* their small superstitions. . . . Some dislike trusting their reason wholly, because, they think, that way agnosticism may lie; some feel in their superstitious beliefs an antiquarian charm, or relation to their forebears; while others appear to have the feeling that, if they cleared the superstitions wholly out, their mental scenery would be rendered base and marred by sameness. . . . They do not all put the question, but all we think are inclined to ask us, as one rather clever old lady has done, what harm the petty superstitions do? Why *not* throw salt over your shoulder if you spill it?"

Correspondence.

ALCOHOL AND CRIME.

Editor Popular Science Monthly:

SIR: Writing of Scientific Temperance and President Jordan's thoughtful article in your January issue, you say, "There is no denying that much the greater part of the crime and misery with which society is afflicted is caused by the use of alcohol in one form or another." May I be pardoned if I say that the proposition may *well* be denied; and may, even without much trouble or skill, be proved totally fallacious? And to prevent misunderstanding, permit me to say that I do not in this communication either advocate or condemn the use of alcoholic drinks: the question may well be left for a separate discussion.

Consider that, if much the greater part of crime and misery . . . is caused by the use of alcohol, it must follow as a corollary that, where alcohol is most used, there we shall find most crime and misery. *But experience teaches that this is not true.* Here in California, at least, and, I think, perhaps throughout the United States and elsewhere, the representative business and professional men, as a rule, use alcoholic beverages regularly, and in much greater quantity than can possibly be obtained by the poor—those most acquainted with misery and crime. I keep well within the bounds of truth in saying that a majority of merchants, lawyers, judges, and men of affairs, "politicians," legislators, and perhaps physicians, drink daily from two to four glasses of spirits; that many, and these not the least reputable and prosperous, drink double this quantity; and not a few, three or four times as much. Beer, in summer time especially, is drunk by great numbers of the active, efficient, well-behaved, and prosperous business and professional men, both American and German, from two to twenty and even more times a day; and these do not seem on an average to be disposed to crime, or to suffer what is called misery. Brewers, as a class of workingmen, are not more disposed to commit misdemeanors, not to say crimes, than others: and they appear to be far enough from misery; yet I am informed by credible people, who know whereof they affirm, that many, indeed most, of them drink daily from twenty to thirty and forty glasses of beer. I have not much personal acquaintance with Wall Street speculators and millionaires, or with their ways; but I conclude, from information and such glimpses into their lives as one occasionally catches, that few of them are abstainers from wine or the stuff called champagne, or from brandy, whisky, etc. If these as a class are criminals (and I for one do not say nay), at least theirs is not the crime, nor is such misery as they may perhaps suffer, the crime and misery of which you speak. I know personally some workingmen, reputable, even respectable, who drink *at home* from two to four gallons of whisky per month; of course, they are not brilliant members of society.

It is true, doubtless, that the money spent by such well-to-do people as I have mentioned does not bear so large a ratio to their incomes as does that spent by many mechanics and clerks and laborers; and therefore it does not impoverish the former as much as it does the latter. But the same is true of other expenses of "living," viz., those for dwellings, butcher meat, bread, clothing, and amusements; yet none of these things are considered to be causes of crime and misery. If it be true that the use of alcohol has any genetic connection with crime, then those who have served terms in the penitentiary, where alcohol is excluded from their diet, should after liberation be less disposed to crime than before; but experience traverses this conclusion.

The truth appears to be that, excluding from consideration people having organic proclivities crimeward, as Sir Thomas More hath it, there is no "punishment so horrible that it can keep them from stealing, which have no other craft [or opportunity] whereby to get their living"; and further, as he saith, "great and horrible punishments be appointed for thieves; whereas, much rather provision should have been made of some means whereby they might get their living, so that no man should be driven to this extreme necessity to steal; . . . for they that be thus destitute of service [opportunity to work] either starve for hunger or *manfully* (*sic*) play the thieves. For what would you have them to do? . . . what can they do but steal, . . . or else go about begging?" Evidently the author of Utopia saw no reason for blaming any particular article of diet or pleasure with the making of thieves or the causing of misery! It is a good rule, in scientific investigations, when you have discovered a sufficient cause for a particular phenomenon, there to rest your case.

GEORGE PYBURN.

SACRAMENTO, CAL., *January* 21, 1896.

[Not having space for the whole of our correspondent's letter, we print only that part of it which bears more or less directly on the point in dispute.

His contention, if we rightly interpret it, seems to come to this: Since a great many people drink who are neither criminals nor criminally inclined, and who can not fairly be included in the category of the miserable, it is not true that crime and misery are to any great extent chargeable to the use of alcohol. We said nothing about the number who drink, nor did we refer to the quantity of spirits or beer which may be taken with impunity by the individual or that may be distributed and consumed by the community at large, these considerations being in our opinion quite beside the question. The fact should be sufficiently obvious that the principal evil connected with the use of alcoholic liquors lies in that excess which is commonly known as drunkenness, the marked tendency toward which is one of the most characteristic features of the drinking habit.

Concerning the aggregate of crime and distress that is plainly traceable to this form of indulgence, there is in the absence of full statistics abundant room for a wide difference of opinion, ranging from an almost total disbelief in the vicious effects of alcohol, to an equally undiscriminating claim that it is at the bottom of most human ills. For ourselves, we are not in sympathy with either extreme. But when we see the papers, particularly of our large cities, containing daily numerous accounts of crimes of violence of all grades from simple assault to murder, committed in the frenzy of intoxication, it is useless to shut our eyes to the fact that alcohol is a most potent inciter to this form of crime. Add to this its acknowledged action in the causation of disease even among moderate drinkers, its debauching influence on the lower classes, the poverty that sooner or later is sure to overtake the victims of its immoderate use, and there can be little question that it is also a most important factor in the production of human misery.—Editor.]

Editor's Table.

THE NATURE OF LIBERTY.

TIME was when John Stuart Mill's little book on the subject of Liberty was thought rather advanced reading. It advocated individualism—the right of every man to think his own thoughts, utter his own views, and live his own life without unnecessary control or intimidation by law or public opinion. It was an attack on every form of bigotry and an earnest appeal to all that is best and most generous in human nature to assert itself and make the world richer and better by doing so. That idea of liberty, however, is to-day to many of our social reformers an outworn mode of thought, quite inadequate, they declare, to the needs of the present time. An eminent writer, Mr. W. D. Howells, has undertaken to enlighten us on the subject in a recent number of The Forum. Part of his article is very much on the lines of certain chapters in Mr. Spencer's Justice, but the rest strikes out from those lines at a wide angle.

Mr. Howells tells us that he was in Venice "during the last years of Austrian oppression," and was a witness of the earnest longings of the people for the liberty which they anticipated from union with Italy. With these longings he strongly sympathized, though his position being an official one, that of consul, he could not venture to express his sympathy openly. He says he had a suspicion that the people were expecting more from "liberty" than they were likely to get out of it; but he assumed that "by and by, when they had been free long enough," they would take the American view of the matter and be satisfied. "They would be able to vote for this one and against that one; to make their own laws or choose legislators to make them; to speak or to print anything they liked; to go and come without asking for a passport; and this would be sufficient, though it was not all they had expected of liberty. It did not," Mr. Howells goes on to confess, "then occur to me that the Venetians had a right to expect from a free state what they unconsciously and yet really expected—security from want and from the fear of want." Had such a notion been suggested to him, he adds, he would have laughed it to scorn.

Mr. Howells has lived to recognize that citizenship in a free country does not always make a man free. It is here that he agrees with Mr. Spencer. Political liberty, he says, "appears something final, absolute, a good in itself; but it is never a good in itself, and is never final; it is a means to something good." According to Mr. Spencer (Justice, Chapter XXII), the man's real rights are the right to live, or, as he more comprehensively expresses it, to "physical integrity," the right to freedom of movement, the right to receive and enjoy what he has earned, the right of free exchange, free contract and free industry, and, finally, the right of free belief, free worship, and free speech. Apart from these, any claims a man may have must, Mr. Spencer says, be of a different kind and "can not be classed as rights." As regards the franchise, all we can properly say of it is that it "gives the citizens in general powers of checking trespasses upon their rights"—powers, he adds, "which they may or may not use to good purpose." That they are not always used to good purpose is evidenced by the fact that, in more than one country where universal suffrage exists, real rights are trampled on. Our own country, we regret to say, is used by the author of the Synthetic Philosophy as an example. "Universal suffrage," he observes, "does not prevent the corruptions of municipal governments, which impose heavy taxes and do very inefficient work; does not prevent citizens from being coerced in their private lives by dictating what they shall not drink; does not prevent an enormous majority of consumers from being heavily taxed by a protective tariff for the benefit of a small minority of manufacturers and artisans; nay, does not even effectually preserve men from violent deaths, but in sundry States allows of frequent murders, checked only by law officers who are themselves liable to be shot in the performance of their duties."

When Mr. Howells, therefore, made the discovery that political liberty might not mean liberty in any very wide sense, he discovered a truth, and one of serious import; but when he went on and attached to the idea of liberty certain advantages which individual success in the carrying on of life alone can give, he went, in our opinion, very far astray, and formulated a doctrine essentially dangerous to the well-being of society. We really wonder how so broad and serious a thinker can bring himself to write as he does in the article to which we have referred. He says: "If the Venetians had agreed with Italy when they were united to it that thenceforward all should be guaranteed the means of livelihood, they would really have all freed themselves. If the French Revolution had established these conditions, the first republic would still be one and indivisible." The nature of liberty, then, according to Mr. Howells, is not alike for all men: to some it means the right to claim a livelihood from others, and to those others it means the obligation to provide the first with a livelihood. It would be interesting to see a document drawn up which should establish liberty in this sense of the word; and after it was drawn up it would be interesting to witness its execution. The visages of the guaranteed parties would, no doubt, betoken a considerable degree of relief and satisfaction at having life's problem so comfortably settled for them; but the guarantors might be pardoned if they were not in an equally jovial mood. Where liberty comes in for the latter is a question we are not prepared to answer. If it be explained that under such an agreement everybody would guarantee everybody, the answer, which every one must feel to be true and sufficient, is, briefly, that that is nonsense.

A man is a free man, Mr. Howells says, "if he has the means of livelihood and is assured in their possession; if he is independent of others." Other similar observations are: "Liberty and poverty are incompatible." "If (a man) has not the means of livelihood in his hands, he can not come and go when he will; he can not command his time, etc." "Liberty is for those who have the means of livelihood." Now, with the utmost respect for the motives of this very able writer, we are compelled to say that, in our opinion, he has here written some very mischievous stuff. By identifying liberty with the advantages which flow from a more or less successful conduct of life he virtually authorizes, so far as his words carry weight, those who have failed to secure such advantages, or who are not satisfied with the share they have gained, to lay violent hands on the possessions of others. It is deeply ingrained in the general consciousness that *liberty* is something which communities and individuals may vindicate for themselves—that liberty is not a thing to sue for, but to seize the moment you feel strong enough. Mr. Howells comes forward and says: "In wealth consists liberty. You have not wealth, and therefore you have not liberty; you are not free men. The only free men in this nation are the men of means, the men whose livelihood is secure." Surely this is warrant enough for those who accept it as true for taking, without more ado, the means of liberty; in other words, for overthrowing violently the present organization of society. Mr. Howells may say that he does not think much of the present order of society; but does he see his way clear beyond the chaos which would ensue if his hint were taken?

This is an old story; still, as the attacks on the true principle of liberty are unceasing, we do not see how the believers in that principle can do aught else than continually come forward in its defense. The important distinction to be observed is this: liberty is one thing; what a man can accomplish with his liberty is another. Some men can accomplish, and do accomplish, much; others, whether they can or not, do, in point of fact, accomplish little or nothing. It might not unreasonably be said that such men are not fit for liberty, and some of them prove it by getting themselves incarcerated for criminal practices. That, however, is another matter. Mr. Howells and others refuse to make this distinction; they say that liberty is not liberty unless you add thereto the fruits of a successful conduct of life, and that the community ought to guarantee these fruits to every man. We thus get the question into a nutshell. Mr. Howells and those who think with him must hold that the community could give such a guarantee and render it effectual; we hold that it could not, and there the argument must rest for to-day.

THE NEW NATURAL HISTORY.

Prof. C. Lloyd Morgan, of Bristol University, during January gave a course of public lectures in New York, under the auspices of Columbia College. The main question considered was, How far is it likely that the individual experiences of parents are transmitted to offspring? In discussing this question Prof. Morgan gave the results of some recent experiments by himself and his students. A chick of a common fowl, hatched in an incubator, was secluded from parental care, and found to be destitute of knowledge that water is good to drink. The little creature would wade in water, and only when it pecked its toes, and so incidentally thrust its bill in the water, did it fill its mouth and turn up its head in the familiar thirst-quenching attitude. Prof. Morgan inferred that it is only by imitating its mother or in imitating another chick that drinking is usually learned. Hence, as a chick is not left to its own ignorance in the matter, natural selection has never had a chance to eliminate birds through their not knowing how to drink. From the fact that the instinct to drink is not transmitted in perfection, Prof. Morgan argues that it is not the inheritance of experience acquired during the individual life, but the natural selection of favorable variations, that determines survival. However, in the case of the megapode of the Philippine Islands, which is hatched in a mound of vegetable matter without parental care. it must be that the chick is born with perfect instinct as to drinking.

Prof. Morgan found his chicks born with an instinct to peck—at no matter what—beads, pinheads were as enticing as grain. One experiment or two at most with a nauseous caterpillar proved enough for careful avoidance thereafter. Young bullfinches left to themselves were observed to pull primroses to pieces in an utterly random fashion; but some thirty trials taught them their work perfectly, so that they came as expertly as adult birds at the drop of sweet dew within the flower. Their intelligence did not create a new activity, but selected from a number of indeterminate acts the one act which was both useful and pleasant, the impulse, and the impulse only, being instinctive.

A London bird fancier, in a large way of business, was quoted by Prof. Morgan as finding that young linnets and thrushes brought up among various other birds, nevertheless sang true; young bullfinches, in the same circumstances, imitated their neighbors. A student of Prof. Morgan's secluded a young bullfinch from all opportunity of observing nests: its first nest was true in form, but not true in material, although the usual material could have been chosen by it; its second nest was true in both form and material. A cat taught by Prof. Morgan to retrieve did not transmit the talent to its family. There are on record three cases of dogs and one of a cat which did transmit to their offspring the capacity to "beg."

Prof. Morgan is to continue experiments the prime interest of which is in denoting that natural history has entered upon a new stage. Instead of merely repeating old observations of birds and beasts, instead of gathering their nests, eggs, and skins as thousands have done before, the naturalist, young or old, can easily carry forward experiments intended to throw light on unsettled questions of profound interest. He can observe how a bird varies its song or the building of its nest under circumstances which exclude the possibility of imitation. He can note the degree of domestication, very great in the case of the quail, possible with easily secured specimens of wild birds. He can ascertain whether "begging" or pointing taught a dog, and unknown before in its race, is transmitted to its puppies when these are secluded from all chance of instruction or imitation. The students who make natural selection the be-all and the end-all of evolution assume that it seizes upon favoring variations, even the slightest, as they appear. Whether these variations are indebted to parental experience directly transmitted is a question which only careful experiment can decide. The significance of the work when interpreted, the charm of coming upon results wholly new, must do much to extend interest in natural history. Often that interest comes early to a weary end in the dust of common-place and meaningless adding of shell to shell and butterfly to butterfly.

Scientific Literature.

SPECIAL BOOKS.

In these days when many wonders are being accomplished through electricity, and greater ones are constantly expected, it is interesting to glance backward into the times when the lodestone and the sulphur globe stood for all that was known about this mysterious form of energy. Such a glance is afforded us by Mr. *Park Benjamin's* * popular history of the advance of knowledge in this subject. Our author has ranged far and wide to gather his material. He has laid under contribution the works of those early philosophers who took all knowledge for their province, the Greek and Roman classics, the results of modern investigation into the old civilization of Phœnicia, Egypt, and even of people of prehistoric epochs, the Norse histories, the ancient writings of the Chinese and Arabs, the treatises of the fathers of the Church, the works of mediæval monks, magicians, cosmographers, and navigators, etc. The significance of the title he has chosen lies in the fact that he has aimed not so much to chronicle the laying of fact upon fact in the building of the present science of electricity as to show how the progress of the human intellect is indicated by the way in which it has grappled with and overcome the problems in this field that have successively presented themselves. He shows how mythology, which was the world's resource for explaining strange phenomena when the lodestone became known, gave way to philosophy, and how philosophy in turn yielded its sway to science. Who first discovered that a freely suspended magnet will point north and south our author does not undertake to say, but from a careful examination of the allusions to the use of the compass in Chinese writings, and a consideration of the Chinese character, he is convinced that it was not the Chinese. For several centuries the development of the compass was the only advance in the field of magnetism made by Arabs or Northmen or the peoples of western Europe. Roger Bacon made some interesting observations on the compass, but it appears that the French engineer, Peter Perigrinus, of whom Bacon speaks in glowing terms, made an experimental study of this instrument, which was far more fruitful than any earlier efforts. Among other things he revealed the law

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* The Intellectual Rise in Electricity. By Park Benjamin. Pp. 611, 8vo. New York: D. Appleton & Co. Price, $4.

that unlike magnetic poles mutually attract, he invented several forms of compass, including the first which could be constantly used to steer by as the modern mariner's compass is used, and he proposed the first magnetic (electric) motor. Columbus figures in Mr. Benjamin's history as discovering the line of no variation of the compass needle. After him comes Hartmann, who discovered the dip of the needle, then Sarpi, whom Galileo addresses as "my father and my master," Porta, Cardano, and other learned Italian physicians of the sixteenth century. These men prepared the way for the important advances made by Queen Elizabeth's physician William Gilbert, who is rightly regarded as the founder of the science of electricity, even if Francis Bacon could never appreciate his talents. The young science was fostered by Galileo and Descartes and von Guericke and the Abbé Nollet on the Continent, by Newton and Boyle and Hauksbee in England. Other men, also, less known to fame, were at work upon electrical problems during the same period. Gilbert's discoveries did not fail to raise up a swarm of charlatans, among whom Van Helmont and Kenelm Digby stand forth prominently. The history stops with Franklin's demonstration that lightning and electricity are identical. This, says Mr. Benjamin, "brings to culmination the long series of events whereby the single incomprehensible effect observed in the lodestone and the amber gradually grew into recognition as a world force, subject to universal law and pervading all Nature." The volume is tasteful as to its mechanical features, and is embellished by reproductions of many of the portraits and quaint engravings in the early books from which its material has been drawn.

Those who are desirous of improving the environment of the poor may obtain valuable guidance from the eighth special report of the United States Commissioner of Labor.* As would be expected, the greater part of the report is devoted to model dwellings, other matters receiving some consideration in the fore part of the volume. Dr. Gould tells what is being done to secure better housing for the poor in New York, the chief cities of Great Britain, and more briefly in western Europe, through building and sanitary laws, and municipal condemnation of insanitary houses. Sanitary aid societies have greatly furthered this end by co-operating with or spurring on the public authorities in their work. A form of private effort that has done much good is the rent-collecting agency of Miss Octavia Hill, in London. The method pursued by her and the assistants whom she has trained is both businesslike and philanthropic. She buys tenement houses with capital furnished by those interested in her work, and undertakes the collection of rents or the whole management of buildings for others, at fixed rates. She rewards prompt payments and proper use of the premises by making repairs and improvements in the buildings. The incorrigible are turned out, but by the use of tact the number of these is kept very small. The moral influence of her system has been to admit women to a greater extent into the management of housing companies. In his account of model buildings Dr. Gould takes up successively "block buildings" or flats, small houses, and lodging houses. He describes model block buildings in Brooklyn, New York, and Boston, and in large cities of Great Britain,

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* The Housing of the Working People. Prepared under the Direction of Carroll D. Wright, Commissioner of Labor, by E. R. L. Gould, Ph. D. Pp. 461, 8vo. Washington.

France, Germany, Holland, and Sweden. Views and plans of many of these buildings are given, which show that in securing convenient interiors neat and attractive exteriors have not been sacrificed. Nearly all of the groups of small houses described have been erected by large commercial corporations for their workpeople. Judging from the number of examples given here, France and Germany seem to lead in this sort of dwellings. In the United States examples are taken from Maine, Massachusetts, Connecticut, and Illinois. The model lodging houses described are confined to Baltimore and five British cities. The author of this report has given prominence to the financial returns from model houses, being convinced that there can be no permanent solution of the housing problem unless improved housing can be shown to pay. Moreover, for the sake of the self-respect in the persons benefited, which a wise philanthropy seeks to build up, such operations should be self-supporting. Model housing has a view to the morals as well as the health of the tenants, aiming to correct the abuse of adults and children of both sexes huddling into the same sleeping rooms. In cities rapid transit has an important influence on the housing problem. For the workingman's purposes space is measured by time, not by distance. Taking into consideration all the agencies that are now operating against unwholesome congestion, the outlook is decidedly hopeful.

There is much food for thought in the relation between man and the animals that he has trained to his service. The most obvious result of their association with him has been to promote most efficiently his ascendency over the actively hostile or inertly resistant features of his environment. This association, also, has greatly modified the numbers, distribution, and development of the domesticated animals, while the necessity of controlling and caring for his dependents has had its influence upon the intellectual growth of man himself. These considerations and others are suggested in the attractive volume on the *Domesticated Animals* * recently issued from the press of the Scribners. It is no dry and formal treatise that Prof. Shaler here presents, nor yet a string of more or less authentic "stories about animals." He has pursued a happy mean by giving facts not only interesting in themselves but having a bearing also upon those problems of the origin, evolution, and intelligence of animals with which science has long been engaged. The first place in the volume is given to the dog—the first of the lower animals to be domesticated. Prof. Shaler discusses the ancestry of domesticated dogs, the variations induced by civilization, the evils of specialized breeding, and the future development of the species. He describes the peculiarities of character exhibited in the principal breeds, and gives considerable attention to canine intelligence, especially with reference to the expression of emotions. The intelligence of dogs is also compared with that of other animals, and it is only in this comparison that cats figure in the book. The horse is described in much the same way as the dog. Briefer consideration is given to the beasts for burden, food, and raiment, among which camels, elephants, and pigs are included with the commoner kinds. There is an interesting chapter on barnyard and water fowl, pigeons, song birds, and falcons; the few useful insects are also duly

* Domesticated Animals. By Nathaniel Southgate Shaler. Pp. 267, 8vo. New York: Charles Scribner's Sons. Price, $2.50.

considered. Prof. Shaler takes up the question, which has appeared only in recent times, as to how far it is justifiable to inflict pain upon animals for the benefit of man, and seeks to reconcile the opposing views on this subject now current. He has something to say, also, on the general conditions of domestication, which indicate the possible future of the art. The volume is handsomely printed, and is bound and generously illustrated in the style of the day.

GENERAL NOTICES.

The lack of a trustworthy and complete work on dietetics * has long been felt among medical men in this country. The dietary of a patient is of no small importance in his treatment, and Dr. Thompson, appreciating this fact, seems to have adequately supplied the want referred to. Of the seventy odd chemical elements, thirteen regularly enter into the composition of the body, and ten more are occasionally found. Although these are comparatively few in number, their molecular arrangement is very complex. In Part I, after a study of these elements as they occur in food, the different foods and food preparations are taken up individually and studied from the various standpoints of the dietician: How much force can be obtained from them, how much heat, are they stimulating or depressing, are they difficult or easy to digest? etc. In Part II, the chemical composition of the common stimulants, beverages, and condiments is given, and then their effects upon body and mind are considered when used in moderation and in excess. The ultimate dangers which their habitual ingestion may lead to in the shape of permanent tissue change, and the special diatheses which absolutely contraindicate their use, are dwelt upon at some length. Cooking, the preservation of food, and the quantity of food required, are the topics dealt with in Part III. The changes which cooking and the various methods of preservation—salting, smoking, canning, etc.—produce in the chemical composition and digestibility of the food stuffs are studied carefully. This is one of the most important departments of dietetics, and yet one which is usually given little attention. Part IV deals with special dietaries for infancy, old age, diet and heredity, climate and season and food, body weight and food, etc. The physiology of digestion, and the conditions which specially affect it, are next considered. The chapter on the general relation of food to special diseases, and the diseases which are caused by dietetic errors, will prove of great value to the layman as well as the physician. Administration of Food to the Sick, Part VII, is also full of practical data for the nonmedical. Part VIII, which consists of about three hundred pages, and which forms the main portion of the book, is devoted to diet in special diseases. Each disease is first described in a general way, and then the appropriate diet for it worked out. This chapter is prefaced by some general remarks regarding the care of the sick-room and the patient. Many of the suggestions seem matters of little importance, but it is these small details that are most frequently disregarded, and that are oftentimes the deciding features in the case. Rations and dietaries are discussed in Part IX, army and navy diets, diet in prisons, in athletic training, the various diet "cures," diet and occupation, artificial infant foods, and sleep and food, being some of the special topics. An appendix containing receipts for the preparation of invalid foods and beverages, and the list of illustrations, finish up the eight hundred and two pages. Dr. Thompson's book should be on every physician's table, and as a part of the general household library it would not be out of place. A large portion of it bearing on hygienic questions, its possession might oftentimes prevent the necessity for calling a doctor, through the prevention of unhygienic feeding and the long train of ills which follow in its wake.

We have already noticed the first two half volumes of the noble work of the Pro-

* Practical Dietetics, with Special Reference to Diet in Disease. By Gilman Thompson, M. D. Pp. 802, 8vo. New York: D. Appleton & Co. Price, cloth, $5; sheep, $6.

fessor of Botany in the University of Vienna,* and have endeavored to speak of it as its merits deserve. The examination of the concluding volume only enhances our appreciation of its value, and, we might add, of its interest, for it has real interest, such that the unscientific or even the casual reader may find that it has a story to tell him. The introduction to the new parts comprises a brief review of the sources of a history of plants, showing how the description of the external characters of plants as given by Theophrastus and Pliny and the earlier modern writers gradually expanded into the study of the conditions of their growth, reproduction, and dissemination. Then came the discovery of fossil plants, leading to the extension of botany to the study of the ancestral history of existing flora and the derivation and development of species. This sketch outlines the order of presentation in these two half volumes, which follows the stages of development of the science. "A history of the entire plant world considered as a single great community must be preceded by a history of species. But each species is the sum of numberless individuals, which are alike in constitution and have the same external characteristics, and a history of species therefore presupposes a knowledge of the history of the individual. Accordingly, our first business is to describe rejuvenescence, multiplication, and distribution of individuals, and to show by what means a plant, considered as a separate organism, maintains itself, takes possession of its habitat and is enabled to keep its hold on that habitat, up to the moment when it is replaced by descendants endowed with a vitality of their own." The discussion of the Genesis of Plant Offspring relates to asexual reproduction by spores and thallidia, and by buds or roots, stems, and leaves; to reproduction by means of fruits, under which the process from the beginning and the office of the pollen, its protection, the means of its dispersion by wind and by animals, the agencies that attract animals, the crossing of flowers, and autogamy are described; and to changes in reproductive methods, including the replacement of fruits by offshoots, parthenogenesis, and heteromorphism and alternation of generations. The History of Species follows, comprising the nature, alteration in the form, origin, distribution, and extinction of species. The work is completed by a glossary of fourteen pages, and an index of fifty-nine closely printed pages.

* The Natural History of Plants. By Dr. Anton Kerner von Marilaun. Half volumes III and IV. Pp. 983, large 8vo. New York: Henry Holt & Co. Price, $7.50. London: Blackie & Son. Price, 25*s*. net.

*Nursery Ethics** is an attempt, and a very successful one, to deal with the big people of the nursery, and to outline the moral relations which ought to exist in this little kingdom between the governing powers and the governed. It is a word well and wisely spoken to mothers and to fathers. It is not formal enough to be called a system of morals. It might even be said to lack what Matthew Arnold is said to have lacked —"a philosophy with coherent, interdependent, subordinate, and derivative principles"— but we find it on this account more effective. Back of the running comment on nursery affairs there lie a consistency and thoroughness which indicate that Mrs. Winterburn has kept her fundamental ethical axioms well in mind, if not in type, and has done no violence to them. In this respect the little book is eminently philosophic. Its one aim is to secure justice for the little people. It is a modern and improved form of Mrs. Doasyouwouldbedoneby. Those whose sense of humor has been touched by Anstey and Frank Flockton, or whose sense of justice has been aroused by that too frequent sight, the abuse of parental authority, will readily admit that no rights are so sacred and inviolable as the rights of little children, because none are so absolutely defenseless. Such a crusade might easily tempt one to rhetorical extremes, but Mrs. Winterburn has shown the same self-restraint in dealing with her literary child that she so strongly recommends to other parents in dealing with their children of flesh and blood. The treatment is full of feeling: it is enriched with deep, womanly sentiment, but it is also calm and clear, and its suggestions have a definiteness which gives them practical value.

In considering the attitude of parents

* Nursery Ethics. By Florence Hull Winterburn. New York: The Merriam Company. Pp. 241, 12mo. Price, $1.

and the nature of their authority, *Nursery Ethics* shows very clearly what few parents evidently realize—that the only foundation for parental authority is the furtherance of childish welfare. This is the strict limit. Any further usurpation of authority is simple tyranny. Obedience to persons is also shown to be without moral sanction. But obedience to conditions imposed by events is a large part of the discipline of life. This is the sort of obedience we should teach our children, and with what graciousness we can teach it if we ourselves yield the same obedience! Above all, there should be no conflict of authority. No one detects this sooner than a child, or sooner takes advantage of it. The deepest moral lesson of the nursery comes, as elsewhere, from a recognition of the law of cause and effect. By associating natural results with action, and by adjusting punishments on the same ground, parents may early begin that judicious abdication of authority which is finally to lead to self-government and the evolution of truly moral beings. It is a point of profound wisdom to let this abdication keep always a step in advance of the child's demand for freedom. The chapters on special problems in nursery management deserve no less careful reading.

Mrs. Winterburn's book contains much to commend. We believe that every word of it is true. In style and outward dress it is also attractive. If the ethical principles which it so clearly develops could but find an application in the nurseries of America, the chief work of education would be accomplished at home, and the subsequent problems of school and college would be infinitely easier than they are at present. We wish the little book a most successful mission.

Since the general adoption of embryology and histology as a part of the regular medical curriculum, there has been a large accession of works on this subject to our literature—more, it almost seems, than the demand justifies. Many of them are translations, and a very large proportion are not at all suited to the elementary student. A certain amount of confusion is inevitable, because of the unsettled state of the subject, but the chief difficulty has been the lack of an impartial treatment—each author being interested in upholding one of the many theories, and subordinating everything else to this end. Dr. *Hertwig's* book * is fairly free from this fault, and seems to have been carefully arranged with reference to the student's needs. As the title indicates, it deals with cell physiology as well as anatomy. The book consists of nine chapters, with numerous subdivisions under each. Chapter I gives a general historical review of the cell theory, the protoplasmic theory, and the literature of the subject. The Chemico-physical and Morphological Properties of the Cell is the title of Chapter II. In the third, fourth, and fifth chapters the vital properties of the cell are discussed. These are followed by two chapters on The Vital Phenomena of the Cell. The title of Chapter VIII is Metabolic Changes occurring between Protoplasm, Nucleus, and Cell Products, and Chapter IX closes the book with a discussion of the cell as the elementary germ of an organism, embracing theories of heredity. The translation is well done despite the difficulties, which must have been considerable, as the editor says, in finding English equivalents for many of the German words. A good feature is the bibliography which is given after each chapter, thus enabling the student to readily follow out more in detail any special point which he may be curious about. The book is fairly well illustrated.

The last ten years have been marked, in botanical study, by numerous investigations upon the *Archegoniates*, as the ferns and mosses are collectively called from the peculiar character and resemblance of the organ in them corresponding with the pistil, and by the extension of our knowledge to many forms which were hitherto but very imperfectly known. But while the collected results of the earlier investigations prompted by Hofmeister's work have appeared for the most part only in text-books, where limitations of space prevented full justice being done to them, those of the later researches have only begun to find their way into the text-books. The author, who is Professor

* The Cell: Outlines of General Anatomy and Physiology. By Dr. Oscar Hertwig. Pp. 368, 12mo. London: Swan, Sonnenschein & Co. Price, 21*s*. New York: Macmillan & Co. Price, $3.

of Botany in Leland Stanford Junior University, has therefore undertaken the present work * mainly for the purpose of presenting, in somewhat detailed form, a summary of the substance of the great mass of literature upon the subject that has accumulated, much of which is out of reach of the botanical workers who have not access to the great libraries. Papers published by him from time to time have served as the basis of the work, and these have been supplemented by somewhat extended series of observations, the results of which are published now for the first time. The illustrations were, as a rule, made by the author from his own preparations, and most of them expressly for this work. A bibliography of fourteen pages and a full index make the work complete as a book.

Limited as is the district to which this volume of the work † is devoted, the southern tier of counties and the coast from the North Foreland to the Land's End, it presents an extraordinary variety of outline, soil, and climatic influences, and is hence of great interest to the climatologist and health-seeker. Each county is taken up separately. The general geological features and the surface configuration are first considered; then the climate, mortality statistics, and other facts bearing on the healthfulness of the more important towns; and finally a summing up of the diseases which are aggravated by and those benefited by a sojourn in this climate. For instance, "rheumatism prevails generally in Cornwall, which therefore is to be avoided by persons of rheumatic tendencies. The county as a whole presents influences, probably in the water, which are preventive of urinary stone and gravel." Devonshire, Somerset, Dorset, Hampshire, and the south-eastern counties are dealt with in detail, and valuable conclusions drawn from their physical and climatic peculiarities. The portion of the work on medicinal springs occupies the last hundred pages, and consists of a consideration of the chemical composition of each water and its probable effect on the body, especially with reference to diseased conditions. The book contains a great deal of interesting information, much of which was before inaccessible to the general reader and practitioner, and with the companion volume promised will undoubtedly take rank as a standard treatise.

The rapid advances which have occurred during the past decade in all the sciences have been nowhere more marked than in the department of surgery. They have made necessary the publication of a book of 1082 octavo pages * as a supplement to a work of six volumes which seven years ago was a complete and exhaustive treatise on surgery. In this volume the aim has been to obtain a digest of accepted and valuable facts; mere novelty and possible future value not being considered sufficient warrant for serious consideration. In carrying out the intention to make the volume a supplement to its predecessors, the authors of the several articles have so far as possible avoided repeating the contents of the previous work. Some topics were originally so elaborately treated as to now require but little discussion, while others —such, for instance, as brain surgery—which may almost be said to have come into existence during the past seven years, have called for more space than did the article in the main portion of the work.

Diseases of the Vascular System and Thyroid Gland † is Part IV of a very thorough and extensive treatise on modern medical practice. While the subjects treated in this volume are few in number, they are of great importance to the general practitioner. The first article, to which more than half the volume is devoted, is on the diseases of the heart and pericardium, and was written by Dr. James T. Whittaker, of Cincinnati. An interesting section of the paper is devoted

* The Structure and Development of Mosses and Ferns (Archegoniatæ). By Douglas Houghton Campbell. Pp. 544, 8vo. London and New York: Macmillan & Co. Price, $4.50; 14*s*.

† The Climates and Baths of Great Britain, being the Report of a Committee of the Royal Medical and Chirurgical Society of London. Vol. I. Pp. 640, 8vo. New York and London: Macmillan & Co. Price, $6.50; 21*s*.

* The International Text-Book of Surgery. Vol. VII. Edited by John Ashhurst. New York: William Wood & Co.

† Twentieth Century Practice and International Encyclopædia of Modern Medical Science. In twenty volumes. Edited by Thomas L. Stedman, M. D. Vol. IV, Diseases of the Vascular System and Thyroid Gland. Pp. 841, 8vo. New York: William Wood & Co.

to the neuroses of the heart, and the portion on valvular affections also deserves special mention. The next two articles, Diseases of the Blood-vessels, by Dr. A. Ernest Sansom, of London, and Diseases of the Lymphatic Vessels, by Dr. Bertrand Dawson, also of London, seem to be complete, and to bring the subject up to date. The closing article is one of especial interest, by Dr. George Murray on diseases of the thyroid gland, including myxœdema, cretinism, exophthalmic goitre, and goitre, as well as inflammation and neoplasms.

A Revision of the Deltoid Moths, by *John B. Smith*, forms Bulletin No. 48 of a series of Smithsonian publications which are intended to illustrate the collection constituting the National Museum. Under the general term deltoids there are usually grouped in lists, catalogues, and collections the moths of a series of species and genera which have a somewhat distinctive appearance and *habitus*, but for which we have as yet no exclusive characters. The home of the group is in that region extending from Maine through Canada, west to the Great Lakes, southward along the Mississippi, and eastward through Ohio along the southern boundary of Pennsylvania to the Atlantic coast. All the species fly at night and are readily attracted to light and sugar. The book is well made, but will only be of interest to the specialist. It is illustrated with fourteen plates.

The third edition of Mr. *Alfred Daniel's Text-book of the Principles of Physics* (Macmillan & Co., $4) has recently come to us. It maintains the characteristics of the previous editions, of clear statement and simple arrangement, and improves upon them in the correction of some minor errors which recent researches have brought to light, and in the adoption of a uniform notation, which will prove a great help to the student. Every equation is considered from the point of view of its dimensions, and this has necessitated the modification of some of the original text accordingly. The book is intended either as a preparation for the more valuable laboratory work of experimental physics or for those who have no access to a laboratory, and who must derive their physics entirely from book reading. Any one having a fair knowledge of mathematics ought to have no difficulty in following the text, which is illustrated wherever clearness is gained.

A valuable little text-book on *Alternating Currents*, by *E. J. Houston* and *A. E. Kennelly*, is the latest volume of the Electro-Technical Series to reach us. This subject of alternating currents is probably the most important and most difficult portion of modern electrical science. It is the department in which most of the advanced experimenters are working, and from which new and valuable results may at any time be expected. A very clear and simple explanation of the two forms of currents is first given, their differences explained and accounted for, and the means by which one may be transformed into the other described. The more important commercial applications of the alternating current in electric lamps and motors are then described in detail. Chapter XVII, which closes the book, discusses multiphase motors. (W. J. Johnston Co., N. Y.)

The *Fourteenth Annual Report of the United States Geological Survey*, for the years 1892–1893, consists of two volumes, the first of which contains the general reports of the director and heads of divisions. The second consists of a series of monographs on geology and related subjects. The first paper, by W J McGee, discusses the potable waters of the eastern United States. He first points out the large part which water takes in our dietaries, and the dangers which arise through its contamination; and then gives a general history of the methods which have been employed for storing and purifying it. In the next article A. C. Peale deals with the natural mineral waters of the United States. The different varieties are named and classified, and the paper is closed by an extended index of the mineral springs, arranged according to States. The Results of Stream Measurements is the title of the third paper, by F. H. Newell. The methods and special instruments by which the measurements are made are first described, and then the data resulting from their employment on various rivers are given. Besides these there are articles on the Laccolitic mountain groups of Colorado, Utah, and Arizona; The Gold-Silver Veins of Ophir, California; Geology of the Catoctin Belt; Tertiary Revolution in the Topography of the Pacific Coast; The Rocks of the Sierra Nevada; Pre-Cambrian Igneous Rocks of the Unkar Terrane, with notes on the petrographic character of the lavas; on the Structure of the Ridge between the Taconic and Green Mountain ranges in Vermont; The Structure of Monument Mountain in Great Barrington, Mass.; and The Potomac and Roaring Creek Coal Fields in West Virginia.

White's Outline Studies in the History of the United States (American Book Co., 30 cents) is an exercise book in which are printed questions which the pupil is to answer by writing or drawing in the blanks left for the purpose, or by marking localities on outline maps.

A volume of *Short Studies in Nature Knowledge* has been prepared by *William Gee* as an introduction to the science of physiography (Macmillan, 3*s.* 6*d.*, $1.10). The chief geographical topics are taken up in successive chapters, beginning with the Great Globe itself and following with Mountains, Valleys, and Great Plains, The Sea, Rivers and their Work, The Winds of Heaven, The Force and the Filigree of Frost, etc. In style and language the book is adapted to pupils of an advanced grade. It is purely descriptive, and while containing a great number of facts the text is always readable and is frequently adorned with poetical quotations. Over a hundred illustrations, a glossary, and an index add to the value of the book.

Dr. *Roger S. Tracy* has put the chief rules of sanitation into a compact and handy form in his *Handbook of Sanitary Information for Householders* (Appletons, 50 cents). Taking as the object of sanitary science to secure good air, good food, and good water, he tells first how proper ventilation is to be provided. His longest chapter is that on house drainage, which contains the rules of the Board of Health of New York city. There is a chapter on disinfection, supplemented by a list of the common disinfectants, with a brief description of each, and the average price at retail. With regard to foods he tells what adulterations are found in the chief articles of consumption and how they may be detected. Means of testing water and guarding against impurities in it are also given. An appendix contains a list of the materials needed for fitting up water-closets, with prices.

A second edition has appeared of *The Theory of Light*, by *Thomas Preston* (Macmillan & Co., 15*s.*, $5), which was noticed in this magazine in 1891. In the new edition the text has been revised and has been augmented by more than a hundred pages of new matter, in conjunction with which several new diagrams have been introduced. The changes occur chiefly in those portions which relate to the rectilinear propagation of light, wave reflection and refraction, and the application of graphic methods to the solution of diffraction problems. More detail has been introduced in some places, especially in the chapter on the velocity of light, where the experiments of Prof. Newcomb have been described.

The *Report of the Department of Health of the City of Chicago for 1894* is notable as covering the latter and more serious half of an epidemic of smallpox lasting from the middle of 1893 to the middle of 1894. By vigorous preventive and remedial measures—over a million free vaccinations being performed—the deaths were kept down to a total of 1,033. This gave a rate of 5·58 to each 10,000 of population against 16·74 in 1864, 17·80 in 1872, and 23·07 in 1882, which were epidemic years. The experience of the health officers in many difficult cases that they had to deal with are given. The report includes a description of the water supply of Chicago by the Commissioner of Health, Arthur R. Reynolds, M. D., the vital statistics of the city, and special reports on the municipal laboratory, on sanitary and meat inspection, on smoke nuisances, and free public baths.

The American Book Company has issued several simple German texts in board covers at 25 cents each. Three of them now before us are by *Seidel* and *Stifter*, two writers of the present century characterized by their naturalness of style. Each book contains about fifty pages of text and a twenty-page vocabulary. They are printed in the Schwabacher type, which is more open and hence more grateful to the eyes than the ordinary German print. In cheaper form and smaller are the Germania Texts, edited by A. W. Spanhoofd (10 cents each). They are designed to supply to advanced classes specimens of the less familiar German authors which have been accessible only in expensive volumes. Among the authors already or soon to be represented are Cholevius, Gervinus, Bürger, Kurz, Goethe, and Khull. The selections are printed in Roman type.

A system of abbreviations has been published by its inventor, Rev. *D. A. Quinn*, under the title *Stenotypy* (the author, 125 Governor Street, Providence; paper, $1; cloth, $1.50). It is designed as a substitute for shorthand, to be used on the typewriter, but there is nothing to prevent its being written with the pen or printed from type. The inventor claims that a hundred and twenty words a minute can be written in this system by an ordinary and three hundred words a minute by an expert typewriter operator, and that only a few hours are needed for learning it in place of the many weeks or months required for learning shorthand. He recommends it especially for use with the telegraph and for persons who read addresses from manuscript, as well as for all mercantile and newspaper work. The first line of Hamlet's soliloquy appears as follows in stenotypy: 2 B R nt 2 B T Z ' qst 6.

The *List of Books for Girls and Women* prepared by *Augusta H. Leypoldt* and *George Iles* (Library Bureau; cloth, $1; paper, 50 cents) brings helpfully together inquirers and authorities in the literature of art, science, and recreation. Its twenty-one hundred works have been chosen by specialists of mark, who add descriptive and critical notes of refreshing independence. Although the list is designed for girls and women, nine tenths of its titles and fully half its hints for clubs would serve boys and men very gainfully. The editors state that this list will probably be followed by others more detailed, the aim being to pass brief, competent judgments on the whole working literature of our time.

The *Sexuality of Nature*, by *L. H. Grindon* (Boston, Mass.: New-Church Union, 75 cents), attempts to prove that "Nature is a system of nuptials. Everything in creation partakes either of masculine or feminine qualities. Animals and plants, earth, air, water, color, heat, light, music, thought, speech, the sense of the beautiful, the adaptation of the soul for heaven—all exist as the offspring or products of a kind of marriage." Under the consideration of inorganic substances we find: "And again, by the marriage of oxygen and nitrogen, two gases invisible and innocuous, *nitric acid*, a yellow, ferocious liquid, is produced." The book is a novel one, and may interest the psychologist. Its science, however, seems rather uncertain, as the formation of a "ferocious liquid," nitric acid, by the "marriage" of oxygen and nitrogen, is something that has not as yet been successfully accomplished in the laboratory.

Pan-Gnosticism, by *Noel Winter* (Transatlantic Publishing Co.), is described on its title-page as "the outlines for a methodized course of thought, in which is submitted a proposition transfiguring the present ultimate conclusions of philosophy: and to the effect that inscrutability is a delusion; or, in other words, that the conditions necessary to absolute mystery involve an absurdity."

A volume of short passages in prose and verse—from two to five to a page—all relating to *Patriotic Citizenship*, has been prepared by *Thomas J. Morgan* (American Book Co., $1). The matter is carefully arranged on a plan intended to stimulate an intelligent patriotism. A large number of authors and speakers, mostly American, has been drawn upon, ranging in time from Edmund Burke and Patrick Henry to persons now prominent in literature and affairs. An appropriate illustration stands at the head of each chapter.

A collection of *Readings and Recitations for Jewish Homes and Schools*, made by *Isabel E. Cohen*, has been issued by The Jewish Publication Society of America, Philadelphia. The selections are mostly poems dealing with episodes in Hebrew history and legend, and are drawn from the works of the best English and American writers. Among the names oftenest appearing are Byron, Disraeli, Emma Lazarus, Longfellow, Charles Reade, and Whittier.

Results of Primary Triangulation, by *H. Gannett*, is the title of Bulletin No. 122 of the United States Geological Survey. The triangulation of the survey is executed solely for the primary control of topographic work upon scales not exceeding 1 : 62,500. The extreme of accuracy is not therefore sought, but only such a degree as to insure that the maximum accumulated error will be imperceptible upon the maps. The results are arranged in chapters by geographical groups, and as an introduction to each chapter there is given a description of the work, outlining the methods employed and instruments used. The groups into which the work is divided are roughly as follows: New England, the Middle Atlantic States, the Southern Appalachian Region, some of the North Middle States, the Black Hills of South Dakota, Aspen, Colorado, and portions of California, the plateau region of New Mexico and Arizona, Texas, Wyoming, Montana, Idaho, and Kansas. There are a number of triangulation maps which illustrate the work done in the various groups.

The second volume of Prof. *Wiley's Principles and Practice of Agricultural Analysis* (Chemical Publishing Company, Easton, Pa., $2) is devoted to fertilizers. In the first three divisions the determination of phosphoric acid, nitrogen, and potash is described, the official methods and a number of other processes being given in each case. The fourth and concluding part is devoted to the examination of miscellaneous fertilizers, some of mineral and others of organic origin. The general principles of fertilizer manufacture and application have been presented, in so far as they seemed to the author to throw light on the rational method of examination and analysis. A list of authorities cited is given at the end of each division of the volume, and there are seventeen figures of apparatus.

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Fragments of Science.

Three Blind Deaf-mutes.—Three blind deaf-mutes whose faculties have been developed from a completely latent condition are subjects of special notice in the report of the Perkins Institution for the Blind, Boston. Edith Thomas is described as furnishing convincing testimony to the efficacy of the system which is pursued in training such children. She has a good share of common sense, but is a little averse to intellectual exertion. Yet she is improving fast, gaining knowledge regularly and systematically, and is "steadily becoming more skillful, attentive, thoughtful, logical, and earnest, and the stream of her thoughts grows broader, deeper, and richer." She is fond of letter-writing, and does it with increasing facility of expression; while her letters show that she appreciates the pleasures of life, and despite her privations enjoys them highly. She likes reading and being read to, but wants her books true to life, and will not listen to fairy or highly imaginative stories. She is able to appreciate the rhythm of poetry, and Whittier and Tennyson are among her favorites. She dislikes arithmetic and is backward in it, but is proficient in geography. She has learned to mold maps in clay, and is able to repeat accurately the details of the surface of the regions she has studied. At the school commencement of 1894 she modeled the map of Massachusetts, divided it into counties in the presence of the audience, and pointed out the natural features and the towns with her left hand, while with her right hand she spelled the names into the hand of a blind classmate, who announced them. She has become a skillful dolls' dressmaker without the aid of patterns, and in teaching the use of the Braille typewriter to her companions she has exhibited the qualities of a strict disciplinarian. Willie Elizabeth Robin, now ten years old, came to the institution four years ago, totally blind and deaf, and ignorant of language. She has become proficient in reading, writing, elementary zoölogy, articulation, and knitting and sewing by the Sloyd method. She has even learned to use her tongue rather than talk with her fingers. She is specially interested in studying animal forms, and searches out the minute details of their structure. She is expected to tell all she can discover of each specimen given her; to represent it in clay; and afterward to write down what she has learned.

Of a crayfish studied thus, she reported: "It has eight arms and two legs and a tail and two eyes, it has an body, it lives in the water. The body is hard and the arms and the legs are not strong, they are soft." Tommy Stringer came to the kindergarten department feeble, inert, exhibiting few signs of intelligence, and seemingly devoid of most of the impulses of children. He is now full of eager curiosity concerning the world about him, enjoys life, and is bright, affectionate, and extremely fond of fun. He is at the head of his class in some of his studies. He is remarkably interested in matters of housekeeping and domestic economy. He has a strong bent toward zoölogical study. In a talk about fish his attention was drawn to the backbone. He felt it carefully from end to end, and then passed his fingers up and down his own backbone to show the correspondence. "On discovering the eyes, mouth, nostrils, etc., of the frog, he pointed to similar features of his own; and when he found joints in the frog's hind legs, he immediately began looking for the joints of his own body and found nearly all." No seeing boy's portrait is more animated in expression than his.

Glaciation in High Latitudes.—In his Glacial Studies of Greenland, Mr. T. C. Chamberlin regards the effect of latitude on glaciation merely in the light of such results as may be attributed to the constancy of the sun above or below the horizon, the low angle of incidence of its rays, their impact from all points of the compass, and similar features. A partial means of determining what these are is found by comparison between the glaciers of Disco Island, only a little within the Arctic Circle, and those of Inglefield Gulf, eight and a half degrees farther north. The Disco glaciers seem to have all the familiar characteristics of glaciers south of the Arctic Circle, while the Inglefield glaciers take on habits significant of their high latitude. The feature which is likely first to impress the observer on reaching the glaciers of the north is the verticality of their walls. Southern glaciers terminate in curving slopes, and the Disco glaciers have the same habit; but the margins of the Inglefield glaciers rise abruptly like an escarpment of rock, a hundred or a hundred and fifty feet or more. The layers of ice are cut sharp across, exposing their edges. This, however, is not quite universal, as sloping forms occur here and there. Occasionally a glacier presents both aspects. These abrupt terminal walls turn toward all points of the compass. Next to verticality, the most impressive feature is the pronounced stratification of the ice, which is vastly more evident than in ordinary glaciers. The ice is almost as distinctly bedded and laminated as are sedimentary rocks. The movement of these glaciers is in most cases exceedingly slow, and many of the ordinary signs of movement are absent; but a few glaciers at the head of the gulf which produce large icebergs are notable exceptions to the rule. Several of the glaciers observed show evidence of retreat. One was seen overriding its terminal moraine in one portion and retreating within it at another, a fact indicating that it had been stationary for a considerable period. The combination of various evidences leads the author to regard the inference as unavoidable that the ice in Greenland, on its western slope at least, has never in recent geological times advanced very greatly beyond its present border. "This," Mr. Chamberlin adds, "carries with it the dismissal of the hypothesis that the glaciation of our mainland had its source in Greenland."

Indians of Piedmont Virginia.—The earliest accounts of the Indians of the Piedmont region of the South Atlantic States are given by Lederer, who explored the country in 1670, and Beverley. According to Beverley, as quoted by Mr. James Mooney in his paper on the Siouan Tribes of the East, each Virginian tribe had a particular tribal mark—such as one, two, or three arrows arranged to point upward, downward, or sidewise—painted on the shoulders, by which its members could be distinguished when away from home. The Virginia Assembly found these marks useful in the recognition of friends, and had badges made and distributed among the tribes, without which no Indian was allowed to come to the settlement. For counting, these Indians used pebbles or bundles of short reeds or straws. Heaps of stones indicated the number of persons killed on a battle ground or of emigrants to some distant region. Time was measured and a rude chronology was arranged by means of strings of leather with knots of various colors, very much as in Peru. This system proved so convenient in dealing with the Indians that it was adopted for the purpose by a governor of South Carolina. At certain ceremonies reeds or straws were arranged in a particular order, and left thus in place after the ceremony, as a record of the character of the performance there enacted. They were never disturbed, as it was deemed a sacrilege to interfere with them. Their pictograph system is described as having been capable of symbolizing mental qualities as well as spiritual things. The English were symbolized under the figure of a swan, on account of their white complexion and their power of flight across the sea. Their traditional history was delivered in the form of long narratives from the fathers to the children, who were obliged to learn them by heart. Among the Saponies fire was made by rubbing together two dry sticks of prepared wood, a process that required about ten minutes. On the occasion of any religious ceremony a new fire was made from two sticks which had never been used before. A strong thread was made from the fiber of a kind of "silk grass," with which baskets were woven and the aprons that formed the chief part of a woman's dress. Spoons were made of buffalo horn, and the Indians believed that these spoons would split and fall to pieces if poison was put into them. It was believed that venison and turkey must never be cooked together, under penalty of provoking the anger of the hunting gods.

Systematic Archæologic Work in Iowa.—A definite plan of research upon the archæology of Iowa was formulated several years ago by Prof. Frederick Starr. It embraced the preparation of a bibliography and of a summary, from which those interested may learn what has been done, the organization of exploration in every part of the State, publication of a report on such exploration and of a map showing the places where relics, etc., have been found, and finally the preparation of sets of illustrations and models of specimens, mounds, etc., to be distributed to schools, colleges, and scientific and historical societies within the State. The Davenport Academy of Natural Sciences has published the bibliography and the summary, both prepared by Prof. Starr. The latter is a brief description of the finds that have been made from time to time, arranged alphabetically by counties, and accompanied by a number of small maps and other cuts. By a wide distribution of this publication through the State of Iowa it is hoped that a body of helpers and coworkers may be raised up to work under direction toward definite ends.

M. Trouve's Acetylene Lamp.—Through the accidental discovery, in the electric furnace, of carbide of calcium, there has appeared a new lighting gas, acetylene. Up to this time the gas (C_2H_2) had been simply a laboratory product, discovered by Davy in 1836. It was found, however, that when calcium carbide, a peculiar spongy material, was plunged into water, acetylene was given off in abundance. It burns with a steady snow-white flame of great brilliancy and high candle power. M. Trouvé, says La Nature, has recently invented a practical lamp for generating and burning acetylene. The reservoir of the lamp is of glass and contains a metallic box in which is placed the calcium carbide. This box is connected with a stopcock, leading to a small gas burner which projects from the top of the reservoir, and is so arranged that as the water in the reservoir is allowed to enter and act on the calcium carbide, acetylene is generated and passes out to the burner where it may be ignited. The admission of water to the calcium carbide has to be carefully regulated, so as not to cause a too rapid evolution of the gas. The lamp resembles an ordinary drop light in appearance, and may be made in a variety of forms, lending itself readily to decorative purposes.

Ice Saws for Opening Navigation.—It is stated in the Journal of the Society of Arts, on the authority of the United States consul at Ghent, that a successful ice-sawing apparatus, by which bodies of fresh water may be kept open for navigation in the winter, is in use on the river Scheldt at Antwerp. It consists of a strongly built boat with rounded sides, carrying a small portable steam engine. At the bow a movable framework which may be raised or lowered at will carries the axes of two circular saws; these latter are operated by power from the portable engine. The boat itself is moved by means of a rope run over a windlass, the loose end of the rope being attached to an anchor fixed in the ice at a distance in front of the boat, and in the direction to be taken. The framework containing the saws is placed at a suitable height, according to the thickness of the ice, and the saws are set in motion. Being separated from each other by a distance of about five yards, they cut out a band of ice which the boat breaks into fragments by its forward movement. By reason of its form it causes these fragments to scatter before it—that is to say, to disappear on the right and on the left under the ice remaining in place. Through ice two inches thick this machine forced a passage at the rate of twenty feet per minute. In eight-inch ice the advance was about one third of a mile per day.

The Cost of an Epidemic.—In a recent number of the British Medical Journal, Dr. Munro gives the following interesting statistics: In the course of an epidemic of enteric fever in 1893 there occurred eight hundred and fifty-nine cases, and seventy-four people lost their lives. The loss in wages was $16,455; the cost of treatment was $21,475; funeral expenses, $1,850. Adopting Farr's estimate of the average value of an individual as a wage-earner, $795, we have for the seventy-four deaths the large sum of $58,830. So that the pecuniary loss to the community, arising in connection with the epidemic, amounted to a total of $98,610. A consideration of these figures, says Dr. Munro, might well suggest the reflection whether any investment was calculated to yield a better pecuniary return than the expenditure involved in the operations of the Public Health Department, which has for its main object the prevention of epidemics.

In the Frankincense Country.—Near Cape Risut, on the coast of Arabia, Mr. Theodore Bent, in his exploration of the frankincense country, found the trees covering a large tract. They have bright green leaves like those of the ash, small green flowers, and insignificant fruit. Frankincense was the old staple of trade in this district, and it is still gathered in three places in the Gara Mountains, and is classified in three qualities. It is only collected in hot weather, before the rains begin, in March, April, and May, for during the rains the trails in the Gara Mountains are impassable. The collectors cut the stem, and after seven days return to collect the gum which has exuded. This they do three or four times a month. In the cool weather, as the gum comes down slowly, they leave the trees alone. The trees belong to the various families of the Gara tribe, each of them being marked and known to its owner. The product is sold wholesale to traders who come after it. This odoriferous gum was much more prized for temple worship and household consumption than it is now, and so precious was it that the old Sabæan merchants invented marvelous stories of genii and dragons guarding the trees and of the woods exhaling deadly odors, in order to protect them from too curious and enterprising trespassers.

Seebohm the Ornithologist.—The science of ornithology has sustained a severe loss in the death of Mr. Henry Seebohm, which took place at his home in London, November 26, 1895. From a brief biographical sketch in the London Spectator we take the following: Coming of an old Quaker family, and from childhood an enthusiastic observer and collector, when he later in life became a large steel manufacturer at Sheffield, he still found time to make numerous excursions to foreign lands, in order to see for himself the English migratory birds in their temporary homes. His History of British Birds and their Eggs is one of the best works of its class. Among the many trips which he took to clear up some question of migration or habitat, the one which led to his discovery of the north coast tundras as the great breeding ground for a large class of European birds is one of the most interesting. In looking for the breeding place of several English birds which regularly disappeared every spring, no one knew whither, he was led to visit the Petchora River, which flows from the Ural Mountains northward and falls into the Arctic Ocean opposite Novaya Zembla. On the upper river is the great Siberian forest, while lower down on either bank below the limit of trees is the tundra, which fringes the whole length of the northern coast. It is called the region of treeless swamp, is uninhabited, and for eight months out of the twelve is covered with snow. Yet he found this to be the unknown land which drains the Old World of half its bird population every spring. At the beginning of April Mr. Seebohm reached Ust Zylma, three hundred miles from the mouth of the Petchora. The surface of the river was frozen as far as the eye could reach, and the frozen forest was as bare of life as the Desert of Sahara. Suddenly summer came, and with it the birds arrived. The ice on the river split and disappeared, the banks steamed in the sun, and innumerable birds of all sizes and colors appeared within forty-eight hours after the first warmth. The tundra was found to be a moor, with here and there a large, flat bog and numerous lakes. It was covered with moss, lichens, heathlike plants, dwarf birch, and millions of acres of cloudberries, cranberries, and crowberries. Forced by the perpetual sunshine of the arctic summer, these latter bear enormous crops of fruit. But the crop is not ripe until the middle or end of the arctic summer, and if the fruit-eating birds had to wait until it was ripe they would starve. But each year the snow descends on this immense crop of ripe fruit before the birds have time to gather it. It is perfectly preserved by this natural system of cold storage until the next spring, when the melting of the snow discloses the bushes with the unconsumed last year's crop hanging on them or lying ready to be eaten on the ground. It never decays, and is accessible the moment the snow melts. The same heats which free the fruits bring into being the most prolific insect life in the world. No European can live there without a veil after the snow melts. Thus the insect-eating birds are provided for. The trip to the Petchora was but one of many similar expeditions which Mr. Seebohm undertook from a pure love of and interest in his science.

The Negro Problem.—Mr. J. L. M. Curry, Secretary of the Board of Trustees of the John F. Slater Fund, has written an interesting pamphlet on The Negro Problem in the South, in which, among other things, he discusses the influence of education on the negro since the war. He says in substance: More than a generation has passed since slavery ceased in the United States. Despite some formidable obstacles, the negroes have been favored beyond any other race known in the history of mankind. Freedom, citizenship, suffrage, civil and political rights, educational opportunities and religious privileges, every method and function of civilization have been secured and fostered by Federal and State governments, ecclesiastical organizations, munificent individual benefactions, and yet the results have not been on the whole such as to inspire most sanguine expectations or justify conclusions of rapid development or of racial equality. Much of the aid lavished upon the negro has been misapplied charity, and, like much other almsgiving, hurtful to the recipient. Schools which were established without any serious need of them have been helped; public-school systems, upon which the great mass of children, white and colored, must rely for their education, have been underrated and injured, and schools of real merit and doing good work, which deserve confidence and contributions, have had assistance legitimately their due diverted into improper channels. A very promising sign, however, is the long-wished-for industrial development which seems to be dawning on the South. Whatever may be our speculative opinions as to the progress and development of which the negro may be ultimately capable, there can hardly be a well-grounded opposition to the opinion that the hope for the race in the South is to be found not so much in the high courses of university instruction or in schools of technology as in handicraft instruction. This instruction, by whatever name called, encourages us in its results to continued and liberal effort. What such schools as Hampton, the Spelman, Claflin, Tuskegee, Tongaloo, and others have done is the demonstration of the feasibility and the value of industrial and manual training. The general instruction heretofore given in the schools, it is feared, has been too exclusively intellectual, too little of that kind which produces intelligent and skilled workmen, and therefore not thoroughly adapted to racial development nor to fitting for the practical duties of life. That the two diverse races now in the South can ever permanently harmonize while occupying the same territory, no one competent to form an opinion believes. That the presence in the same country of two distinctly marked races having the same rights and privileges, of unequal capacities of development—one long habituated to servitude, deprived of all power of initiative, of all high ideal, without patriotism beyond a mere weak attachment—is to be regarded as a blessing, is too absurd a proposition for serious consideration.

Respirability of Vitiated Air.—The breathing of air in which a candle flame will not burn is generally considered dangerous. In a paper by Mr. Frank Cloues, read before the British Association, at the Ipswich meeting, the results of some interesting experiments were given. It was found that the flames of ordinary candles and lamps were extinguished by mixtures which contained, on an average, about 16·5 per cent of oxygen and 83·5 per cent of the extinctive gases. A flame of coal-gas, however, required for its extinction a mixture still poorer in oxygen and containing 11·3 per cent of oxygen and 88·7 per cent of the extinctive gases. These results have since been confirmed by a different method, which consisted in allowing a flame to burn in air inclosed over mercury until it was extinguished; the remaining extinctive atmosphere was then subjected to analysis, when its composition was found to be practically identical with that previously obtained from the artificial mixtures. An analysis of air expired from the lungs proved that it was also of the same composition as that which extinguished the flame of an ordinary candle or lamp. The average composition of expired air and of air which extinguishes a candle flame is as follows: Oxygen, 15·9; nitrogen, 80·4; carbon dioxide, 3·7. Now, an atmosphere of this composition is undoubtedly respirable. Physiologists state that air may be breathed until its oxygen is reduced to ten per cent. The maximum amount of carbon dioxide which may be present is open to question, but it is undoubtedly considerably higher than three per cent. Dr. Haldane maintains that the above atmosphere is not only respirable, but would be breathed by a healthy person without inconvenience of any kind; he further states that no permanent injury would result from breathing such an atmosphere for some time. The conclusion to be drawn from these facts is that an atmosphere must not be considered dangerous and irrespirable because the flame of an ordinary candle or oil lamp is extinguished by it. The popular notion about such an atmosphere might often deter one from doing duty of a humane or necessary character.

Death of Hoppe-Seyler.—Ernest Felix Immanuel Hoppe-Seyler (his name was Hoppe; he changed it to Hoppe-Seyler in 1862) was born in Freiburg, on the Umstrut, Saxony, on December 26, 1825. At eleven he had lost both father and mother. He was taken in charge and educated by the governing body of an endowed institution in Halle. Beginning the study of natural science in 1846, he received the degree of Doctor of Medicine in 1850, and began practicing in Berlin. In 1856 he was appointed prosector in the University of Greifswald, and in 1858 was called to Berlin to act as Virchow's assistant; three years later he was called to the chair of applied chemistry in the University of Tübingen, and in 1872 was appointed to the only ordinary professorship of physiological chemistry in the German Empire, at the Kaiser Wilhelm Universität at Strasburg. Here he worked until the very eve of his death. He died on the forenoon of August 10, 1895. In 1857, while at Berlin, he published the first paper in a long series of valuable contributions to the physiological chemistry of the blood. In 1858 appeared the first edition of his Handbook of Physiologico-Chemical and Pathologico-Chemical Analysis. In 1862 he published one of his most valuable papers, On the Behavior of the Blood-coloring Matter in the Spectrum of Sunlight. The researches which followed on the chemistry of the blood-coloring matter probably constitute his highest claim to distinction. In 1877–'78 he founded the Zeitschrift für physiologische Chemie. Profs. Baumann and Kossel are, it is understood, to be the future editors of this journal. Although he did much to advance both physiology and pathology, Hoppe-Seyler is said to have been more of a chemist than a biologist.

A Colony for Epileptics.—The Craig Colony for Epileptics, named from the late Oscar Craig, of Rochester, is located on a tract of nearly nineteen hundred acres in the Genesee Valley. Its post office and railway station is called Sonyea, an Indian word signifying sunny place. The land is extremely fertile and the district a very beautiful one. There have already been erected some thirty or forty buildings. The colony will be a country village, only differing from others in being composed entirely of epileptics. The butcher, the baker, the grocer, the shoemaker, the mason, all will be sufferers from this curious disease. About thirty years ago a somewhat similar attempt was made in northern Germany; it has now developed into one of the most important labor colonies in Europe. The origin and history of this colony, which is called "Bethel," are given in detail in a previous issue of the Monthly. There are one hundred and twenty thousand epileptics in the United States; these unfortunates—perfectly well able to work, and many of them very competent—are debarred from almost every occupation, because of their liability to "fits." They are not admitted to the public schools, and are hence much handicapped in getting an education. In fact, about the only places where they are received are insane asylums and poorhouses. There are over a thousand epileptics in almshouses in New York State. The first work of the Craig Institution will be to remove these from the care of the State; after they are provided for, then outsiders will be admitted. There are no restrictions as to the age of patients, but necessarily no insane epileptics will be received. As the patients are received they will be set to work or at study in various ways. They will take care of the farms, gardens, and orchards; they will plan and build new houses; in fact, every sort of employment, every sort of recreation, everything, in short, that goes to make up the life of a country village will be found in this colony. The resources of the land are such, it is thought, that by judicious management the community can be made self-sustaining.

MINOR PARAGRAPHS.

Among the singular native customs prevailing in the western division of British New Guinea, the official report mentions that of the woman making the proposal of marriage and sending for the man to visit her; while the sister-in-law of the bride is often given in marriage in exchange, without regard to her wishes. The skeletons of dead relatives are sometimes kept in the villages; the skulls of enemies are preserved as trophies; and occasionally the body of an enemy is cooked and partly eaten.

Besides the considerable collections of the minerals and fossils of the region in the University Museum and the Deseret Museum, the University of Utah enjoys the advantage, in the Deseret Museum, which has been placed in its building, of an extensive series of specimens illustrating the persons and habits of the cliff dwellers and other aboriginal tribes of the region. Besides numerous perfect and fragmentary specimens of desiccated remains, this collection comprises many examples of weapons, tools, and domestic workmanship of these early people, which as a whole afford a valuable record of this phase of American archæology. The specimens are arranged with special reference to the requirements of study and teaching.

The conclusion results from an archæological exploration of the James River and Potomac River Valleys by Mr. Gerard Fowke that the aboriginal remains between tidewater and the Alleghanies, from Pennsylvania to southwestern Virginia, pertain to the tribes who lived or hunted within the territory at the beginning of the seventeenth century. Nothing indicating a more ancient or another race was found; while the occurrence of objects which could have been obtained only from white traders fixes approximately the date of some burial places, and resemblances in various points necessitate the classification of others as not far removed in time or origin from these.

From a review of the results of a transcontinental series of gravity measurements by George R. Putnam, Mr. G. K. Gilbert concludes that they appear more harmonious when the method of reduction postulates isostasy (or hydrostatic equilibrium) than when it postulates high rigidity. Nearly all the local peculiarities of gravity admit of simple and rational explanation on the theory that the continent as a whole is approximately, and the interior plain is almost perfectly, isostatic. Most of the deviations from the normal arise from excess of matter and are associated with uplift. The Appalachian and Rocky Mountains, and the Wasatch Plateau, all appear to be of the nature of added loads, the whole mass above the neighboring plains being rigidly upheld. The Colorado Plateau Province seems to have an excess of matter, and the Desert Range Province may also be overloaded.

NOTES.

In the article on The Collecting of Naval Stores, in the February Monthly, we inadvertently omitted to give credit for the cut on page 479, illustrating the French method of tapping or "bleeding" pine trees for their turpentine. The block was kindly placed at our disposal by the Forestry Department at Washington, to which we owe our acknowledgment.

From a note in the Revue Scientifique we gather that M. L. Roncorini, of Turin, a pupil of M. Lombroso, has recently made some interesting microscopical researches on the brains of epileptics, criminals, and idiots. He found alterations in structure which were fairly constant, and which in most cases were marked enough to differentiate them from the normal brain. If his work is confirmed by future observations it will justify M. Lombroso's theory that criminals and epileptics are closely related.

A new application of the phonograph is described in a recent issue of Industries and Iron. The Knowles Steam Pump Company has a large pumping station on the Elk River in California. Something went wrong with the big pump, and the manager of the station, in order to save the expense of having an expert come on from New York, conceived the ingenious notion of using a phonograph. He first spoke into the receiver, giving a general account of the matter, and then placed the receiver so that the working of the pump was recorded on the wax roll. When the cylinder was put into the machine in New York, the voice of the manager of the pumping station was heard giving the symptoms, and then asking the listeners to pay attention to the pump's action. By this means the difficulty was made out and the proper remedy forwarded.

In a letter on the poison ivy, in Garden and Forest, W. H. Harrison says: "The poison of the ivy, though always present, probably, like all sap, varies slightly in activity with the season, though perhaps not more than does man's power of resisting it, for the warm, perspiring skin of summer with its open pores takes in and throws out juices much more readily and is more easily irritated than the dry, firm skin and contracted pores of the exposed parts in winter. Aside from the sand form, all parts of the poison ivy are poisonous at all seasons, the root being by far the most virulent of all. I have seen a robust physician in the prime of health poisoned almost fatally and rendered nearly helpless for many days simply by pulling the roots. The poisoning, which is of an erysipelatous nature, usually appears in light cases at the point where the ivy juice comes in contact with the skin, but severe cases are apt to centralize at some point where the skin is tender. The remedies for this poison are unsatisfactory. The best way to effect a cure is to let the irritated area severely alone, notwithstanding the itching."

At the August meeting of the German Society of Anthropology, Dr. Waldeyer delivered an address on the somatic differences of the two sexes. He argued that since a wide collation of measurements and statistics proves that woman has a smaller brain, has less physical strength, preserves more traits of infancy and childhood in adult life, and has practically in all times and places held a position inferior to man, in our schemes of social improvement these undeniable facts should be respected, and he quoted with approval the opinion of Bartels, that the education, physical and mental, of woman, however high it may be, should be always aimed to fit her for the duties of the family circle only.

The Argentine Medical Club of Buenos Ayres offers three prizes, the first of three hundred dollars, for researches in bacteriology, to be presented before May 31, 1897. The prizes are offered to honor the memory of Pasteur.

Messrs. Macmillan & Co. announce in preparation An Atlas of Nerve Cells, by M. Allen Starr, M. D. Its object is to present to students and teachers of histology a series of photographs showing the appearance of the cells which form the central nervous system, as seen under the microscope.

As the result of a trial carried on for a year the New York Agricultural Experiment Station has found that a lot of Leghorn hens, having ground and moistened grain as thirty-seven per cent of their food for the year, cost less to feed, both as regards live weight and the eggs produced, than a similar lot having their grain food dry and whole. With two pens of Cochins the same result was obtained as regards live weight, but the opposite in regard to the production of eggs. As to the comparative profits from large and small breeds, this experiment turned out rather favorably to the large ones.

BENJAMIN SMITH BARTON.

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PRINCIPLES OF TAXATION.

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II.—THE PLACE OF TAXATION IN LITERATURE AND HISTORY.
PART III.

TAXATION IN THE MEDIÆVAL PERIOD.—With the termination of the Roman Empire of the West, which is regarded as having taken place A. D. 476, when Odoacer, chief of the Germanic tribe Heruli, captured the city and assumed the title of King of Italy, a new and great element was introduced into European life, through the intermingling of the northern barbarians with the civilized, Christianized, and degraded Romans of the south. The following period, for at least five hundred years, was characterized, to an extent never before surpassed in the world's history, by bloodshed, license, licentiousness, turmoil, robbery, and woe. Franks, Burgundians, Visigoths, Saxons, Slavs, Huns, Danes, and Normans crowded upon and warred with each other. From such a period, when neither the agriculturist nor the artificer could control to any great extent the fruits of his labor, and when the merchant "stole along the hedges, shrank from the eye of the passer, and stepped into rivers cautiously, seeking a ford, lest the man at the bridge should rob him," but little in the way of economic or fiscal principle could be deduced. In short, a new society, the foundation and precursor of what now exists, was in the process of evolution; but in order that evolution might commence, it would seem to have been necessary that all the elements of the old should have been completely dissolved, in order that its atoms might move freely—a condition like that to which the chemist is compelled to bring earthy mineral substances in order to effect their purification and crystallization.

The period when the molecules of society seem to have begun to combine anew, is generally assigned by historians to the eleventh century, when feudalism had become systematized into something analogous to general government, and the power of the Church was especially manifesting itself; and was recognized to such an extent that it was able to establish throughout nearly all Europe a period known as "God's Truce," when warfare, plunder, and bloodshed were forbidden from sunset on Wednesday to sunrise on Monday; and "during the Christmas holy days and Lent no new defenses were to be erected, nor old ones repaired. But this was not all. The provisions made for the protection of the laborer and for the produce of labor were far more characteristic of the dawning of a new era. Peasants in hostile territories were not to be injured or confined; the tools of agriculture, the hay and the grain stacks and the cattle, were all taken under the protection of the Church; and if seized, it must be for use and not for destruction. He that violated this truce was placed under censure of ecclesiastical power." From this period, therefore, it is only practicable to take up anew the thread of history, and attempt to resume the relation of some of the most instructive incidents that have since characterized the attempts of governments to defray their expenditures by levies upon the persons and property of their subjects or citizens. Preliminary, however, to so doing, the following historical facts may properly find a place.

How the Druids collected Revenue.—An annual payment in the nature of a tax was exacted by the ancient Druids from every family for the benefit of the priests of the temple in the district in which the family lived. The families were obliged, under penalty of an ecclesiastical curse, to extinguish their fires on the last evening of October, and attend at the temple with a prescribed annual payment. This being made, they were entitled to receive, on the first day of November, some of the sacred fire from the altar, to rekindle the fires of their houses; and their neighbors were also forbidden, under a similar penalty, in any way to assist them. The result was, that delinquent taxpayers found themselves not only interdicted from the society of their fellow-men and from justice, the usual sequence of ecclesiastical excommunication, but also from the use of fire during the approaching winter. This expedient for collecting a revenue was referred to by the British Chancellor of the Exchequer, in a speech in Parliament in 1871, in connection with a proposal to tax matches; and the motto, *Ex luce lucellum*, was proposed to be inscribed on match boxes in case the tax was enacted.*

* Toland's History of the Druids, quoted by Dowell, in History of Taxation in England.

Mediæval System of Land Tenure.—Among the nations that succeeded to the sovereignty of Rome, the title and ownership of land was regarded, as it is to-day in China, and in England and other European countries, as inhering primarily to the sovereign or chief of the state; and when partitioned among his nobles or chiefs, was held by them as it was termed on "tenure;" that is, on condition of performing certain services—mainly military, or the payment of a tribute—in the nature of rent. These conditions were ratified by oath; and the chiefs could only sublet, to their serfs or inferiors, on terms consistent with their own tenure.

Large domains were also set apart for the exclusive use of the sovereign *—both in his public and private capacity—the state and the sovereign being one and the same; and from the revenues thus accruing, and various fees and feudal incidents, the monarch, or feudal lord, was expected to defray all the expenses of the state, both public and private. Thus, the annual revenue of William the Conqueror is estimated to have been £400,000; which, taking into consideration that the *pound* at that time contained three times the weight of silver that it now does, and that silver had a comparatively great purchasing power, must have been equivalent to at least four or five millions of present money; and of the public expenditures of these ages it is important to note that there were very few that represented the bulk of the expenditures of modern governments.

Thus, for example, education was mainly confined to the clergy and the Church; and was efficiently supported by the produce of their own estates, or by tithes levied on the estates of others. There were few roads, and the labor of the serfs or peasants for a few days, before or after harvest, sufficed to keep in passable condition such as were needed to meet the demands of a very limited intercourse and commerce between different sections of the country. The administration of justice was held to be the perquisite of the lords or chiefs holding their estates direct from the crown, and, in place of being an expense, became through abuse and corruption a source of emolument. The standing army, which more than any one agency has tended to the impoverishment of modern Europe, could hardly be said to have then existed; the tenants in chief of the crown supporting the sovereign whenever

* The royal demesne (right of ownership) under the Norman kings was at one time of vast extent, comprising, according to Domesday Book, no less than fourteen hundred and twenty-two manors or lordships, besides farms and lands. It was divided into (1) forest; (2) land held by rural tenants; (3) royal cities, burghs, and towns. The first formed the king's hunting ground, and afforded supplies of venison, etc., for the royal table; the second supplied the king's table in other respects; the third was mainly the source of contributions for the discharge of the king's debts.

he took the field with a body of retainers, armed and maintained in a large degree at their own expense. The necessity of taxes in the ordinary sense was, therefore, by these conditions entirely superseded; and if at any time there was a deficiency of revenue from the crown estates and fees, other sources of revenue were resorted to in preference to anything that could by any possibility be regarded as taxes.

Numerous old-time writers of authority—Montesquieu among the number—might be cited in support of what was then regarded as an eminently sound principle, that governments ought to be supported from revenues derived from the public domains, and that taxation should be resorted to as rarely as possible; because, as one of them expressed it, "one enters into civil society to protect one's property, and not to have it taken away from him." It is also interesting to note in this connection the tendency at the present time to go back to this old doctrine, and for states and municipalities to derive their revenues from other sources than taxation—as from the granting of franchises for railways, telegraphs, telephones, gas supply, lotteries, etc., on condition of participation in profits on gross receipts. Thus, the present net profit on the German state railways is understood to pay the interest on the public debt of Germany. Nearly all the Continental states of Europe derive a considerable portion of their needed revenues from the profits of their domains and forests—Prussia to the extent of about $11,000,000 per annum; France, $5,500,000; Hungary, $3,000,000, and the like. The city of Paris derives about twenty per cent of its revenue from participation in the operation of franchises and income from productive property. In Berlin eighteen per cent. of all the municipal expenses are reported as derived from the public gas supply. In Illinois the State expenses are mainly defrayed from the State's share of the annual profits of the Illinois Central Railroad; and in Louisiana also, the State formerly and recently has participated in the profits of an authorized State lottery. If the ideas of Mr. Henry George, of a single tax on land, should prevail, and if such a tax does not diffuse itself, then the entire land of the country would in the course of time become the property of the state exclusively; and the old principle that a state should be supported from its own landed resources and property would be reasserted and established.

The following were some of the sources of revenue, other than what were assumed to be *taxes*, that were resorted to in mediæval times to make good any deficiency of income which the crown, as representing the state, derived from its special properties and privileges; and a reference to which is important, by reason of the flood of light they shed upon the concurrent social condition of the masses, and the utter disregard of their rulers of anything akin to justice in their administration of government. One of the most notable of these sources was the Jews, who during the middle ages had no rights of citizenship in Christianized Europe, and were held, in respect to their persons, goods, wives and children, at the absolute disposal of the chief of the state, to be taxed and despoiled by him at his pleasure. This utilization of the Jews as sources of revenue was far more thoroughly and systematically carried out in England than in any other country. "They were, in fact, the private property of the king; living instruments of his revenue; carefully protected by his government, unless in cases where exceptional necessity on his part or obstinacy on theirs made it expedient to bear upon them with unusual weight;* not serfs bound to the soil, but slaves of the highest value, to whom to allow free action in the acquisition of wealth was the needful condition of reaping the fruit of their labor. There is a writ of Henry III in which, in payment of a debt to his brother Richard of Cornwall, he assigns and makes over to him "all my Jews of England." †

William Rufus (William II of England) actually forbade the conversion of a Jew to the Christian faith. "It was a poor exchange," he said, "that would rid him of a valuable property and give him only a subject."

Under Edward I of England the Jews were plundered and amerced to such an extent that it is estimated that they paid over one tenth of the entire revenue of the crown.

An explanation of the apparently anomalous circumstance that the Jews, although deprived of all civil rights and debarred from following most occupations, were able to be plundered to such an extent, is found in the fact that they were the "royal usurers," and under the king's protection spoliated through extreme usurious interest the Norman barons, who were always in want of money, and were not the men to readily tolerate "benevolences," or any other form of direct taxation for supplying the king with money necessary for the support of the government. So that when the king plundered the Jewish money lenders, he in reality obtained indirectly the money he needed from his barons, with far less odium and more profit than if he had proceeded against them directly.

Very curiously, this mediæval idea of regarding the Jews as a

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* Such a case of urgent necessity or inexcusable obstinacy must have been assumed as existing by King John, of whom it is related, that on one occasion he demanded the sum of ten thousand marks (thirty thousand dollars) of a Jew at Bristol, and on his refusal to pay, ordered one of his teeth to be drawn every day until he should comply. The Jew, it is chronicled, lost seven teeth and then paid the sum required of him.

† Oxford Essays. By J. Bridges, Fellow of Oriel.

permanent, legitimate, and desirable source of revenue for the state, continued to find favor in England as recently as the reign of William and Mary, or in 1689; when, money being needed to prosecute the war with France, it was seriously proposed to exact, under the semblance of taxation, a hundred thousand pounds from the Jews, and the proposition was at first favorably received by the House of Commons. "The Jews, however, presented a petition to Parliament in which they declared that they could not afford to pay such a sum, and that they would rather leave the kingdom than stay there and be ruined; and after some discussion the Jew tax was abandoned." For, as Macaulay expresses it, "Enlightened politicians could not but perceive that special taxation, laid on a small class which happens to be rich, unpopular, and defenseless, is really confiscation, and must ultimately impoverish rather than enrich the state." *

It is hardly necessary to point out that ill treatment of the Jews has not been confined to English rulers and people. In every country or state of Christendom they have been subjected to arbitrary, unequal, and unjust exactions, deprived of ordinary political privileges, and driven as homeless wanderers from cities which their presence and their purses had enriched. And that this race antagonism continues to be perpetuated to the present day, is demonstrated by their recent and virtual expulsion from Russia; and even in the United States (where it might least be expected) by a vulgar and brutal denunciation by a member of the Federal Senate of the chief executive officials of the country, for the assumed reason that they had entered into a fiscal correspondence with an Englishman of Jewish descent, whom England had admitted to a seat in her Parliament, and whose whole life had been characterized by strict integrity, courtesy to all, and large benevolence.

Another extraordinary source of revenue to the crown in feudal times, was the forfeiture of lands and estates for offenses; and of the immense sums thus obtained, some idea may be formed from the circumstance, that up to the time of Elizabeth it has been estimated that nearly all the land in England had at some time fallen to the crown under the law of forfeitures. Other devices for the raising of revenue which were very productive, were fines for the alienation (legal conveyance) of land, which were exacted oftentimes to the extent of one third of their yearly value, whenever the tenant found it necessary to make over his land to another; and from the sale of titles, which even as late as 1626, under Charles I, afforded considerable revenues. The right of marriage was subject (at least in the case of nobles

* Macaulay's History of England, vol iii, chap. xv.

and gentry) to the consent of the crown; and in some instances large sums were paid for the privilege; Simon de Montfort paying Henry III a sum, equivalent to five hundred thousand dollars at present, for permission to control the marriage of the heir of Gilbert d'Unfrankville. Mr. Dowell, in his History of Taxation in England, quotes the following as among one of the "fiscal curiosities" to be found on the Rolls of the Exchequer during the early Norman period: "Ralph Bardolph fines in five marks for leave to rise from his infirmity. The Bishop of Winchester owes a tonnell of good wine for not reminding the king (John) about a girdle for the Countess of Abunarle; and Robert de Vaux fines in five of the best palfreys that the same king would hold his tongue about the wife of Henry Pinel."

Another branch of the ancient revenues of the English crown worthy of special notice from its singular recognition within a comparatively recent period, was the right to "royal fish," meaning thereby the whale and the sturgeon, when the same were either cast ashore or caught near the coast; and which were originally acquired by the crown on the assumption that the sovereign guarded and protected the seas from pirates and robbers. This perquisite had so long been in abeyance that its sanction by law was hardly recognized in 1850, when the Duke of Wellington, as Lord Warden of the Cinque Ports, claimed and exacted the price—fifty pounds—of the carcass of a whale brought ashore and sold by certain boatmen on the coast of Kent. A point of contention was made by the boatmen, that since the law was enacted, natural science had proved that the whale was not a fish; but the duke insisted upon his right under the letter of the law of compact with his office of warden—i. e., to protect the seas—as representative of the sovereign, and maintained it. He, however, subsequently practically admitted the lack of any moral foundation for his claim by dividing the price, after it had been formally paid him, with the boatmen.

Taxation in England.—Previous to the reign of Henry II of England (1154), the "tenure" or holding of lands from the crown required the personal attendance, at his own expense, of every tenant—knight or baron—with a certain number of retainers, upon the king in arms, for a period of forty days in each year; and failure to attend, or render the quota of men required by the tenure, would have involved a forfeiture of the tenant's lands for nonperformance of duty. Such a military system, however sufficient for home protection or border warfare, proved ill adapted to foreign wars, which in the case of France were for a long period almost continuous; inasmuch as in those days of slow traveling a forty days' service upon a distant expedition would have been of little account. For what could be more inconvenient for the leader of an army than to be under the necessity, on the expiration of the forty days, either to cut short the campaign, or purchase, by payments or promises, the continued service of his best soldiers? To overcome this difficulty a new system was arranged, it is said, by Thomas à Becket, which marked an important era in English taxation; whereby the king, in lieu of personal service by his barons and their retainers, agreed to substitute a tax called "*scutage*," or shield tax; which, as levied at the rate of ten marks (£1 6*s.* 8*d.*) on every estate held by tenure, of the annual value of twenty pounds, was *a land tax*, payable in money, which before that period had not been definitely recognized. And thus it was that the king practically disarmed the feudal power by accepting money from the knights in place of armed service; and at the same time greatly strengthened his own power. As with the money thus raised he created a permanent and subservient army of mercenaries—a process which Michelet, the French historian, has characterized as a provision by the nobles of a bit and bridle for their own restraint.*

Historians can find no evidence that the right of the English kings to levy taxes was in any case made contingent on any formal grant of any national council until toward the close of the reign of Richard II (1190); † and we have a statement from the historian Hallam that, previous to that time, the system of extortion practiced by the Norman kings upon their English subjects was "what we should expect to find among Eastern slaves."

Progressive civilization and the necessity for larger revenues

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* The reign of this English king—Henry II—is also signalized by an organization of the royal (state) revenue system which in some of its features has continued to the present time. Under it the management and general superintendance of the royal revenues were intrusted to certain officers of the king's household, who constituted the "Court of the Exchequer," so called from the checkered cloth laid upon the table upon which the tax collectors or treasurers told out the king's money; and the chief financial officer of the British Government at the present time is designated by the title of "Chancellor of the Exchequer." The payments when made were entered into an account book, and from this transferred to a strip of parchment; which last was sent through a pipelike opening into a room specially provided, and called a "tally count," where a "tally" was made of it. This tally was a piece of dry wood on which "the cutter of the tallies" had to cut notches corresponding to the sum paid, while the "writer of the tally" wrote the sum down on both sides of the wood in figures. According to the length of the incision, one notch denoted £1,000; another £100; £20; 20*s.*; 1*s.*; and so on. The chamberlain then split the notched stick down the middle in such a manner that each half contained the written sums and the incised notches. The two matching parts thus split asunder were called "tally" and "counter tally," or "tally" and "foil" (folium). The one was retained by the chamberlain, the other was kept by the payer as a receipt and proof to be produced to the account department of the exchequer. This curious system of receipts was maintained in force until 1783; and it was through the burning, with a view to getting rid of an accumulation of these tally sticks, that the old House of Parliament in London was burned in 1834.

† Constitutional History of England, Stubbs, vol. i, p. 577.

than the domains and perquisites of the crown could supply to meet the expenditures of continued wars and the maintenance of standing armies, gradually, however, broke down (as has been before pointed out) the feudal system for defraying the expenses of the government; and the sovereigns were compelled to petition their tenants in chief, or the representatives of the great estates of their realms, to meet in assembly and co-operate with the crown in raising revenue by a more or less general system of forced contributions upon the persons and property of the people. And in this necessity is to be found the origin of the modern parliaments or states general; and also the inception of the modern system of taxation through the representatives of the people. And the manner in which the great principle that representation should accompany taxation began to find a place in English legal or economic experience, through what was clearly a process of evolution, was undoubtedly as follows:

Under the Saxon and, for a lengthened period, also under the Norman kings, the revenues of the crown (as before shown) were mainly derived from taxes on land, which were paid in kind (produce), and what, as the holders of land were regarded as tenants of the crown, were in the nature of rents.* But when, in order to enlarge the basis of revenue, personal property, in the form of movables or income, was brought under contribution, the situation became different; inasmuch as the titles of all such property not being primarily derived from the king, the consent of its owners to an official inquisition, necessary for proper valuation and assessment, was implied, and naturally was not willingly granted. And the great religious houses and orders, who in the main were the principal owners at this time of such property and were all-powerful, especially insisted that this consent should be recognized as a prerequisite to assessment; and, in at least one instance, re-enforced their position by an interdict from the Pope.

The successive steps, also, by which this great principle became recognized and incorporated into general practice have also been clearly worked out by historians. Thus, in 1181, under the reign of Henry II, each freeman was required to equip himself (for war) according to his means; and to determine what his means were, or his liability for taxation in respect to other than landed property—namely, chattels and income—four or six lawful

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* Rents (taxes) paid in kind continued in force in England after the Conquest, and certainly down to the reign of Henry I. Indeed, by reason of the scarcity of money, there was practically no other method of payment. But at the same time the collectors of the king's revenue, in the settlements of their accounts, were accustomed to reckon the value of produce in money at an established ratio: as, an ox at 1*s.*; a sheep at 4*d.*; so many measures of corn at so much, and the like.

men of his parish were chosen to determine and declare under oath the extent of his personal liability. In the next reign, that of Richard I, this new principle of jury assessment was applied in a general way to the assessment of lands as well as chattels; and from thence the representative principle in taxation begins to ascend through successive stages, until it becomes established and recognized as the highest function of the British and all other essentially free governments.*

The abandonment, furthermore, of the right on the part of the sovereign to make arbitrary exactions in respect to personal property, and the assumption by a class of privileged subordinates—i. e., legislators—of the right to vote or deny supplies to the king or state, and for the attainment of which results the English clergy of the thirteenth century led the way, marks also the dawn of constitutional or free government. All authorities are agreed, that on the clause in the Magna Charta of 1215 respecting the taxing power, is based all that has since been achieved in respect to English liberty. By it the king (John) was allowed to reserve for himself but three feudal aids, or rights, for extraordinary money allowances from the state, which very curiously have never been alienated from the English crown by any subsequent legislative enactment. Namely, to ransom the king in the case of his capture by an enemy; to defray the expenses of the knighthood of his eldest son; and third, on account of expenses incident to the marriage of his eldest daughter. In all other respects the charter provides that "no *scutage*"—by which is understood a land tax in commutation for personal military service—"or aid shall be imposed in our realm, save by the Common Council of our realm"; and this provision of the Great Charter was more

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* It is, however, worthy of note that the only time when this subject appears to have prominently attracted the attention of the British Parliament and occasioned debate, was in connection with the imposition of taxes, without representation, on the British colonies in North America, and which assumption of right on the part of the crown to thus act, subsequently led to the American Revolution. The question at issue before Parliament was, had the state the right of taxing the colonies under existing circumstances, in default of representation of the taxpayers? The colonists did not deny the right of Great Britain to tax them; but they did hold that for the people of Great Britain to appropriate any part of the property without their consent was neither reasonable nor consistent with the British Constitution. And in the great debate in Parliament on this subject, in 1764, Mr. Pitt sustained the position of the colonists; and Lord Camden, who followed, said that "taxation and representation were inseparable," and that a blade of grass growing in the most obscure part of the kingdom could not rightfully be taxed without the consent of its proprietor.

Recent historical investigations have, however, shown (as before pointed out, chapter ii) that the grievance alleged and complained of by the American colonists was not peculiar to them, but was shared by the people of the mother country to such an extent that at the time of the colonial revolt not one tenth of them were allowed to participate by vote in the election of members of Parliament.

explicitly reaffirmed and embodied in the form of law by a Parliament in 1297, which enacted that no tax should be levied by the king without the consent of the knights, burgesses, and citizens in Parliament assembled.

Again, in the earlier periods of English history, and probably also in the history of the other states of Europe, when the revenues from the property, fees, and perquisites of the crown, supplemented as they were from time to time by special parliamentary grants, benevolences, and subsidies, and the plunder of special classes—as the Jews—were found inconvenient and unreliable, and were replaced by more regular systems of contribution, the idea of taxation was, as centuries before in Rome, simply to obtain the necessary revenue, without much regard to the incidence of the tax or the interest of the producer, consumer, or trader. The end was alone considered, and not the means; and this policy, pervading all schemes and experiences of taxation, was then, as it ever has been, the most fertile source of bad taxes. The objects from which contributions at the period under consideration could be obtained were almost exclusively tangible and readily visible, as lands, hearths (representing houses), cattle, slaves or serfs, and the crudest of agricultural products. But as trade, or the business of exchanging, increased, it soon came to be looked upon as a proper subject for exaction. Customs, or taxes upon trade, were accordingly very early established, and at first were probably confined to domestic or internal trade. But with the rise and growth of foreign commerce the practice very naturally extended to foreign trade, and the terms "customs" and "duties," which had an antecedent origin and meaning, eventually became restricted in their application to "taxes" or "exactions" on exports and imports. But yet so slowly did the customs in this sense become an important source of English revenue, that the entire amount collected in 1603 was but £127,000, or but little in excess of $600,000. Such taxes at the outset were furthermore held to be the king's private or personal dues, to be levied by him independently of any statute, according to his discretion, or, rather, according to his necessities; and it was not until the reign of Edward I that Parliament undertook to interfere with what had been considered an hereditary right of the crown, by providing in 1275, that for the purpose of correcting irregular seizures and exactions, a limitation should be established on the amount of duty that the king might take on the exports of wool and leather; and the duties thus regulated by statute on these two articles are regarded as the first legal foundation of the English customs revenue. But before the close of the reign of Edward III, or in 1353, the exclusive right of Parliament to authorize or control every form of indirect taxation was fully established, and for the time fully exercised; and the right thus achieved by the representatives of the people of participating in the levy of indirect or customs taxation, also necessarily drew with it the right to participate in general legislation, or upon all subjects which Parliament might deem proper.

It is also interesting to recall in connection with this subject, that when the old English kings began to levy tolls on ships entering into harbors, in common with tolls on transportation by roads and navigable streams, the tax was on the ship directly, and not specifically upon its contents. And in early charters instances occur of grants to individuals or monasteries of an exemption from toll for one ship of burden; and in the event of the destruction of the particular ship, the privilege was extended to another ship. But with such tolls or taxes once established, the idea soon developed that like forms of exaction might be made to serve a commercial purpose as well as produce revenue; and, as might have been expected, they therefore early became instrumentalities for fiscal oppression; and, with a view of advancing the interests of English merchants, or of protecting native industries, they were especially directed against the commerce of foreigners. And while the crown, as early as 1275, was deprived of much of its arbitrary power of levying customs for revenue, its prerogative of restraining trade and imposing onerous burdens on exchanges with foreigners remained not only undisturbed but undisputed. Foreign merchants, or trading companies, frequently purchased immunity from such exactions; but yet, according to Mr. Hall, in his History of the English "Customs," "to the 'custos' of the ports, to the riverside baron, to the wayside outlaw and the town apprentice, the Lombard or Flemish peddler or merchant appeared as fair game for violence and extortion of every kind." And in the earlier records of England's customs experience, their oppressive features are of higher interest than their revenue or fiscal characteristics. English producers and traders, furthermore, having secured immunity from arbitrary taxation themselves, were quite willing to see this instrument of restraint and oppression turned against their foreign competitors; and, accordingly, during the whole of the sixteenth, seventeenth, and eighteenth centuries, and the first quarter of the nineteenth century, the whole commercial policy of England was based on the theory of the so-called "mercantile system"; the fundamental principle of which was that commerce could benefit one country only to the extent that it injured another; and that it was the part of wisdom always to secure a favorable balance of trade by selling as much and buying as little as possible, and receiving pay for what was sold, not in other useful products, but in gold.

But notwithstanding the early restrictions imposed by Parliament on the power of the crown to appropriate the property of the people for its support, arbitrary exactions in the name of taxation continued to characterize the rule of all the English monarchs down to the time of Charles I, when the claim of the king to a divine right to take taxes from subjects, with or without their consent, was settled by the dethronement and execution of the monarch and the establishment of the Commonwealth; and ever since then the grants of an annual Parliament have been a prerequisite to any lawful expenditure for the maintenance of the English state.

To the necessities of the Long Parliament, during its contest with the crown, and when the receipts of revenue from former sources were interrupted, we owe the permanent incorporation of the so-called excise taxes into the tax system of England. Another most novel contrivance of this period for the raising of revenue was the so-called weekly impost of a single meal; every citizen being required to retrench one meal per week and pay an amount representing the saving, in the form of money, into the public treasury; a tax that yielded in six years £608,400, or more than $3,000,000; an aggregate that represented a far larger purchasing power than the same amount would at present.

During the nineteen years that elapsed from the beginning of the English Revolution to the restoration of the monarchy under Charles II, the average annual expenditures of the Commonwealth were about seven times greater than those of the preceding royal Government; and as unlawful taxation was the prime cause of the establishment of the Commonwealth, so excessive taxation furnished the prime cause of popular rejoicing when the Commonwealth was got rid of.

A circumstance of no little importance, but which historians generally have overlooked, is, that the revolt of the American colonies and their separation from Great Britain, were in the first instance due to an effort on the part of the landholders of Great Britain to transfer from themselves to the people an ever-increasing portion of the expenses of the Government. But such was the fact. In 1767 the British Parliament, which was mainly composed of landholders, reduced the previously existing land tax to the extent of about half a million pounds per annum; and it was for the purpose of making up a resulting deficiency of receipts to the British treasury, that the Chancellor of the Exchequer of George III resorted to the taxation of tea, glass, and other articles imported into the American colonies, as well as the requirement for the use of stamps on the paper instrumentalities used by the Americans, and the payment for which the colonists resisted.

Finally, a feature of special importance in connection with the history of English tax experiences, one often overlooked in historical essays and discussions, but which ought to command the attention of all interested in the origin of the structure and diversities of governments, is the demonstration it affords of the close connection between taxation and popular liberty. Take up the history of any people, state, or nation that has fought its way, like England, out of despotism into liberty, and what are the transactions that most significantly mark and constitute its progress? The story is substantially the same in every case. First, a government of might supported by arbitrary exactions from persons and property—tribute, *taille, scutage, gabelle, corvée,* escheats, *octroi, vingtième,* customs duties, subsidies, benevolences, and the like—levied at the will or caprice of an absolute and despotic chief or monarch, and without any consultation with or assent of the governed. Then, in some hour of royal adversity or need, the monarch appeals for aid to the more powerful of his subjects—lords and nobles—who, in turn, taking advantage of the situation, vote or grant it, in consideration of the concession of some "Magna Charta," limiting in a measure the sphere of exactions on the part of the monarch, or at least securing to a few of his privileged subordinates a voice in regulating and legalizing the same. Later comes the struggle between the privileged few and the unprivileged many, and sooner or later, by peaceful political progress, or by violence and revolution, the privileged class ceases to be a separate potential element of the state, and thence passes to the people the sole right to determine, through their chosen representatives, what grants of supplies shall be made for the support of the state, and how the burden of taxation which they entail shall be distributed. And then, if further progress is to be achieved, to the end that in exercising the great power of appropriating private property for defraying the expenses of government, no more be taken than is necessary; that none shall be assessed unequally; that the greatest freedom may be secured for production and distribution, and the greatest restrictions placed on monopolies, there must be, through study and investigation, such an improvement and remodeling of all existing systems of taxation as will completely eliminate from them all practices that rest upon no better basis than old prejudices and narrow, selfish interests, and make them conformable to principles and conditions which, when presented abstractly, will command almost universal assent.

THE discovery of a twilight band on Mars is announced by Mr. Percival Lowell, on the authority of observations by Mr. Douglass and Prof. Pickering.

THE PRACTICAL RESULTS OF BACTERIOLOGICAL RESEARCHES.*

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GENTLEMEN: In selecting a subject for my presidential address I have thought it best to restrict myself to that branch of biological science with which I am most familiar; and, as a technical paper might prove uninteresting to many of those who constitute my present audience, I have chosen a title for my address which will enable me to speak in a general way of the development of our knowledge relating to the low vegetable organisms known as bacteria, and the practical results which have been the outcome of researches commenced in the first instance solely on account of their scientific interest.

Attention was first prominently called to the bacteria by the investigations relating to spontaneous generation. It was generally believed prior to the researches of Spallanzini, in 1776, that the development of micro-organisms in boiled organic fluids exposed to the air was by heterogenesis. Spallanzini showed by experiment that in some instances putrescible liquids when boiled and kept in hermetically sealed flasks could be preserved indefinitely without undergoing change. But he was not always successful in this experiment. Bastian, and other supporters of the theory of heterogenesis, at a later date, repeated these experiments with similar results, and maintained that when a development of micro-organisms occurred in a boiled fluid contained in a hermetically sealed flask it could only be by spontaneous generation. But Pasteur, in 1860, gave the true explanation of the appearance of living bacteria under such conditions. He proved that when development occurs it is because the organic liquid has not been completely sterilized, and that certain micro-organisms (spores of bacilli) withstand the boiling temperature, especially when they are suspended in a liquid having an alkaline reaction. At the present day this question is regarded as definitely settled, at least so far as known conditions are concerned; and we have an exact experimental knowledge of the thermal death-point of many micro-organisms of this class.

The principal pathogenic bacteria are destroyed at temperatures much below the boiling point of water. Thus, in experiments made by the present speaker in 1885 it was ascertained that

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* Address of the President of the Biological Society of Washington, delivered December 14, 1895, under the auspices of the Joint Commission of the Scientific Societies of Washington.

the cholera spirillum is destroyed by ten minutes' exposure to a temperature of 52° C.; the typhoid bacillus by 56°; the micrococcus of pneumonia by 52°; the streptococcus of erysipelas (*S. pyogenes*) by 54°; etc. According to Loeffler, the bacillus of glanders is destroyed in ten minutes by a temperature of 55° C.; the bacillus of diphtheria by 60°. The experiments of Yersin show that the tubercle bacillus does not survive exposure for ten minutes to a temperature of 70° C. The practical value of such knowledge is apparent. Articles of clothing infected with any of the pathogenic bacteria mentioned would be speedily disinfected by immersion in water heated to 70° C. or above, and water or milk recently heated to the same temperature would evidently be without danger so far as infection by these "disease germs" is concerned. The recommendation of sanitarians that water or milk or food suspected of being contaminated by pathogenic bacteria should be exposed to a boiling temperature before it is used is based upon the experimental data referred to; and the knowledge that organic liquids can be sterilized by heat constitutes the foundation upon which the bacteriology of the present day has been established. To obtain reliable information with reference to the biological characters of any particular micro-organism it is necessary to experiment with pure cultures, and this requires a sterile culture medium.

It is hardly necessary to call attention to the fact that an immense industry in the preservation of food products depends upon the sterilization of these products by heat, and their preservation in hermetically sealed receptacles.

When Pasteur demonstrated the fact that sterile organic liquids, when protected by a sterilized cotton air-filter, can be kept indefinitely without undergoing any putrefactive or fermentative change, he also proved that such changes are due to the presence of micro-organisms; and, extending his investigations, he found that certain definite kinds of change are due to particular species of low organisms. Thus the alcoholic fermentation of a saccharine liquid was found to be due to a torula (*Torula cerevisiæ*), the acetic fermentation of an alcoholic liquid to a bacterial ferment (Pasteur's *Mycoderma aceti*), etc. Subsequent researches show that alcoholic fermentation may be induced by several species of torula, and even by certain bacteria; while the number of bacterial ferments now known to science is very considerable and is constantly being added to. Among the most important of these we may mention the *Bacillus acidi lactici*, which is the usual cause of the acid fermentation of milk; the various anaërobic bacilli which give rise to the formation of butyric acid in solutions containing starch, dextrin, sugar, or salts of lactic acid; the bacteria which cause the alkaline fermentation of urine; those which produce marsh gas by the fermentation of cellulose; those which effect the decomposition of albumin, with an evolution of hydrosulphuric acid; those which give rise to the putrefactive decomposition of organic material, the number of which is very large; the bacteria in the soil which reduce nitrates with liberation of ammonia and free nitrogen, and those which oxidize ammonia. The study of these bacterial ferments is still being vigorously prosecuted, and practical results of importance in agriculture and the arts have already been attained. In the future we may look for numerous additions to these practical applications of our knowledge. The use of pure cultures for producing useful fermentations must give the best result with the least liability to loss of material from the presence of undesirable species. It is known that the flavor of butter and of different kinds of cheese is due to various bacterial ferments, and there is good reason to suppose that a better product and greater uniformity would be attained by the use of pure cultures of the species upon which special flavors depend. I understand that in this country quite a number of dairies are now using pure cultures of a certain bacillus (Bacillus 41 of Conn) for giving flavor to their product. It is probable that similar methods will soon be introduced in the cheese-making industry. A recent English publication, which I have not yet seen, is entitled Bread, Bakehouses, and Bacteria. It will, no doubt, be found to contain information of practical value to those engaged in bread-making.

Pasteur's studies relating to the micro-organisms causing abnormal and injurious fermentations in wine, the results of which he published in 1866 (*Études sur le Vin, ses Maladies*, etc.), have resulted in an enormous saving to the wine-making industry in France and other countries where wine is produced upon a large scale; and his investigations relating to the cause and prevention of the infectious diseases of the silkworm, which threatened to destroy the silk industry in France, have resulted in even greater benefits to the material interests of his country and of the world (published in 1870).

Agricultural chemists predict that in the near future cultures of the nitrifying bacteria of the soil will be made on a large scale for the use of farmers, who will add them to manures for the purpose of fixing the ammonia, or perhaps will distribute them directly upon the soil. Should this prove to be a successful and economic procedure, the extent of the interests involved will make it a "practical result" of the first importance. Another application of our recently acquired knowledge which has already proved useful to farmers in certain parts of Europe relates to the destruction of field mice by distributing in the grain fields bread moistened with a culture of a bacillus which causes a fatal infectious disease among these little animals.

In Greece, in Hungary, and in other parts of Europe the quantity of grain consumed by field mice constitutes a very serious loss. Recent experiments made with cultures of two different bacilli (*Bacillus typhi murium* of Löffler and the bacillus of Lasar) show that it is practicable to destroy these pests, in the fields where their depredations are committed, in the manner indicated. Mice which consume the bread moistened with cultures of one of the pathogenic bacilli referred to die within a short time from general infection, and their bodies are consumed by other mice, which also become infected. Thus a veritable epidemic is induced by which their numbers are very materially reduced.

This leads us to the subject of the prevention of infectious diseases among domestic animals. We have now a precise knowledge of the specific infectious agents ("germs") in the diseases of this class which have caused the greatest losses. The most important of these are anthrax, glanders, tuberculosis, infectious pleuro-pneumonia, swine plague, hog cholera, hog erysipelas, and fowl cholera. All of these have been proved to be due to bacterial parasites, the morphological and biological characters of which are now well known. The infectious agent and usual mode of infection being known in any given disease, we have a scientific basis for measures of prophylaxis. These naturally include the destruction of the specific micro-organism to which the disease is due wherever it may be found. An enormous amount of experimental work has been done for the purpose of determining the comparative value of disinfecting agents and the practical advantages of each, having in view questions relating to cost, stability, solubility, odor, toxic properties, etc., also to the difference in resisting power of different pathogenic bacteria, the presence or absence of spores, the character of the material with which they are associated, etc. As a result of this extensive laboratory work our knowledge with reference to the efficiency and availability of agents of this class is very complete, and enables those who are familiar with the experimental evidence to formulate rules for the destruction of the various pathogenic bacteria wherever they may be found. The infected animal is itself a focus of infection which under certain circumstances had better be destroyed *in toto*, the individual being sacrificed and the body put out of the way of doing harm by means of cremation or burial. Under other circumstances it may be sufficient to isolate the infected animal and to disinfect all discharges containing the pathogenic germ and all objects contaminated by such discharges. By such measures the extension of epidemic diseases fatal to domestic animals may usually be arrested. But it may happen that the extent of the epidemic prevalence and the number of animals already exposed to infection make these measures inadequate or difficult of execution. In this case we have, for certain diseases, another method of prophylaxis which has been extensively employed with excellent results. I refer to the method of protective inoculations, which we owe largely to the genius and patient researches of the distinguished French chemist Pasteur and his pupils.

Toussaint, a pioneer in researches relating to protective inoculations, has a short paper in the Comptes-Rendus of the French Academy of Sciences of July 12, 1880, entitled Immunity from Anthrax (*charbon*) acquired as a Result of Protective Inoculations.

In this paper he announces his discovery of the important fact that the anthrax bacillus does not form spores in the tissues or liquids of the body of an infected animal, but multiplies alone by binary division: "*Sa multiplication se fait toujours par une division du mycélium.*"

In the same communication he reports his success in conferring immunity upon five sheep by means of protective inoculations, and also upon four young dogs. We must therefore accord him the priority in the publication of experimental data demonstrating the practicability of accomplishing this result.

In a communication made to the French Academy of Sciences, September 27, 1880, Pasteur gave an account of an experiment made July 14, 1879, upon two cows, which, in connection with a subsequent experiment, made August 6, 1880, upon four cows, led him to the conclusion that a single attack of anthrax protects from subsequent attacks.

The next important steps in the line of experimental research leading to protective inoculations in the disease under consideration were reported by Pasteur in his communication to the French Academy made at the *séance* of February 28, 1881 (with the collaboration of Chamberland and Roux), entitled *De l'Atténuation des Virus et de leur Retour à la Virulence.* In this connection Pasteur announces his discovery of the fact that when cultivated at a temperature of 42° to 43° C. the anthrax bacillus no longer forms spores and rapidly loses its virulence.

In a later communication (March 21, 1881) Pasteur says that he has found by experiment that when attenuated varieties of the anthrax bacillus form spores, these again reproduce the same pathogenic variety, so that cultures of each degree of attenuation can be maintained indefinitely.

On June 13, 1881, Pasteur communicated the results of his famous experiment at Pouilly-le-Fort, near Melun. He says:

"On the 5th of May, 1881, we inoculated, by means of a Pravaz syringe, twenty-four sheep, one goat, and six cows, each animal with five drops of an attenuated culture of the anthrax bacillus. On the 17th of May we reinoculated these animals with a second virus, also attenuated, but more virulent than the first.

"On the 31st of May we proceeded to make a very virulent inoculation in order to test the efficacy of the preventive inoculations made on the 5th and 7th of May. For this experiment we inoculated the thirty vaccinated animals, and also twenty-four sheep, one goat, and four cows which had not received any previous treatment.

"The very virulent virus used on the 31st of May was obtained from spores preserved in my laboratory since the 21st of March, 1877.

"In order to make the experiments more comparable, we inoculated alternately a vaccinated and a non-vaccinated animal. When the operation was finished, all those present were invited to reassemble on June 2d—i. e., forty-eight hours after the virulent inoculation was made.

"Upon the arrival of the visitors on June 2d, all were astonished at the result. The twenty-four sheep, the goat, and the six cows which had received the attenuated virus all presented the appearance of health. On the contrary, twenty of the sheep and the goat which had not been vaccinated were already dead of anthrax; two more of the non-vaccinated sheep died before the eyes of the spectators, and the last of the series expired before the end of the day. The non-vaccinated cows were not dead. We had previously proved that cows are less subject than sheep to die of anthrax. But all had an extensive œdema at the point of inoculation, behind the shoulder. Certain of these œdematous swellings increased during the following days to such dimensions that they contained several litres of liquid, deforming the animal. One of them even nearly touched the earth. The temperature of these cows was elevated 3° C. The vaccinated cows did not experience any elevation of temperature, or tumefaction, or the slightest loss of appetite. The success, therefore, was as complete for the cows as for the sheep."

Subsequent experience has fully established the value of protective inoculations in this disease, and the method of Pasteur has been practiced on a large scale in France, Austria, Russia, and Switzerland.

The results of anthrax inoculations made in France by Pasteur's method during twelve years were summarized by Chamberland in 1894. The veterinarians who made the inoculations were each year called upon to answer the following questions: 1. Number of animals inoculated. 2. Number of deaths from first inoculation. 3. Number of animals dying within twelve days after the second inoculation. 4. Number of animals dying of anthrax within a year after protective inoculations. 5. The yearly average loss before inoculations were practiced. The total number of animals inoculated during the period to which this report refers was 1,788,677 sheep and 200,962 cattle. The average annual loss before these protective inoculations were practiced is said to have been about ten per cent for sheep and five per cent for cattle. The total mortality from this disease among inoculated animals, including that resulting from the inoculations, was 0·94 per cent for sheep and 0·34 per cent for cattle. Chamberland estimates that the total saving as a result of the inoculations practiced has been five million francs for sheep and two million francs for cattle.

Podmolinoff gives the following summary of results obtained in 1892 and 1893 in the government of Kherson (Russia): Number of sheep inoculated, 67,176; loss, 294 = 0·43 per cent. Number of horses inoculated, 1,452; loss, 8. Number of cattle inoculated, 3,652; loss, 2. The conclusion is reached that Pasteur's method of inoculation affords an immunity against infection with virulent anthrax bacilli in greater amounts than could ever occur under natural conditions.

Another disease in which inoculations have been practiced on a large scale is erysipelas of swine (*rouget* of French authors), which prevails extensively in France and other parts of Europe.

Pasteur's first studies relating to the ætiology of *rouget* were made in collaboration with Chamberland, Roux, and Thuillier in 1882. Pasteur found that the virulence of his cultures was increased by passing them through pigeons and diminished by passing them through rabbits. By a series of inoculations in rabbits he obtained an attenuated virus suitable for protective inoculations in swine. In practice he recommended the use of a mild virus first, and after an interval of twelve days of a stronger virus. These inoculations have been extensively practiced in France, and the fact that immunity may be established in this way is well demonstrated.

In a paper published in 1894 Chamberland states that in the preceding seven years, during which time protective inoculations had been practiced in France on a large scale, the mortality from *rouget* had been reduced to 1·45 per cent, whereas before these inoculations were practiced the mortality from this disease was about twenty per cent.

Hutyra has given the following statistics of inoculations made in Hungary during the year 1889 with "vaccines" obtained from the Pasteur laboratory in Vienna: 48,637 pigs were inoculated on 117 different farms. Of these, 143 (0·29 per cent) died between the first and second inoculations. After the second inoculation 59 animals died (0·1 per cent). During the year following the inoculations 1,082 inoculated pigs died of *Rothlauf*. Before the inoculations the annual loss in the same localities is said to have been from ten to thirty per cent.

In a communication (1894) to the Central Society of Veterinary Medicine (of France), Arloing claims that he has demonstrated the ætiological relation of a bacillus first described by him in 1889 (*Pneumobacillus liquefaciens bovis*) to the infectious disease of cattle known as pleuro-pneumonia. The demonstration was not complete until recently, because of failure to reproduce the disease by inoculation with a pure culture of the bacillus.

Although this demonstration is of such recent date, protective inoculations against this disease have long been successfully practiced. For this purpose serum obtained from the lungs of an animal recently dead has been employed, this having been proved by experiment to be infectious material, although the exact nature of the infectious agent present in it was not determined.

In the Bulletin of the Central Society of Veterinary Medicine of May 24, 1894, M. Robcis reports the results of inoculations made with cultures of Arloing's *Pneumobacillus liquefaciens bovis*, and with injections of pulmonary serum. His statistics with reference to the last-mentioned "legal" inoculations he has obtained from official documents relating to the Department of the Seine.

The total number of infected localities in this department during the years 1885 to 1891 was 1,253; total number of contaminated animals, 18,356; total number inoculated, 18,359; total number of deaths prior to inoculation, 1,753; total number of deaths after inoculation, 2,741; total number of deaths due to the inoculation, 94; total percentage of mortality, 22·8 per cent. After discussing these and other statistics Robcis arrives at the conclusion that Arloing's method of preventive inoculations with cultures of the *Pneumobacillus liquefaciens bovis* gives better results than the legal method with serum from an infected animal, the total loss among animals exposed to contagion not being over twelve to fourteen per cent.

In the infectious disease of cattle known under the names of "black leg," "quarter evil," or symptomatic anthrax, protective inoculations have also been practiced with success. The disease prevails during the summer months in various parts of Europe, and to some extent in the United States. It is characterized by the appearance of irregular, emphysematous swellings of the subcutaneous tissues and muscles, especially over the quarters. The muscles in the affected areas have a dark color and contain a bloody serum in which the bacillus is found to which the disease is due. This is an anaërobic bacillus which forms large oval spores.

The ætiology of the disease was first clearly established by the researches of Arloing, Cornevin, and Thomas (1880 to 1883).

Strebel, in 1885, published the results of protective inoculations made in Switzerland in 1884. The inoculations were made in the end of the tail with two "vaccines," with an interval between the two of from nine to fourteen days. The vaccines were prepared by exposure to heat, as recommended by Arloing, Cornevin, and Thomas. The most favorable season for inoculations was found to be the spring, and the most favorable age of cattle for inoculation from five months to two years.

In seven Swiss cantons 2,199 cattle were inoculated; 1,810 inoculations were made among animals which were exposed in dangerously infected pastures. Of these but two died, one two months and the other four months after the protective inoculations. Among 908 inoculated cattle, which were pastured with 1,650 others not inoculated, the mortality was 0·22 per cent, while the loss among the latter was 6·1 per cent. The following year (1885), according to Strebel, the number of inoculations, exclusive of those made in the canton of Bern, was 35,000. The losses among inoculated animals are reported as having been about five times less than among those not protected in this way.

In the Bulletin of the Central Society of Veterinary Medicine of France (1892) Guillod and Simon give the results of 3,500 inoculations made since 1884. The mortality among cattle in the region where these inoculations were practiced had been from ten to twenty per cent, but fell to 0·5 per cent among the inoculated animals.

The success of Pasteur's method of prophylaxis against hydrophobia is now well established, although the specific germ of this disease has not yet been demonstrated.

Perdrix (1890), in an analysis of the results obtained at the Pasteur Institute in Paris, calls attention to the fact that the mortality among those treated has diminished each year, and ascribes this to improvement in the method. He says:

"At the outset it was difficult to know what formula to adopt for the treatment of each particular case. Upon consulting the accounts of the bites in persons who have died of hydrophobia, notwithstanding the inoculations, we have arrived at a more precise determination as to the treatment suitable for each case, according to the gravity of the lesions. In the cases with serious wounds we inject larger quantities of the emulsion of cord and repeat the inoculations with the most virulent material. For the bites upon the head, which are especially dangerous, however slight their apparent gravity may be, the treatment is more rapid, and, above all, more intensive—that is to say, the virulent cord is injected several times."

The statistics arranged with reference to the location of the bite are given by Perdrix as follows:

Bitten upon the head,	684;	died,	12 = 1·75 per cent;
Bitten upon the hands,	4,396;	died,	9 = 0·2 per cent;
Bitten upon the limbs,	2,839;	died,	5 = 0·17 per cent.

In the infectious diseases of man, which have been proved to be due to pathogenic bacteria, the most satisfactory evidence of the value of protective inoculations has been obtained in cholera and in diphtheria. In the first-mentioned disease protective inoculations were practiced on a large scale in Spain, during the epidemic of 1884 and 1885, by the method of Ferran. This consisted in the introduction of a small amount of a pure culture of the cholera spirillum into the subcutaneous connective tissue, by means of a hypodermic syringe. Shakespeare, who was sent by our Government to investigate the merits of this method of prophylaxis, was disposed to think well of it. He says:

"There is still another result of the preventive inoculations of Ferran apparently shown by these statistics. I refer to the apparent marked shortening of the course of the epidemic after a large percentage of the inhabitants have become inoculated. It would seem, therefore, from analysis of the official statistics, that the practice of the anticholeraic inoculation after the method of Ferran, besides giving the subject inoculated a considerable immunity from attack and death by cholera, furnishes a means of bringing an epidemic rapidly to an end."

More recently Haffkine has advanced evidence in favor of the protective value of subcutaneous inoculations with cholera cultures. His experiments in India have been made in Calcutta, Gaya, Cawnpore, and Lucknow. Those exposed, during the epidemic prevalence of cholera, under the same conditions as to locality, water supply, etc., are divided into two groups, the inoculated and the non-inoculated. In the first group, which includes 500 inoculated individuals, 21 cases occurred, of which 19 were fatal, a mortality of 3·8 per cent. In the second group were 1,735 individuals; the number of cases in this group was 174; number of deaths, 113; percentage of mortality, 6·51.

Whether this method will be found to have any great practical value can only be determined by more extended experiments. But in view of the fact that other measures of prophylaxis, well known to sanitarians, are sufficient for the prevention of cholera epidemics, and that nurses and others who necessarily come in contact with cholera patients are not likely to contract the disease if they use proper precautions with reference to their food and drink, the disinfection of their hands, etc., we doubt whether protective inoculations will ever come into general use as a measure of prophylaxis against this disease. Certainly they can not take the place of those sanitary measures which have been proved to be sufficient for the prevention of epidemics—namely, exclusion by a proper inspection service at ports of entry ("quarantine"), isolation of the sick, disinfection of excreta, general sanitary police of exposed towns and cities, boiling the water used for drinking purposes, etc.

But it must be remembered that these measures of prophylaxis, which have undoubtedly resulted in the saving of thousands of lives, are based upon exact knowledge obtained as a result of bacteriological researches. Since the discovery of the cholera spirillum by Koch in 1884, a very large number of skilled investigators have devoted themselves to researches relating to it, and especially to questions relating to its resistance to various destructive agencies. These researches show that it is quickly destroyed by a comparatively low temperature (60° C.), by desiccation, and by all known germicidal agents. It is especially susceptible to the action of acids, in comparatively dilute solutions. Our measures of sanitary prophylaxis are therefore established upon a sound experimental basis, and the extension of the disease in civilized countries is the result of a failure to apply well-known means of prevention. As a matter of fact, these measures have been successful in excluding the disease from this country during the last two widespread epidemics in Europe, and have enabled sanitarians to greatly restrict the epidemic spread of the disease in those countries into which it has recently been introduced.

The prevalence of typhoid fever has also been greatly restricted by measures based upon an exact knowledge of the biological characters of the typhoid bacillus, and if the recommendations of sanitarians were fully complied with there is reason to believe that it would be practically banished from our cities and towns.

The bacteriological examination of the water supply of towns and cities is now generally recognized as an important matter, as indicating the sanitary purity of the supply. The detection of the dangerous pathogenic species should lead to the disuse of a water for drinking purposes, or to the recommendation that it be boiled before it is used. The presence of certain other bacteria indicates sewage contamination and consequent danger to those drinking the water without proper precautions as to filtration or sterilization. In Berlin, where the water supply is taken from a river known to be contaminated by sewage, it is passed through carefully constructed "filter beds," and expert bacteriologists make frequent tests to ascertain how well these filter beds are accomplishing their purpose. In France the Pasteur-Chamberland filter is largely used, and recent reports indicate that it has been instrumental in effecting a great reduction in the rate of mortality from typhoid fever, especially among the French soldiers in certain parts of the country where this disease a few years since caused a considerable mortality, and where the civil population, not using the filters, still furnishes many victims to this disease.

The exact knowledge which we now possess with reference to the micro-organisms which are the cause of erysipelas, puerperal fever, septicæmia, wound infection, etc., has also led to the employment of intelligent measures of prophylaxis. The brilliant success which has attended the carrying out of these modern antiseptic and aseptic methods in surgical and obstetrical practice are too well known to call for extended remark. But some statistics relating to this branch of our subject may serve to impress the matter upon the minds of those who have not fully appreciated the saving of life which has resulted from the employment of methods based upon a knowledge of the usual modes of wound infection and the micro-organisms to which such infection is due. Lister, the distinguished pioneer in the employment of antiseptics in surgical practice, reports that during the years 1864, 1865, and 1866, before he resorted to the use of antiseptics, the mortality in his surgical cases exceeded forty-five per cent, largely from septic complications. During the period from 1871 to 1876, in a total of 453 surgical cases treated by him with strict antiseptic precautions, the mortality from such complications was only 0·36 per cent.

The German surgeon Volkmann reports that prior to the introduction of antiseptic methods the mortality from compound fractures in his practice was forty per cent. After adopting Lister's methods he had 135 successive cases of compound fracture without a death from septic causes; two deaths only occurred out of the whole number of cases; one of these was the result of delirium tremens and the other of fatty embolism of the lungs.

Brignot, a French surgeon, reports that in French hospitals the mortality from major surgical operations before the introduction of antiseptic methods was 52·5 per cent, and that since it has been reduced to a little less than eleven per cent. In a series of 736 cases of compound fracture collected by Prof. William White, of Philadelphia, all of which occurred before the introduction of antiseptic methods, the mortality was forty per cent. In a second series of similar cases in which these methods were employed the mortality was only four per cent. Dennis, of New York, has reported a series of 516 cases of compound fracture without a single death from septic causes.

Thirty years ago the mortality from puerperal septicæmia in lying-in hospitals was frequently something frightful. In the *Maison d'Accouchements* in Paris the mortality rate at times was as high as one out of every three patients delivered. Similar conditions existed in Berlin and in other European cities. At the present day the mortality from septic infection in similar cases is even less than in private practice. In the Maternity Hospital of New York, for example, in one thousand deliveries there were but six deaths, and but one of these was due to puerperal septicæmia.

If we take a more general view of the results attained in preventive medicine by the application of modern methods based upon our knowledge of the causes of infectious diseases, we shall find that a very large saving of life has been accomplished, as shown by diminished mortality rates in all parts of the civilized world. This is well illustrated by the carefully kept English statistics. The facts are very concisely stated by Sir Edwin Arnold in an address recently delivered at St. Thomas's Hospital upon Medicine, its Past and Future. He says:

"One of the high authorities already quoted has furnished a calculation of the salvage of life effected, even during the early years of the present reign, by the commencing improvements in preventive and curative medicine. In the five years from 1838 to 1842 London, with an average population of 1,840,865 persons, had an average annual mortality of 2,557 in every 100,000. In the five years from 1880 to 1884 the average metropolitan population was 3,894,261, and the average annual death-rate 2,101 in each 100,000. A calculation will show that these figures represent a saving or prolonging of lives during that lustrum to the number of 96,640. The mean annual death-rate has now been reduced to a point lower than shown in these. It was 22·16 per 1,000 for England and Wales at the commencement of the reign, and it is to-day better than 19·0 per thousand, while in her Majesty's army and navy the diminution of mortality apart from deaths from warfare has proved even more remarkable, and in India, where we used to lose 69 per 1,000 yearly, this has been reduced to 16 per 1,000."

We can not claim that this reduction in the mortality rate is due alone to the development of our knowledge relating to the pathogenic bacteria, for much had been accomplished by practical measures of sanitation before we had any exact knowledge of disease germs. But this exact knowledge has added greatly to our sanitary resources, and has doubtless been an important factor in the reduction in the mortality rate which has occurred within the past twenty-five years. Sir Edwin Arnold, in the address above referred to, says:

"A great authority has declared that 'a day will come when in London, in Berlin, in Paris, man will not die of diphtheria, of typhoid, of scarlet fever, of cholera, or of tuberculosis, any more than he dies in these cities to-day of the venom of snakes or of the tooth of wolves.'"

But it is not alone in preventive medicine that important practical results have been accomplished. Therapeutics has also been greatly and favorably influenced by the discovery of the specific germs of a considerable number of infectious diseases. Naturally, the effort is to destroy these germs at the focus of infection, or to render the conditions in the body of the infected individual unfavorable for their development. When the focus of infection is superficial or within comparatively easy reach, as in erysipelas or diphtheria, local treatment with germicidal agents is often attended with favorable results. But when the deeper tissues and organs of the body are invaded, or the germ multiplies abundantly in the blood, but little can be accomplished by the use of agents of this class. Our bacteriological researches have, however, recently resulted in the discovery of a method of treatment which has been employed with remarkable success in two of the infectious diseases of man, and which there is reason to believe may eventually be found to have a more extended application. I refer to the therapeutic use of antitoxins contained in, or obtained from, the blood of animals rendered immune by repeated inoculations with cultures of a specific disease germ. The diseases in which the greatest success has been attained by this mode of treatment are tetanus and diphtheria. As the last-mentioned is by far the most important from a practical point of view, I will confine my remarks to the results of treatment in this disease. Fortunately, I have at hand a recent summary of the clinical evidence in favor of this mode of treatment, made by a very competent and conservative physician—Prof. William H. Welch, of the Johns Hopkins University. Prof. Welch concludes his paper as follows:

"The principal conclusion which I would draw from this paper is that our study of the results of the treatment of over seven thousand cases of diphtheria by antitoxin demonstrates beyond all reasonable doubt that antidiphtheric serum is a specific curative agent for diphtheria, surpassing in its efficacy all other known methods of treatment for this disease. It is the duty of the physician to use it."

A recent report on antitoxin treatment in Germany, obtained by collective investigation, on a total of 10,312 cases occurring in a period of six months from October 1, 1894, gives very striking results. Of the whole number, 5,833 were treated with serum, and 4,479 without it. The proportion of deaths in the former group was 9·6 per cent, in contrast to 14·7 per cent in the latter.

In 401 cases of children under the age of two years, in which the serum treatment was used on the first and second day, the mortality rate was 11·8, in contrast with 39·7 where under similar conditions it was not used. Of 2,556 children between two and ten years of age, the death-rate was 4 per cent after antitoxin treatment, instead of 15·2 per cent in the other group.

Prof. Welch very truly and forcibly remarks: "The discovery of the healing serum is entirely the result of laboratory work. It is an outcome of the studies of immunity. In no sense was the discovery an accidental one. Every step leading to it can be traced, and every step was taken with a definite purpose and to solve a definite problem."

The importance of prompt treatment in this very fatal malady is shown by the following figures which we take from Prof. Welch's paper. The cases referred to were reported by nineteen different observers, and the total number treated was 1,489, with a mortality of 14·2 per cent. Of these cases, 222 were treated with the antitoxic serum on the first day of sickness, with a mortality of 2·2 per cent; 456 cases on the second day, with a mortality of 8·1 per cent; 311 on the third day, with a mortality of 13·5 per cent; 168 on the fourth day, with a mortality of 19 per cent; 116 on the fifth day, with a mortality of 29·3 per cent; 44 on the sixth day, with a mortality of 34·1 per cent; 104 after the sixth day, with a mortality of 33·7 per cent; 68 undetermined.

The time at my disposal will not permit me to dwell longer upon the practical results already attained in preventive medicine and in specific therapeutics as a result of bacteriological investigations. But before closing I desire to call attention, as briefly as possible, to the value of the recent additions to our knowledge relating to the causes of disease, in the way of an exact and early diagnosis. In certain infectious diseases such knowledge is of great importance, not only in the interest of the patient, but of others liable to infection. This is especially true in diphtheria and in tuberculosis of the lungs. In the first-mentioned disease an early differentiation of true diphtheria from pseudo-diphtheria is often impossible without resort to methods by which the bacteriologist is able to detect the presence of the diphtheria bacillus. In pulmonary tuberculosis, also, the bacteriologist can usually detect the tubercle bacillus in the sputa before the clinical expert can recognize with certainty the physical signs of the disease. Scientific physicians in all parts of the world now resort to the use of the microscope and the staining methods by which this bacillus is recognized for making an early diagnosis in cases of this nature. Other diseases in which the recognition of the specific germ establishes the diagnosis are relapsing fever, typhoid fever, glanders, and anthrax—the two last mentioned being diseases of lower animals which may be transmitted to man. And in tuberculosis and glanders affecting domestic animals we have still another method of establishing the diagnosis in suspected cases. This is by the subcutaneous injection of a proper dose of a filtered culture of the specific pathogenic bacteria. These filtered cultures, containing the soluble toxic products developed during the growth of the bacillus, are known in the one case (tubercle bacillus) as tuberculin, and in the other (glanders bacillus) as mallein. The effect is similar in each case. When an animal infected with tuberculosis receives a suitable dose of tuberculin a characteristic febrile reaction is produced. In the non-infected animal this reaction does not occur. The same is true as regards animals infected with glanders which receive a dose of mallein. This test of infection is now extensively used both in this country and in Europe with very satisfactory results. The importance of an early recognition of these chronic infectious diseases is apparent. The danger from infected animals is not limited to the extension of the disease to others of the same species, but in tuberculosis those who consume the milk are exposed to the danger of infection, especially in cases where the udder of the animal is the seat of a tubercular infection.

I have by no means exhausted my subject, and an attempt to do so would probably exhaust the patience of my audience. In conclusion, I would say that the painstaking laboratory work which has led to the important practical results referred to is still being prosecuted with unabated vigor, and without doubt we may look for further valuable additions to our knowledge. These, together with a wider appreciation of the present status of this department of scientific investigation, can not fail to add largely to the practical results which will hereafter be achieved in the field of preventive medicine and of specific therapeutics, and in agriculture, in the dairy, etc., as heretofore indicated.

The Prince of Monaco recently reported to the French Academy of Sciences on the results of his deep-sea dredging expedition of 1895, from Portugal to the Azores and back to the English Channel. The dredgings were carried to the depth of forty-two hundred metres, where weirs were deposited; and numerous soundings were made, some of them as far down as five thousand metres, and specimens of the water drawn up. Fine captures were made in the weirs from fifteen hundred metres, in which echinoderms, mollusks, and fishes were plentiful. Thus, three hundred and fifty-five animals were taken in twenty-four hours in the same net—three hundred of them fishes, large red shrimps, and cephalopods. Besides the usual fauna of such profundities, crayfishes eighty centimetres long and superb holothurias of forty-six centimetres were drawn up from the depth of four thousand metres.

TROPICAL FRUIT TREES.

By BERTHA F. HERRICK.

ALTHOUGH the fruits of the tropics seldom ripen in temperate climates, the trees are often cultivated merely for the beauty of their foliage; so that it may prove of interest to become further acquainted with their general appearance and uses in their far-off native habitats.

The beautiful date palm is indigenous to Africa and Asia, though flourishing in all hot countries. There are said to be nearly a thousand species, the most vigorous specimens reaching the height of eighty feet and living for two hundred years. Each tree yields from one hundred and sixty to two hundred pounds of fruit in a single season, some of the clusters weighing nearly forty pounds. It is propagated by suckers from the root, whence its name of "Phœnix," and bears its first crop when about eight years of age.

No less than three hundred and sixty uses are claimed for this invaluable tree. The trunk furnishes timber for furniture and house-building as well as fuel, cooking utensils, and bows and arrows; the roots are utilized for fencing and roofing, and the fiber is woven into mats, fishnets, ropes, baskets, and articles of clothing. Among the natives of the Orient the nutritious fruit is the principal food for nearly the entire year, and, pounded into solid cakes, is carried by Arabs journeying over the scorching desert, the stones being used as fodder for the camels. Roasted and ground, the kernels make a fair substitute for coffee, and are also valued on account of their oil.

These trees are sometimes known as the "palms of victory," as the large, frondlike leaves are supposed to be identical with those that were strewn before the Saviour on his entry into Jerusalem, and that were borne with songs of rejoicing before ancient conquerors returning from their triumphs on the battlefield; while on Palm Sunday and at the Jewish Feast of Tabernacles they are highly prized as church decorations. In some varieties the flower-spathes yield a large quantity of sweet sap, which upon evaporation becomes "date sugar," this being fermented into an intoxicant called "arrack." The terminal bud or "cabbage" is considered a great delicacy, and is boiled and eaten like a vegetable.

Another well-known fruit tree of the tropics is the graceful *Musa*, or banana, a relative of the plantain. The rapidly growing suckers are productive at any season of the year, in a period of from nine to eighteen months, according to the altitude, the tree dying after ripening several bunches, some of which weigh nearly eighty pounds. Many of the large, handsome leaves—usually torn to fringes by the trade winds—measure ten feet in length by two

Banana Tree.

feet in breadth, their uppermost crests waving twenty feet above the ground.

From the fibrous petioles or leaf stalks is manufactured a fine, white flax, which is woven into delicate muslins, or, when in a half-finished state, is used for tinder or wadding; while one variety in the Philippine Islands furnishes the well-known Manilla hemp.

Green bananas are sometimes dried and ground into meal or flour, which is baked or fried in cakes. So common is this fruit in the tropics that a huge cluster may be purchased for the trifling sum of twenty-five cents, and a generous bunch always hangs in the hallway or on the veranda of the hospitable planter's home.

Tradition claims that plantains flourished in the Garden of Eden, together with the "tree of life" and "the tree of the knowledge of good and evil." They are larger and more succulent than bananas, and are used for almost the same purposes. Like the

Breadfruit Tree.

date-palm and the cocoanut tree, the "cabbage" of this plant is a favorite article of diet.

The breadfruit, or *Artocarpus*, is a native of the Indian Archipelago and the islands of the Pacific. It attains an elevation of about fifty feet, and grows wild in the forests. The leaves are large, glossy, and deeply pinnated, like the fronds of a fern, and the fruit resembles a muskmelon—the edible interior being of the

Lower Part of Mango Tree. Hawaiian Islands.

consistence of newly baked bread, and tasting like batter-pudding or boiled milk and potatoes. It is sometimes fried in slices, and served with meat as a side dish, or eaten with milk and sugar; but the usual mode of preparation is to bake the unripe quartered portions in rude ovens of heated stones, arranged in layers with earth and leaves, on the same principle as scalloped oysters. As there are many varieties, ripening at different seasons of the year, the supply is practically inexhaustible. Some kinds yield valuable timber, and from the inner bark of other species the natives manufacture clothing.

The "Jack-fruit"—a South Sea representative—is long and gourdlike, and weighs from twenty to sixty pounds. Although most of the crop is borne on the boughs, in the usual manner, some of the fruit grows directly on the bare trunk, a foot or two from the ground, presenting a very singular appearance. It ripens numerous seeds, which are considered very nutritious, and are eaten like chestnuts.

An Indian tree of great beauty and interest is the tamarind, with its thick, lofty trunk, wide-spreading branches, and clusters of purplish or yellowish flowers. So fine and light is the foliage that the Koran doomed lost souls in hell to have their thirst quenched only once in a thousand years with as much water as could be held in a single leaflet. The long, narrow pods contain citric and tartaric acid, sugar, and potash, and are imported in large quantities from the East and West Indies, to be utilized in various economies.

The fruit of the curious *papaya,* sometimes called the papaw, suggests a pumpkin in taste and general appearance, and a score or more are attached in a mass to the naked stem, immediately beneath the crest of leaves. As they contain a large amount of pepsin, they are widely used medicinally; and tough meat, wrapped for a couple of hours in one of the leaves, becomes exceedingly tender, and in time almost rotten.

Ohias, or Mountain Apples.

There are numerous kinds of guavas, the best being the red and the white species, which are famous for their jelly-making possibilities. The fruit is about the size of a small apple, and is obtainable at nearly every season of the year.

The mango came originally from Hindostan, and is a magnificent shade tree, forty feet high, with leaves something like those of a peach tree, and quantities of juicy yellow plummets, suspended from the branches by very long, slender stems. Some wild varieties have an unpleasant taste of turpentine, but the better-flavored sorts are manufactured, when in an unripe state, into preserves and pickles for exportation.

The shining emerald leaves and the pretty scarlet flowers of the pomegranate (*Punica granatum*) are familiar to nearly every one who owns a garden or frequents a city park. The fruit of this plant was mentioned by Moses as one of the attractions of the Promised Land; and he was commanded to make golden pomegranates and their blossoms alternately on the hem of the ephod; while four hundred specimens of these curious globes

OHELO, OR HAWAIIAN HUCKLEBERRY.

were wreathed around the capitals of the two brass pillars of King Solomon's temple.

Various parts of this shrub were used by the ancients for medicine, and the bitter juice furnished a light but indelible blue stain.

The *ohia,* or Malay apple, is a common timber tree of the Hawaiian Islands, though not peculiar to that locality. On the Island of Maui is a mammoth orchard of wild ohias, extending from the sea to the mountains, and measuring twenty miles in length by from five to ten miles in width. The trees are from forty to fifty feet in height, some of the largest yielding nearly

Avocado, or Alligator Pear.

fifty pounds of fruit, the total crop being said to be sufficient to fill a fleet of one hundred steamers. The beautiful crimson or white apples, however, are unfit for transportation, as they last but a short time in a good condition.

Near the Volcano House on the island of Hawaii are great thickets of the *ohelo,* or Hawaiian huckleberry (*Vaccinium* *reticulatum*), which the natives consider sacred to Pele, the goddess who is supposed to preside over the famous crater of Kilauea; and which, together with white pigs and chickens, are thrown by them into the boiling red lake during an eruption, to appease the wrath of the aggressive dame, and thus cause the rivers of lava to cease flowing on their destructive course.

These berries grow in clusters on low bushes right on the very brink of the brimstone beds, and are so numerous that a bushel may be easily gathered in half an hour. In appearance they somewhat resemble a cranberry, and the flavor is pleasantly suggestive of grapes.

Space forbids more than passing mention of many other fruit trees of the tropics—such as the *avocado*, or alligator pear, tasting like our ordinary salad; the curious pineapple, with its cactuslike leaves; the mandarin orange, glowing brightly against its deep-green foliage; the *cherimoya*, or custard apple; the lime, the lemon, and the Japanese *loquat*—though they are all of great beauty and extended usefulness.

WAR AND CIVILIZATION.

By W. D. LE SUEUR.

THE events of the last few months in the field of international politics, though they have been of a sufficiently disquieting character, have served at the same time to reveal the profound antagonism between the idea of war and the developed moral consciousness of the age. Rumors of war have filled the air, and, in more than one highly civilized community, popular passions have been roused to a dangerous pitch; yet, in spite of the raging of demagogues and the angry acclaims of the populace, war has not broken out. The sky has been black with thunder clouds, but the storm has not burst. To say that war between civilized nations is henceforth impossible would be to speak with singular rashness, in view of the vast and ever-increasing preparations for war which the most civilized nations have, during the last ten or twenty years, been engaged in making, and in view also of the waves of warlike sentiment which have lately swept over communities that might be supposed to be by instinct and principle most inclined to peace. At the same time it is impossible for those who abhor the thought of war not to derive hope and comfort from the fact that it seems almost impossible even now to bring the dread result about. Jingoes and other light-hearted and light-headed persons may talk as they like; the moral difficulties to-day in the way of a war between any two very advanced countries are enormous. We do not say they can not be overcome, that the dielectric can not be ruptured by some sudden and enormous rise of potential; but we do say and rejoice to say that the strain will have to be enormous, and the circumstances fateful to the last degree, before such a result is reached.

We freely grant that, looking at the question theoretically, it is very difficult to imagine the complete cessation of war or the complete discontinuance of warlike preparations. De Quincey, in his celebrated essay on War, took the ground first that war could not be abolished, and secondly that it ought not to be abolished. He regarded it, as he tells us, first as "a physical necessity, arising out of man's nature when combined with man's situation," and in the second place as "a moral necessity connected with benefits of compensation, such as continually lurk in evils acknowledged to be such." War *ought* to exist, he further explains, "as a balance to opposite tendencies of a still more evil character, . . . as a counter venom to the taint of some more mortal poison." De Quincey has developed and, as they say in French, "embroidered" this thesis with his usual eloquence; but we can not admit that he has proved it, which after all is the principal thing. After dismissing the idea that wars have frequently had their rise in the most trivial causes, such as quarrels of the boudoir or a king's ill-humor vented in the first place on his foreign minister and by the latter diverted to a neighboring nation, he states that the real causes of war "lie in the system of national competitions; in the common political system to which all individual nations are unavoidably parties, with no internal principle for adjusting the equilibrium of those forces, and no supreme Areopagus, or court of appeal, for deciding disputes." He points out too, what is perfectly true, that war conducted by responsible powers according to recognized rules is better than unregulated conflicts and reprisals along the frontiers of adjoining states; but, unless we are to assume that such unregulated conflicts could not be prevented by the internal police of the respective countries, we can hardly accept this as a valid argument for the necessity of war. In point of fact such conflicts are prevented in this precise manner; and the frontiers of two neighboring civilized states enjoy in time of peace just as much security and tranquillity as the rest of their territories.

More serious is the argument that war necessarily results from the natural rivalries of states. De Quincey speaks of it as "an instinctive *nisus* for redressing the errors of equilibrium in the relative position of nations. Civilities and high-bred courtesies," he adds, "pass and ought to pass between nations; *that* is the graceful drapery which shrouds their natural, fierce, and tigerlike relations to each other. But the glaring eyes, which express this deep and inalienable ferocity, look out at intervals from below these gorgeous draperies; and sad it is to think that at intervals the acts and the temper suitable to those glaring eyes *must* come forward." That differences of national temperament, differences of institutions, and commercial rivalries do breed animosities is, unfortunately, true; but still the question presents itself: How long will the civilized nations of the world persist in a willingness to slaughter one another for these causes? It is acknowledged on all hands that the character of war has changed greatly for the better in modern times. It still is a matter of killing and of maiming in the endeavor to kill; but, decade by decade, it has to reckon more and more with the spirit of humanity. In this age, when civilized nations fight, they fight because they must or think they must, because overmastering circumstances have driven them to it; but the spirit to do the dreadful deeds which they set out to do is not what it was in past times: they neither hate nor contemn their enemies sufficiently to make war quite a satisfactory pastime. Our essayist talks of the "glaring eyes." Doubtless there is always danger when the eyes glare, for the next thing may be a spring; but the eyes may glare under momentary provocation, when there is no permanent rancor in the heart; and then what woe it would be if a moment's madness should mean the wrapping of a kingdom or a continent in the flames of war!

These are the thoughts which, we believe, are pressing themselves more and more upon the minds and hearts of men in the present day. Our essayist himself tells us that war is "ever amending its modes," and that, though it is a necessary final resort, it is even in that character "constantly retiring farther into the rear." This was written fifty years ago, when as yet arbitration between nations was scarcely known. The question which we may reasonably ask is, how much further war will have to retire into the background without falling into practical desuetude. War, moreover, tends continually to its own extinction, inasmuch as it is continually bringing the principles of international justice into clearer relief, and operating as "a bounty upon the investigation and adjudication of disputed cases." In this way "a comprehensive law of nations will finally be accumulated"; so that "it will become possible to erect a real Areopagus or central congress for all Christendom; not" (the essayist is careful to add, keeping in mind his thesis) "with any commission to suppress wars, but with the purpose and effect of oftentimes healing local or momentary animosities, and of taking away the shadow of dishonor from the act of retiring from war." It is encouraging to think that these words have more point to-day than ever they had before; that the progress of events and the development of humanitarian feeling have within the last fifty years very greatly increased the difficulties in the way of war, and powerfully inclined nations to regulate their relations with one another on principles of equity. Where is this process to stop? There is evidently a radical contradiction between the appeal to reason and the appeal to force; and if the habit of appealing to reason is gaining strength day by day, can we believe that the nations will go on indefinitely making preparations on the most enormous scale for the other mode of arbitrament? "One thing is clear," says De Quincey, "that when all the causes of war involving manifest injustice are banished by the force of opinion focally converged upon the subject the range of war will be prodigiously circumscribed." It is a great satisfaction to know that things are most distinctly moving in this direction. As a much more recent author, M. Ernest Lavisse, in his admirable little book, entitled A General View of the Political History of Europe, observes: "The ambition of territorial aggrandizement is tempered by a certain modesty. At the present day no sovereign would dare to undertake annexations on pretexts such as Louis XIV gave before attacking Spain in 1667, or Frederick II in 1740 after invading Silesia. If Poland's existence, miserable as it was, had been prolonged a few decades, her destruction would perhaps have been impossible."

That wars have directly or indirectly resulted in some advantage to the world in past times, it would be vain to deny; and that their rôle of usefulness even between so-called civilized nations is wholly and forever at an end, it would not be safe to assert. This, however, may be said, that if war ensues between two such nations, it is owing not to their civilization in any true sense, but to some lack in the civilization of one or other or both —some predominance of the spirit of greed, some inaccessibility to the dictates of reason, some fault of domestic government by which the crude passions and ignorant prejudices of the multitude or possibly the interested and partial views of a governing class, are allowed undue sway, some national overweeningness, some aberration of public opinion. War in such a case teaches sharp and much-needed lessons; but, unfortunately, it does not invariably advance the cause of justice. It shows where power resides, but does not always indicate the right. It may chasten where chastening was less needed, and exalt the pride of those who already were too insolent. Whatever evil it may destroy, it leaves new-created evil in its path. All we can hope is that, upon the whole, the education of the world may be advanced by the dire experience. We need not, however, laud war on this account, any more than we laud the epidemic which, taking its origin in neglect of sanitary principles, attacks by preference the weakly constitutions in the community, and, having passed, leaves the average of constitutional vigor somewhat higher than before. If we do not laud war, still less should we laud the dispositions that lead to war. Yet this is precisely the fatal error into which many fall: because some of the ulterior effects of war have in certain cases been beneficial, they hold themselves justified in cultivating and encouraging the war spirit. As well might we deliberately heap up garbage for the purpose of breeding a second epidemic because a preceding one had, from a sanitary point of view, produced some good results. The lesson to be learned from epidemics is how to avoid them, not how to bring them on; and, so with war, the question should ever be how to prevent it for the future, how to destroy the *nidus* in which its seeds germinate.

As we have already hinted, the eloquent De Quincey is far, in our opinion, from having proved his contention that war ought to exist, even if we had power to abolish it. He is not the only writer, however, who puts forward this view. "It is a question," says M. Lavisse, in the work to which we have already referred, "whether universal peace is a desirable object, whether it would not diminish the original energy of national genius, whether the best way to serve humanity would be to create human banality, whether new virtues would arise to replace the virtues of war. It is also a question whether universal and perpetual peace is not radically and *naturally* impossible." The doubts expressed by so competent a writer, and one commanding so wide a survey of the historical field, are certainly deserving of all consideration. What strikes us, however, at the first glance is, that plausible as these generalities may be, they have nothing whatever to do in determining the course of events, or in guiding the policy of a single state. Even could it be proved, much more conclusively than has ever been done yet, that war, with all its drawbacks, was favorable to the progress of the world, no nation would *on that account* burden itself with a war budget. The sole reason why nations tax themselves for the maintenance of armaments is because they consider it necessary to their safety to do so. There is not a power in Europe to-day that would not gladly disband its armies and dismantle its fleets if it were fully persuaded that no prudential reasons existed for keeping them in a condition of efficiency. This, it seems to us, is the broad fact to look at: war may be a school of virtue and may have a thousand other beautiful aspects, but it is not for the promotion of virtue, or the alimentation of poetry and romance, or for any general philanthropic purpose, that the nations of the world arm themselves to the teeth. Their views are of a more practical kind. They dread the injustice and greed of one another; each would feel its existence imperiled if it did not provide in ample measure to resist foreign aggression. If war is the blessing and benefit that some pretend, the logical thing would be to have war for war's sake, quite independently even of so flimsy a pretext as the Venezuela boundary. Then, by a due course of murder and rapine, we could train our youth to virtue, our army contractors to public spirit and honesty, our newspaper writers to modesty and truthfulness, our legislators to a lofty patriotism, and everybody else to a correspondingly high moral level.

War is the avenger of the *faults* of civilization; but, like other avengers, it is too furious to be discriminating. It may sweep a certain amount of "rubbish to the void," but none the less are the brain and brawn and heart of noble manhood crushed under its relentless feet. It may destroy some of "the cankers of a calm world and a long peace," but it blights at the same time the fairest promise of the age, and extinguishes its brightest hopes. There are virtues developed in the battlefield and the bivouac; but how much of virtue perishes in the slaughter of the battle or moans itself away within hospital walls! It is easy to talk glibly of the benefits of war; but if we seriously consider the havoc it makes in homes and hearts, and the horrible sufferings of every kind that it entails, not to mention the check that it gives to peaceful industry, and the burdens that it imposes on future generations, the benefits in question will appear very unsubstantial in comparison.

Concrete examples will, however, serve our purpose here better than any amount of generalizing. Twenty-five years ago there was a great and bloody war—of course the bloodier a war is the more we may expect from it—between France and Germany. We may, therefore, advantageously study the effect of the struggle upon both nations, and as regards one of them, Germany, we have the facts of the case ready to our hand in an article by A. Eubule Evans in the February number of the Contemporary Review. The first result which this writer, who is far from wanting in sympathy with the German people, notices is that their national self-consciousness and susceptibility are greatly increased. They wish now to exclude all foreign words from their language, even from the language of commerce, in which it is a decided advantage to have as many words as possible of world-wide signification. Before the war the French word "billet" was commonly used for a railway ticket; now it is banished in favor of "Fahrkarte." Before the war there was a disposition to abandon the crabbed German character, and use the open Roman print, common to the rest of Europe; to-day that idea, we are informed, is tabooed. "The old letters have become the symbol of patriotism, and no one talks of discarding them." So German eyes must suffer, and additional difficulty must be thrown in the way of the acquisition of the German language by foreigners, simply that Germans may enjoy a greater sense of separation from—and doubtless of superiority to—the rest of the world. To the natural abruptness of German manners there has been added, we are told, a decided flavor of aggressiveness which was not characteristic of them before the war. National self-assertiveness has become, the writer states, "a positive cult. It is encouraged," he adds, "by the authorities; it is fostered in the schools; perhaps some day it will form a subject for examination."

The most serious injury, however, has been done to the spirit of liberty. Prosecutions for lese majesty are the order of the day, and the charges on which such prosecutions are based are often of the most trivial kind. Editors accused of this crime for their criticism of the Government or the emperor are "treated in many respects like ordinary felons." They are not allowed out on bail before trial, but are kept in confinement, and at trial are brought up in prison dress. "Any adverse criticism of the Kaiser's utterances is a penal offense. Praise or silence—these are the alternatives." And yet, as Mr. Evans very truly observes, there has never perhaps been a monarch whose speeches more loudly challenged criticism. Such, however, is the price, or part of the price, which the German nation is paying for success in a great aggressive war. It is not only in political matters that the utmost restriction of political liberty prevails. "It is the same in everything. There is little possibility of independence in speech or action. The police are always at your elbow; and woe to you if you do not carry out their injunctions to the letter!" He adds: "To live in Germany always seems to me like a return to the nursery. . . . In fine, generally speaking, the aspect of affairs in modern Germany is by no means exhilarating. It seems to me that it may be summed up in a few words: an enormous increase of power and influence abroad, but at home less comfort, less liberty, less happiness."

It did not fall within the scope of the article from which we have been quoting to refer to any of the political events that have marked the interval between the termination of the Franco-German War and the present time; but an instructive commentary on the spirit which warfare, particularly successful warfare, breeds is afforded by the fact that five years after the close of the war the victorious and all-powerful German nation was only prevented by the peremptory prohibition of the Czar of Russia from falling again, without a shadow of justification, upon its weakened adversary, with the avowed intention of so crushing and maiming it, by further loss of population and territory, as to reduce it definitively to the rank of a second-class power. We have said "without a shadow of justification"; but to the military mind, and to a people intoxicated with military glory, it was justification enough that their defeated enemy was showing great powers of recuperation. The moral sense of Europe was shocked by this cynicism; but if war is such a beautiful thing as some pretend, and so useful an instrument of Divine Providence, how can we be sure that any war is to be condemned?

If we look at France, can we say that she has profited greatly by the ordeal passed through? An indirect result of the war was a change in her form of government, and considering the fundamental instability of the Napoleonic *régime* this must be counted a permanent advantage. The change had to come, and it was well that it was hastened. If, however, we look for signs of moral or intellectual improvement in the nation at large it is doubtful whether we shall find them. The politics of the country has been honeycombed by corruption; so that more than once it has seemed as if the people, sick of the misdeeds of their legislators and full of contempt for the whole parliamentary system, were on the point of sending the Third Republic packing after the first two, and making another desperate experiment with some "savior of society." If we consult the literature of the day, we certainly see no signs of moral advance. If such up-to-date writers as Paul Hervieu and "Gyp" may be trusted, the higher walks of society could hardly be more abandoned than they are to greed, luxury, and lust. Education has been making rapid progress, and so has crime; while the financial burdens of the state go on increasing at a portentous rate. The nation has doubtless learned from its calamities some lessons of self-restraint; and, as we have said, it has escaped from an essentially bad form of government, but it is difficult to assign any other beneficial results to the terrible scourging it received in the war with Germany. Comparing it, however, with the latter country, it seems to have suffered almost less from its defeats than the latter from its victories.

Crossing the Channel, we see a country which, though not unaffected by the increase of the military spirit which has marked the last quarter of a century, illustrates in a broad way the advantages as regards individual liberty and civilization in general which flow from at least a relative aversion to war. For forty years the British nation has waged no war in Europe, nor any war abroad that has at all seriously taxed its strength; and the methods of the government and the habits of the people are consequently more in harmony with a *régime* of peace and industry than is the case in any of the continental nations. Interferences with individual liberty which on the Continent would be taken as a matter of course would in England be resented as acts of tyranny. One of the chief marks of the industrial, as opposed to the military, *régime*, according to Herbert Spencer, is that under it the civil authority is chiefly known to the individual citizen as the protector of his rights, not as the director of his actions. This is the case in Great Britain to a remarkable extent. Authority there puts on no airs; it has duties to perform, and demands respect for itself in the performance of them; but it does not pretend to occupy a position of superiority over the people at large. What it does it does in their interest and by their warrant, and the only feeling, therefore, which a magistrate or other officer of the law has in that country is that he is co-operating with others for the general weal. In the courts lawyers may sometimes try to browbeat witnesses; but lawyers are *not* invested with authority, and the appeal of the witness in that case lies to the judge, who, as a rule, will not allow that kind of thing to go too far. In Victor Hugo's Misérables there is an interview between a young man of good social position (Marius) and a subordinate police officer, whose assistance the former has been obliged to invoke against a band of criminals. The petty potentate questions the young man very brusquely, and, finding him quite self-possessed and free from fear, compliments him in the following terms: "You speak like a brave and honest man. Courage does not fear crime, and honesty does not dread authority." An Englishman would have felt like knocking the fellow down for his impertinence and taking all risks. The preposterous idea that a citizen seeking the assistance of a functionary in a matter which the functionary is paid for attending to, should stand in any dread of him! But in countries infected with the military spirit civil authority can hardly help putting on the airs of absolute power.

The history of England may, however, be appealed to in support of the principle that individual liberty waxes and wanes according to the greater or less predominance of militarism. Wars conducted abroad, though they have an important reactive effect at home, do not affect domestic administration as wars carried on within the nation itself. The Norman conquest secured for England, if we except the struggles which occurred after the death of Henry I, a long period of comparative internal peace, toward the close of which parliamentary institutions began to take form and substance. Then followed the Wars of the Roses, which led to a decided increase in monarchical absolutism. But again peace came to the help of liberty; and, in the words of Bagehot which Mr. Spencer quotes, "the slavish Parliament of Henry VIII grew into the murmuring Parliament of Queen Elizabeth, the mutinous Parliament of James I, and the rebellious Parliament of Charles I." For over a century after the Commonwealth, liberty and social order continued to gain ground; but again came a period of reaction brought on by the incessant wars waged by England between 1775 and 1815. So severely were the resources of the nation strained that the military point of view dominated every other, the Government regarding the people, as has been said, in no other light than as "a taxable and soldier-yielding mass." "While," as Mr. Spencer observes, "the militant part of the community had greatly developed, the industrial part had approached toward the condition of a permanent commissariat. By conscription and the press gangs was carried to a relatively vast extent that sacrifice of the citizen in life and liberty which war entails. . . . Irresponsible agents of the executive were empowered to suppress public meetings and seize their leaders, death being the punishment for those who did not disperse when ordered. Libraries and newsrooms could not be opened without license; and it was penal to lend books without permission. Booksellers dared not publish books by obnoxious authors." * It was during this period that the poets Coleridge and Wordsworth found themselves being tracked by a detective in their walks through the country lanes of Somersetshire, the meditative manner and earnest discourse of the two bards doubtless impressing the intelligent minion of the law with the idea that they must be hatching revolutionary schemes. With the re-establishment of peace on a secure foundation liberty revived; and domestic legislation began to assume a distinctly humane and beneficent character. The penal code was greatly ameliorated, the long list of capital offenses being reduced till there remained but one, and the pillory and imprisonment for debt being abolished. Penalties and disabilities for religious dissent were gradually removed; the franchise was enlarged; municipal reform was inaugurated; the corn laws were abolished; free trade was introduced, liberty of the press established, and the police system of the kingdom greatly improved. These are the works and triumphs of civilization, and they flowed in almost unbroken streams as soon as the nation had recovered from the effects of its prodigious military efforts.

But, another change is now in progress, induced partly by the extreme tension of the Continental situation, and partly by circumstances peculiar to the present time. The apostle James in his day gave a very summary answer to the question, "Whence come wars and fightings among you?" "Come they not hence," he said, "even of your lusts that war in your members?" A recent article in the London Spectator, under the title of The New Form of International Greed, might almost be taken for a commentary on this text. What the journal in question points out is that while in past times the greed of nations was for territory without special regard to its wealth-producing properties, the greed to-day is for actual wealth and for such territory as is ex-

* Principles of Sociology, vol. ii, p. 626.

pected to yield wealth. "As the root of socialism," it says, "is the thirst of the poor for more physical comfort, better food, better lodging, and more leisure, so the root of international jealousy is the thirst for a larger national fortune. The peoples are eagerly scanning the roads to wealth, and find them, not in industry and reduced taxation, but in tropical possessions, in foreign trade, in the immense businesses based on 'concessions'—that is, in reality, upon mining rights, state contracts, and monopolies of all descriptions. In particular the thirst for gold in its concrete and tangible shape has broken out everywhere, almost as strongly as it broke out in the sixteenth century among Spaniards, Portuguese, and Elizabethan Englishmen." It happens that most of the gold-bearing territories are in English hands, and this, the Spectator thinks, accounts for a great deal of the jealousy with which England is regarded. Here we have, most unfortunately, a special and somewhat ignoble cause for the intensifying of the military spirit in the present day; and how to find a remedy for it is an extremely difficult question. The Spectator advises the English people "to remember that prosperity and success involve certain duties, one of which is to suffer others to be prosperous too, and another to abstain from boasting."

Here the baffling question arises, Can a whole people be advised? Individuals may listen to counsel; but, when it comes to a whole people, one wonders whether anything but experience, with a touch of natural selection thrown in, can teach. It certainly is the case that, *if* the nations would abate their greed and boastfulness, the danger of war would be much reduced, and the terrible burdens which it imposes be greatly alleviated. Patriotism is a good thing, but we fear that much evil is wrought in its name. It is not patriotism to disparage rival nations, or to seek to secure for one's own unjust advantages. Not unadvisedly did old Dr. Johnson, in a phrase now sadly trite, but perhaps never more apt than in the present day, describe patriotism as "the last refuge of a scoundrel." The doctor had doubtless seen more than one specimen of the loud-mouthed breed who shout for the flag and execrate the foreigner, but who would cheat their country at the first turn if they could get the chance. Patriotism, let us tell our children, if we can not get wider audience, is not a matter either of shouting or reviling, it is a matter of disinterestedly serving the country in which our lot is cast, and in which we enjoy the benefits of citizenship. That is the whole of it, but that is much. It may mean laying down our life; it may mean sacrificing our property; it may mean incurring unpopularity through fighting against wickedness in high places or in low places, and struggling for the good name of our country against those who are bringing it into discredit; at all times it means a faithful performance of the public duty that lies nearest at hand. "The old flag and an appropriation!" is the motto of a certain well-known brand of patriot; but the true patriot not only drops the "appropriation," but makes his reserves about the flag, which may or may not be associated with a righteous cause. The motto which commands his allegiance is, "My country's honor and well-being!" No less a cause than this is worthy of a good citizen's devotion.

Much is being said at the present time about the importance of cultivating patriotism in the public schools, and, not only so, but of preparing the scholars—the boys at least—by military drill for more quickly transforming themselves into soldiers at a future day. In several States of the Union this system is already in force, and there are ceremonial occasions when the flag is saluted, and so forth. Whether all this is for the best may well be doubted. It is difficult to put a gun into a boy's hand and drill him without creating in his mind a desire to kill somebody. Do we or do we not wish to cultivate this spirit in the rising generation? There is no doubt that the ease or difficulty with which a country is led into war depends very largely upon the dispositions of its population. If their thoughts run on war; if they have been accustomed by a semi-military training in the schools to make little of the horrors of war, and perhaps less of its crimes; if they have taken in the idea which continually haunts the military mind that might makes right, there can be no doubt that, in a given contingency, when a spirit of moderation and justice would smooth over an international difficulty, the voice of such a people will be given for war. They will perhaps then learn a needed lesson; but how foolish for people to set to work with their eyes open to produce the dispositions which lead to such a result! Admitting that the nation which had sedulously cultivated bellicose sentiments in its youth, and at great expense put itself in a condition to back up any aggressive or offensive policy on which it might enter, should conquer in an ensuing war, would that be a thing to be proud of, if the war were unjust? If the blood of Abel "cried from the ground," what of the blood of a hundred thousand, or two hundred thousand, or five hundred thousand Abels needlessly slain—slain that a restless military class might have the means of winning distinction in their chosen profession; slain that army and navy contractors should enrich themselves by a nation's calamities; slain that vulgar and ignorant passions might find vent in bloody action?

There is no subject to-day on which public opinion needs more to be enlightened than on the connection between peace and liberty on the one hand, and between war and tyranny on the other. Mr. Spencer's chapters on this subject, in the volume we have referred to, well repay perusal and reperusal. It may truly be said that we do not as yet know in the full sense what liberty is, and it may be added that, if the military spirit resumes possession of the world, as it is threatening to do, we are not likely to know. In a well-written article on this subject by Mr. A. B. Ronne, in a preceding number (June, 1895) of this magazine, it was pointed out that, since the close of the war of secession, there have been many manifestations of a more arbitrary spirit in the Government of this country than the people had previously been accustomed to, and that the idea of "regulation" was altogether too much in the air. There is one thing to be said on this point, and that is, that the misuse of liberty leads to regulation. Were there only one nation in the world, that nation might fall under a tyranny if its citizens could not use their liberties aright. If peace helps liberty, liberty should take counsel of justice and moderation, so that Peace be not ashamed of her work. We must learn to curb in peace those lusts that lead to war. A nation whose own internal condition was wholly satisfactory could by no possibility be dragged into a war of aggression, and would run extremely little risk of having to wage a war of defense. In such a nation the feelings that prompt to war would be wholly lacking.

We began this article by referring to the fact that very serious impediments, which we were glad to believe were largely of a moral kind, seemed to stand in the way of war between civilized nations in the present day; and, even as we have been writing, news comes that the principle of arbitration is more and more commending itself to the common sense and common humanity of mankind. There seems at the present moment every probability that, as between England and the United States, that principle will ere long be adopted as a fixed and, as it were, constitutional mode of settling international differences; and if once this step is taken the effect on the world at large will be very marked. Governments that have not advanced to the same point will seem to occupy altogether an inferior position; and it will not be long before their subjects begin to inquire with no little urgency why they can not enter into similar treaties and, by so doing, put an end to the terrible tension and hideous waste of human labor which the present situation involves. An article in the February number of the new international magazine Cosmopolis—a happy omen, we take it, of the better times to come—reviews in a very interesting and encouraging manner the progress which the principle of arbitration has made in the world. Since 1872, we learn—that is, since the Alabama arbitration—" nearly forty cases have been settled by arbitration; the large majority of these refer to differences between American republics, or of European states with American republics. The United States referred ten disputes to arbitration and England eight, and of these four were between England and the United States." The writer, W. J. Gennadius, quotes two very apposite declarations, one by General Grant, and one by that experienced and sagacious statesman, the late Earl Russell. Grant's words are, "Though I have been trained as a soldier, and have participated in many battles, there never was a time when, in my opinion, some way could not have been found to prevent the drawing of the sword." And Earl Russell's: "On looking at the wars which have been carried on during the last century, and examining into the causes of them, I do not see one in which, if there had been proper temper between the parties, the questions in dispute might not have been settled without recourse to arms." These declarations are worth reflecting on. The proviso introduced by Earl Russell is particularly significant: "*If there had been proper temper between the parties.*" That is what is wanted, "proper temper." It resolves itself thus into a question of national righteousness. The cynic may laugh at the conclusion; but those who are not cynics will venture to believe that the problem is not hopeless.

THE X RAYS.

By JOHN TROWBRIDGE,
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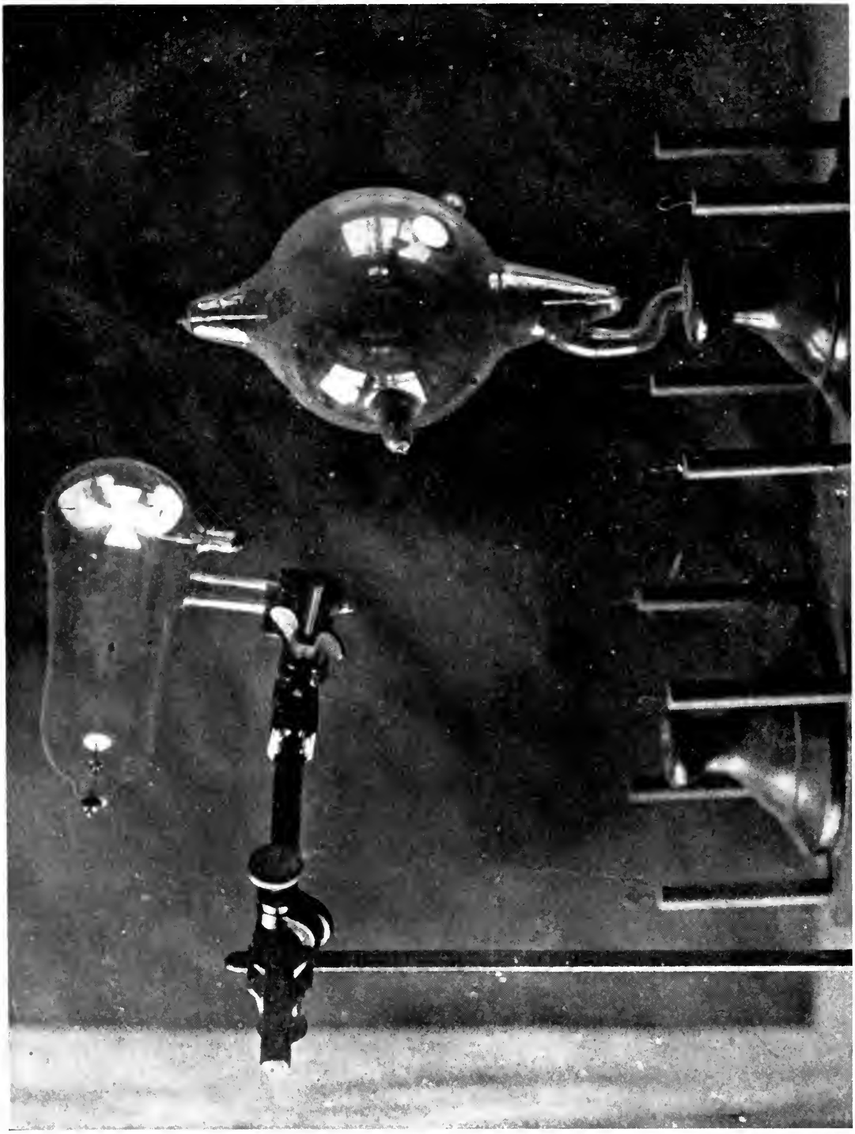
SINCE the publication of Hertz's paper on the penetration of thin sheets of metal, notably aluminum, by the cathode rays, interest in the remarkable phenomena investigated first by Prof. Crookes has been reawakened to a marked degree; and most physicists during the past five years have regarded the subject of cathode rays as the most important one in electricity. In 1893 Lenard succeeded, by means of a Crookes tube provided with a small aluminum window, in detecting the cathode rays outside the tube in the air space of an ordinary room. He used paper disks covered with a very fluorescent substance, which became luminous when the cathode rays struck them; and he also succeeded in showing photographic effects of the rays. Now Röntgen, by the use of ordinary dry plates and without the use of an aluminum window, has taken photographs through wood and through the human hand by means of what he terms the X rays, which he supposes are excited either in the glass walls of the Crookes tube or in the media outside the tube by means of the cathode rays.

We see, therefore, that the literature of the subject must be sought in the papers of Crookes, Hertz, Lenard, and Röntgen; and the interest in the mysterious manifestations of these invisible rays is twofold: first, in regard to the possible application of the phenomena to surgery, since the rays show a specific absorption, passing more easily through the flesh than through bones or glass or metallic particles; and, secondly, in relation to the questions whether we are dealing here with radiant matter shot forth from the negative pole or cathode or with longitudinal waves of electricity.

Let us first examine the possibility of the practical application of the cathode photography to surgery. The term cathode is applied to the zinc pole or negative pole of an ordinary battery. It is that terminal of an electrical machine which glows least in the dark when the machine is excited. It is the shortest carbon in the ordinary street electric lamp. The positive carbon or anode burns away twice as fast as the negative carbon or cathode. If the electric light is formed in a high vacuum by means of a great electro-motive force, we no longer have a voltaic arc or a spark; instead of this the exhausted vessel is filled with a feeble luminosity, and a beam of bluish rays is seen to stream from the negative terminal or cathode. When these rays strike the glass walls of the vessel they excite a strong fluorescence. If the glass contains an oxide of uranium this fluorescence is yellow; if it contains an oxide of copper it is green. Röntgen supposes that this fluorescence excited by the cathode rays is connected in some way with the formation of what he terms the X rays. Now, a photograph of the bones in the hand, for instance, can be obtained by placing a sensitive plate in an ordinary photographic plate-holder. Resting the hand on the undrawn slide in the daylight, with the palm of the hand outward and toward the cathode, and about six inches away from it, the bones of the hand are thus brought in the nearest possible position to the sensitive plate. At the time of the present writing, the breast and the abdomen of the human body present too great thickness for successful photographs, and the attempts to obtain representations of the cavity in which the brain is situated have been failures, since the rays do not show any marked difference in fleshy tissues. Nothing can be obtained in these attempts to photograph the brain but a contour of the cavity in which it is situated, and possibly a shadowy representation of a bullet which might be imbedded in the head. The method of obtaining a successful photograph of the hand shows the present limitations of the method. In order to obtain a fairly sharp shadow of a bone or of a shot, it should not be more than an inch away from the sensitive plate. The term shadow, however, is somewhat misleading. The photograph of the hand by the X rays is entirely different from one produced by resting the hand in a similar position to that above described against an uncovered sensitive plate in a dark room and then lighting a match. By the last method we should obtain a true shadow of the hand, the flesh would throw as dense a shadow as the bones, and the latter could



Crookes Tubes.

not be detected in the general blackness. In the cathode photograph, on the other hand, a difference in absorptive power is shown: the flesh looks like a hazy film around the skeleton, and even the medulla cavities can be made out, and the varying thickness of the bones is more or less shown. This specific absorption is of great scientific interest as well as of practical importance.

Now, these X rays will penetrate several inches of wood, with varying amount of absorption, but they are almost entirely cut off by glass as thick as a window pane. They pass through thin layers of aluminum, even layers as thick as a silver ten-cent piece, while the silver coin almost entirely intercepts them.

It therefore immediately occurs to one, Why not return to Lenard's tube, provide a Crookes tube with an aluminum window, and thus save the great absorption of the glass walls of the tube? There are certain practical difficulties in the way. The aluminum must be very thin. Lenard used a window which was about one eight-thousandth of an inch thick, and it was necessarily very small, in order to stand the atmospheric pressure. An aluminum window one eighth of an inch thick, or as thick as a ten-cent piece, would absorb nearly as much as the glass walls of the present forms of Crookes tubes, which are not more than one sixtieth of an inch thick. Glass vessels seem at present to be more practical than any composite form, in which aluminum is glued to a glass-supporting vessel: first, because it can be blown very thin, and in a shape strong enough to withstand the atmospheric pressure; secondly, because the occluded air can be more effectively driven off the inner walls of the vessels by heating it while it is being exhausted than it can be expelled from a vessel of any other material.

To obtain successful photographs, the exhaustion of the air must be pushed to a high degree; and this is also interesting from the scientific point of view. Moreover, a high electro-motive force is necessary. Pictures can be taken in less than one minute of the skeleton of the human hand by means of high vacua tubes excited by high electro-motive force. Even in this bare recital of the present limits of the application of the X rays to photography, we perceive great possibilities in the application of the method to the surgery of the human extremities. There is no doubt that small foreign bodies, like shot and pieces of glass, can be detected in the fleshy tissues of the hand. Certain accessible regions of the body, like the mouth, can possibly be examined by placing a sensitive film inside the mouth and the cathode outside of the cheek; and it does not seem improbable that a suitable cathode vessel can be inserted into certain abdominal regions and a photograph be obtained by placing a sensitive plate on the outside of the body. By employing two cathodes, at the proper distance apart, stereoscopic representations of the bones can be obtained, and an estimate formed of the position of foreign bodies.

Let us now turn to some of the interesting scientific questions

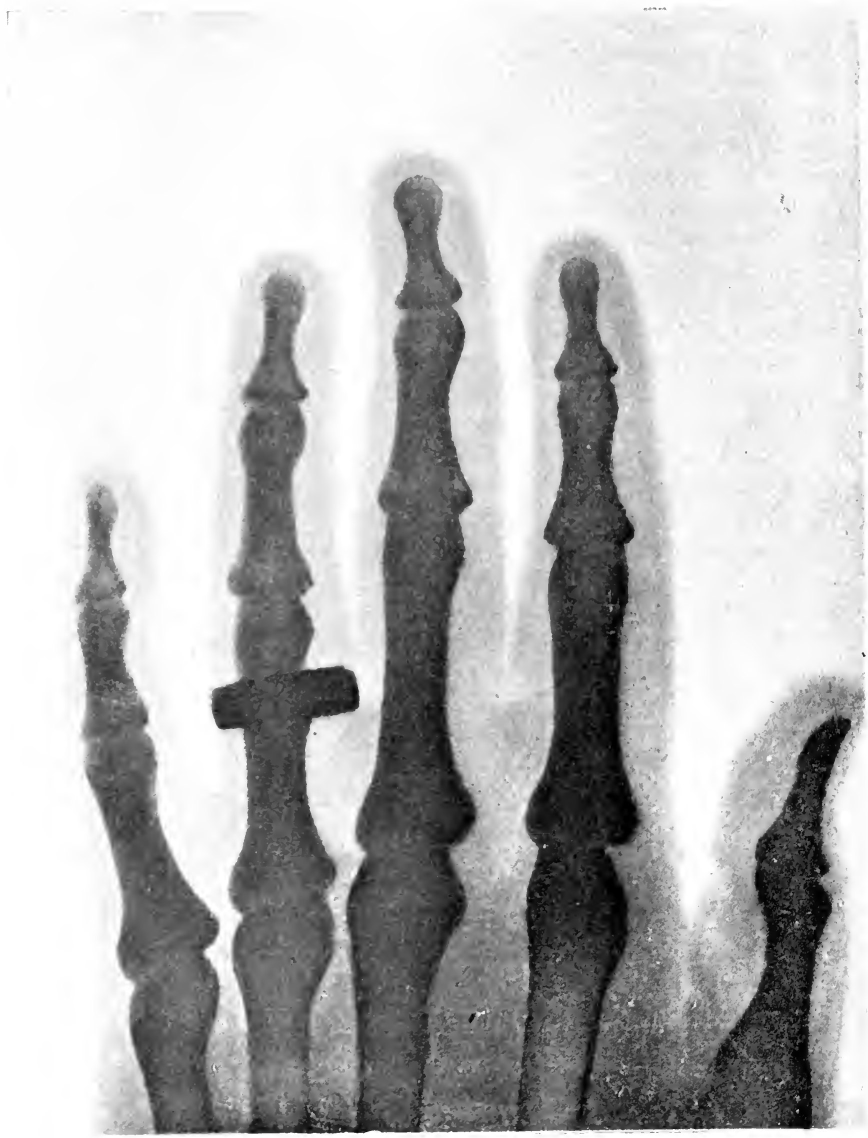
Hand after an Exposure of One Minute.

which have arisen in regard to this apparently new manifestation of the cathode rays. In the first place, they are apparently not refracted by paraffine, vulcanite, or wood, or by any substance which is penetrated by them. To test this, I employed a double-convex lens of wood and also a double-concave lens of the same material. I placed two copper rings in the concavity of the double-concave lens of wood, and also a similar copper ring outside the lens at the same height from the sensitive plate, as one of the rings which rested on the wood of the lens. I also placed a ring on the double-convex lens, and employed two cathodes to obtain two shadows from different positions. The thickness of the wooden lenses varied from half an inch to three quarters of an inch. The images obtained through the wood of the lenses were not distorted or changed in figure in any way by the wood, and therefore no refraction could be observed by this method. On account of the quick diffusibility of the rays, no accurate method of determining a possible index of refraction seems possible. If the photographic effect is due to longitudinal waves in the ether, and if these waves travel with great velocity, no refraction would probably be observed. Maxwell's electro-magnetic theory of light supposes that only transverse waves are set up in the ether, and no longitudinal waves exist. On the other hand, Helmholtz's electro-magnetic theory of light postulates longitudinal waves as well as transverse waves. The longitudinal waves travel with an infinite velocity. Is it therefore possible that the X waves are the longitudinal waves of Helmholtz's theory? Our apparent inability to refract the rays lends color to this hypothesis. Röntgen, in the preliminary account of his experiments, intimates that the phenomena may be due to longitudinal waves, and in a late article in the Annalen der Physik und Chemie, by Jaumann, entitled Longitudinal Light, Maxwell's electro-magnetic equations are modified so as to embrace the phenomenon of cathode rays; and the author shows that even Maxwell's theory can, under certain conditions, give a longitudinal wave.

The cathode rays can be deflected by a magnet, and it is said that the X rays can not. It must be borne in mind, however, that when the cathode rays are widely divergent it is difficult to deflect them by a magnet; the stream density, so to speak, is too feeble. The X rays, therefore, may be only cathode rays modified by passing through the glass vessel; and the stream of rays may be of too feeble a character to be influenced by a magnet—that is, they may be still cathode rays. The want of refractive power and the want of magnetic action have not been fully established. Crookes early showed that two cathode beams sent out from two cathodes placed beside each other, repelled each other, as if they consisted of streams of negatively electrified molecules. If the two beams were of the nature of electrical currents, they ought, being of the same sign, to attract each other. This experiment seems to point to an electrostatic nature of the cathode rays. The electrostatic lines of force go out from a charged conductor at right angles to the surface of the conductor. I have had constructed a Crookes tube with two parallel terminals of aluminum. The fluorescence in the walls of the vessel, when it was exhausted, showed that the cathode rays went out from every element of the cathode at right angles to it. By bending it into an arc of a circle the cathode beams traveled over the surface of the vessel, forming zones of light the centers of which were in the bent wire. Is it not possible that by the electrostatic action the few molecules of air left in the high vacua are shot off with great velocity and bombard the walls of the vessel, thus giving rise to the fluorescent light, and also giving rise to an agitation of the molecules of matter outside the vessel? This may be called the molecular view of the phenomenon. I confess it is difficult to see why the molecular agitation is stopped by a thin sheet of glass and not by an inch of wood. It is certain that a few molecules must be left in the high vacua, for the cathode rays can not be formed in a perfect vacuum.

It is also true that it is useless to attempt to obtain photographs in any reasonable time from tubes which do not show a strongly marked cathode beam, or from tubes which on reversing the electric current through them do not show a marked difference between the light at the cathode and that at the anode. In poorly exhausted tubes one can perceive a faint appearance of a cathode beam, which is lost at a short distance from the cathode, as if the molecules which are shot off meet with such a crowd of more slowly moving ones that their energy is soon lost, and the cathode beam is quickly diffused like a beam of sunlight passing into milk and water. Thus the beam of cathode or X rays emerging from the glass vessel into the air is soon no longer conical in form. The sides of the cone of rays are no longer straight; they are curved, as if the generatrix of the cone were a curved line instead of a straight line, and the beam is soon lost in a turbid medium. One can imagine a stream of projectiles being similarly dispersed in striving to pass into a region of sluggishly moving shot. This molecular view of the phenomenon seems at first sight to be a more tangible one than the longitudinal wave theory. It is possible, too, that the impact of the molecules on the aluminum window of Lenard, or on the glass sides of the vessel, may serve to start ripples, so to speak, in the ether, which are propagated with the velocity of light.

The Röntgen phenomenon seems to be a manifestation of cathode rays brought to light and endowed with great practical interest by its application to dry-plate photography. When we return to the classical investigation of Lenard mentioned in the beginning of this article, we are impressed by an apparently crucial



Röntgen Picture of a Hand after Lengthened Exposure.
From The New York Medical Journal.

experiment which he describes in regard to the existence of an ether. He caused the cathode beam to pass out of his high vacua through an aluminum window into another tube about three feet long, which had been exhausted to such a high degree that no electrical discharge would pass through it. It seemed, therefore, to have an infinite electrical resistance. No cathode beam could be generated in it; nevertheless, by moving suitable disks of fluorescent matter from point to point in the tube by means of an outer magnet which attracted bits of iron on the disks, Lenard showed that the cathode beam passed through the vacuum. Energy passed into the vacuum and could be detected from point to point. We can conceive of its passing through the ether in the tube by a wave motion, but not by a molecular movement, for there were no molecules to move. The molecular bombardment must have stopped at the aluminum window, and the resulting energy may have been propagated by ripples in the ether. This experiment of Lenard seems to me the most interesting one in the subject of cathode rays. The greatest mystery, however, which envelops the subject is the action of the X rays on bodies charged with electricity. When the rays fall on, for instance, a charged pith ball, the charge disappears. A positive as well as a negative charge is dispelled by the X rays. The energy of the medium about the pith ball is changed to a marked degree, and in this phenomenon we seem to be brought closer to a wave theory in a medium than to a molecular theory of movement of matter.

ACCLIMATIZATION.

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SECOND PAPER.

WHAT is the first effect of a tropical climate upon the human body and its functions ?* The respiration becomes more rapid for a time, although it soon tends toward the normal;† the pulse beats more quickly;‡ the appetite is stimulated;# and a surexcitation of the kidneys‖ and the sexual organs ensues;^ the individual as a rule becomes thinner;◊ the liver tends to increase in size, which is perhaps the cause of a certain sallowness of skin;‡ and in females menstruation is often

* This general subject is somewhat technically discussed in Revue d'Anthropologie, new series, ii, p. 135.

† Jousset, *op. cit.*, p. 160. Also Bulletin de la Société de Géographie de Paris, 1878, p. 427.

‡ Ibid., p. 197. # Ibid., pp. 208, 211. ‖ Ibid., p. 221. ^ Ibid., 229.

◊ Ibid., p. 139. Healthy Europeans in the tropics are lighter in weight than the same class at home (Archiv für pathologische Anatomie, etc., cxix, p. 254).

‡ Hirsch, *op. cit.*, iii, p. 388; *cf.* Peschel, Races of Man, p. 92.

disturbed, the age of puberty being sooner reached.* A very important change, which has not perhaps been fully investigated as yet, is a temporary rise of temperature, which often lasts for some time after the individual leaves the tropics. † Sir Humphry Davy was the first to note, on a voyage to Ceylon, that the temperature of travelers tended to rise in this way, ‡ and Dr. Guegnen confirms his conclusions, although he shows that the rise is less than had been supposed.# Dr. Maurel concludes that it varies from 0·3° to 0·5°. ‖ Observations on Europeans between Khartoum and the equator showed that for those who had been there less than two years the average was 99·5°, or nearly a degree above the normal. Those who had been there longer than four years exhibited a lower temperature of 99·1°, still a half degree over the average in Europe.^

It is not impossible that these delicate variations of temperature may bear some relation to the racial pathological predispositions which we have noted, as well as to the liability of the newcomer in the tropics to contract fevers and other zymotic diseases from which the natives and the fully acclimated whites are immune. ◊ Darwin indirectly hinted at such a solution many years ago, and suggested at the same time a study of the relation of the complexion to immunity from fevers. But no one appears to have followed it up. ‡ The recent development of the science of hydrotherapeutics certainly points to this conclusion. Several observers have already noted a permanent difference in the normal mouth temperature of the different races. Glogner has shown that the temperature of the Malay is slightly lower than that of Europeans, ‡ the brown skin radiating heat more freely. ‡ The Mongolian race more nearly approaches the European than does the negro, whose norm is considerably lower.** Dr. Felkin †† gives observations to show that the average mouth temperature of six

* This well-known fact is clearly shown by statistics in Revue d'Anthropologie, second series, v, p. 373.

† Jousset, *op. cit.*, pp. 201, 207, 259, 391.

‡ Proceedings of the Royal Society, London, 1814. civ, 1825. Other references in Bulletin de la Société d'Anthropologie, Paris, 1884, p. 374.

Archives de Médecine navale, January, 1878.

‖ Bulletin de la Société d'Anthropologie, 1884, pp. 375 *et seq.*

^ Proceedings of the British Association for the Advancement of Science, 1889, p. 787.

◊ The true creole, for example, is immune from yellow fever.

‡ Descent of Man, i, p. 233 *et seq.*

‡ Archiv für pathologische Anatomie und Physiologie und für klinische Medicin, cxvi, p. 540.

‡ Ibid., cxix, p. 256. Contains many tables of results.

** Bulletin de la Société d'Anthropologie, Paris, 1884, p. 380. Jousset affirms the same quite independently, *op. cit.*, p. 383.

†† Proceedings of the British Association for the Advancement of Science, 1889, p. 787.

hundred negroes between the equator and 10° north latitude was 97·8° F., the European normal being 98·6°. Higher than either were the Soudanese, whose average was 99°. In the European coming to the tropics, therefore, the temporary rise of body temperature increases still more the difference between his own and the indigenous normal in most cases. It has, indeed, been suggested that this is the cause of malarial fever in the tropics, but the matter has never been fully investigated, especially in its relation to other zymotic diseases.

Among animals the connection between minute variations of body temperature and the liability to contract diseases due to micro-organisms is well established. A fowl, whose normal temperature is considerably above that of the horse, the dog, or the rabbit, is immune from splenic fever, to which these other animals are liable; and yet Pasteur, by reducing its blood heat to their level, by immersing its legs in cold water, was able successfully to inoculate it with the anthrax bacillus.* And other fowls were cured of the fever so contracted by artificially raising their temperature to a point at which the bacillus could no longer thrive. For the same reason tuberculosis does not flourish in frogs or other cold-blooded animals, unless their blood temperature is sufficiently raised to permit of its germination. It is too early to assert that the same law will apply to the "traumatic" diseases of the tropics; but one point is certain, that newcomers in those regions are particularly liable to zymotic diseases during that period when their temperature is most above the native normal; and that immunity from attack, or at least a more benign form of the disorder, often comes with that fall in temperature which is perhaps the surest sign of true acclimatization. Finally, it will be noted that even when this temperature falls once more to the European normal, it is still higher than that of the natives. And if there were any truth in this theory, the perfect accommodation to the environment which the natives of the tropics enjoy, would be attained only when the normal temperature of the European had been reduced to their level. But the persistence of physiological ethnic traits is a well-known fact; the Hindu to-day, despite his long sojourn in the tropics, has a temperature merely reduced to his own racial normal—to reduce it still further to the level of the negro would require ages of time.†

Acclimatization in this physiological sense, of a gradual approach and approximation to the normal type of the natives, must of necessity be an exceedingly slow process, involving many generations of men. Yet in every respect except of temperature it

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* Sutton, Evolution and Disease. London, 1890, p. 253.

† Jousset, *op. cit.*, p. 382.

appears that the first effects of a sojourn in the tropics is to induce symptoms which point toward the peculiarities of the native type. Thus the increase in the size of the liver indicates the operation of those causes which have finally made the negro's liver normally larger than that of the European.* The only present difficulty is that an unusual strain is suddenly put upon the various organs in this process of gradual adaptation which is often too severe; as, for example, the high mortality among Europeans from derangement of the liver, such as hepatitis, bilious fever, abscesses, and the like, which indicates that some physiological change has taken place which has entailed an excessive demand upon the activities of this organ. Similarly the extreme liability of the negro to diseases of the lungs in the temperate zone may be due to his lack of physiological accommodation to those circumstances which have in hundreds of generations produced the European type. To expect that man can in a single generation compass the ends which Nature takes an age to perform is the height of folly. The exact nature of the physiological processes induced by the tropics is, however, so imperfectly known that we must in general rely upon concrete experience for our further conclusions.

Results of Hygiene.—Hygiene and sanitation have accomplished wonderful results in assisting the individual to withstand those immediate effects of climatic change which, as we have said, are so often fatal.† The yearly loss at one time in India was eighty for each regiment of one thousand men. In 1856 it had been reduced to sixty-nine; from 1870 to 1879 it ranged about sixty-two; and in 1888 the annual loss was only fifty, including deaths and invaliding.‡ The loss in Cochin-China per regiment

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* This is suggested by Bastian in Zeitschrift für Ethnologie, Part I, 1869; *vide* also J. R. Mayer, Die Mechanik der Wärme, p. 97 (Stuttgart, 1867), and Jousset, p. 108. The physiological characteristics of the negro are well described by Jousset as follows: A weakly developed chest (p. 85), less respiratory power and lung capacity (p. 88), more rapid pulse (p. 95), diminished muscular tension (p. 100), lower temperature (p. 107), less perspiration (p. 111), and a tendency toward slimness (p. 139). The lessened vitality and power of endurance is also to be noted (p. 144). Pruner Bey confirms these results in his studies of the vascular system of the negro. *Vide* also Quatrefages, *op. cit.*, p. 407. Drs. Baxter and Gould, in their studies on our soldiers during the civil war, confirm this fully. (Investigations in the Military and Anthropological Statistics of American Soldiers, Cambridge, 1869; and Medical Statistics of the Provost-Marshal General's Bureau.)

† Discussed by Hunt, *op. cit.*, p. 140, and by Dr. Montano, *op. cit.*, p. 8 *et seq.*; by Davidson, *op. cit.*, for India; and by Dr. Farr, in Journal of the Royal Statistical Society, xxiv, p. 472. *Vide* also, for statistical information, ibid., iv, p. 1; viii, pp. 77, 193; ix, p. 157; x, p. 100; xiv, p. 109; xv, p. 100. Tables of the comparative mortality of British troops in various countries are conveniently given in Revue d'Anthropologie, new series, iv, p. 175. Macculloch, Statistical Report on the Sickness and Mortality of Troops, London, 1840, gives a vast amount of information.

‡ Scottish Geographical Magazine, vii, p. 647.

was one hundred and fifteen in 1861; the actual deaths have now been reduced to twenty-two, although a much higher figure would be needed to include invaliding. The terrific annual loss of one hundred and forty-eight per thousand in Senegal from 1832 to 1837 is now reduced to about seventy-three. In this last case, however, one hundred and fifty per thousand are returned for sickness every year.* A large proportion of these would undoubtedly die if not removed immediately. One may indeed be hopeful from such results that, with further advance in the science of prevention, these figures may be yet further reduced. The system of vacations,† of strict regulation of diet, the avoidance of excessive fatigue and exposure, and especially of all forms of agricultural labor, and the extension of the hill-station system, will do much in this respect; so that it is conceded by most candid observers that, with few exceptions, such as Cochin-China and the coast of Africa, robust individuals by great care stand a fair chance of good health in the tropics. Nevertheless, this should never be allowed to conceal the real fact that the English to-day are no nearer true acclimatization in India than they were in 1840. To tolerate a climate is one thing, to become independent of it is quite a different matter. The securing of a permanent footing in the tropics depends upon factors of a totally different nature.

FERTILITY.—Passing now from the consideration of the individual to that of the race, the keynote of the matter rests in the much-controverted question of the influence of change of climate upon fertility. For, however well the individual may be enabled, by artificial means or otherwise, to exist, the race will never accommodate itself permanently unless the birth-rate exceeds the death-rate. ‡ Here we must first carefully eliminate the effects of ethnic crosses with natives of the tropics; for a fatal mistake of many observers has been the neglect to distinguish the possible sterility induced by intermixtures of race from that caused by a change of climate and of life conditions; or statements of one have been accepted by tyros as equivalent to the other. It has been confidently asserted for so many years that sterility of the white race ensues after three generations in the tropics that it has become a household word in anthropology.#

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* Revue d'Anthropologie, third series, iv, p. 346.

† In Cochin-China one year in three is the allowance. The improvement in Senegal is largely due to the brief sojourn of the troops, who are relieved at short intervals. This system now prevails also in India, in sharp contrast to the old practice of keeping the soldiers there for long terms, in the hope of forcing acclimatization in that way.

‡ *Vide* remarks of Prof. Virchow on this point in Verhandlungen der Berliner Gesellschaft für Anthropologie, 1885, p. 202.

\# Many examples of acceptance of this theory of infertility will be found in popular works. Pearson (National Life and Character, p. 89) bases his whole argument upon it

The result of comparative study of the lower forms of life is suggestive in this connection.* With plants and animals a sudden change of habitat will often produce a temporary sterility, which disappears only after a series of chance variations. The chrysanthemum remained infertile for sixty years after its introduction into France from China, so that continued importation of the seed was necessary. Finally, in 1852 a few plants developed seeds; and from these others were raised, until to-day the species is self-sustaining in Europe. A similar experience with corn at Sierra Leone, with the goose at Bogotá, and European poultry in America, is instanced by De Quatrefages.† His rather optimistic argument with regard to the future of acclimatization is based, indeed, upon the study of animals and plants, rather than of man. He reasons by analogy that if fertility becomes re-established by spontaneous variation in this sphere, it may be likewise affirmed to be true for man, thus giving countenance to the view that climatic changes do indeed produce infertility.

Despite the authorities who hold on general principles that sterility in man follows—or at least that it ought to follow—a sudden change of climate, direct proof for it is very hard to find. Broca has indeed affirmed that the Mamelukes in Egypt became infertile for that reason; ‡ but in his case, as in all others, no attempt is made to eliminate a number of other factors. Jousset declares, on the contrary, that no direct effect upon fecundity can be traced to climate.# Dr. Fritsche concedes that, although sterility may result, there is as yet no direct evidence to prove it. ‖ The difficulty, it will be observed, is to eliminate the effects of crossing with the natives, or else of marriage with newly arrived immigrants. A physician of twenty-seven years' experience in the Dutch Indies has never known a European family to keep its blood unmixed in this way for the necessary period of three generations. Only one example of pure isolation is known, in the island of Kisser, and sterility there is by no means certain.△ Ste-

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Prof. Virchow even asserts it to be true in Verhandlungen der Berliner Gesellschaft für Anthropologie, 1885, p. 213. It was at the bottom of the exploded theory of Knox and Brace with respect to the decreasing birth-rate in America. *Cf.* Mémoires de la Société d'Anthropologie, iii, p. 25.

* Discussed by Wallace in Encyclopædia Britannica. Also for forest trees in Kirchhoff's Forschungen, iii, p. 28 *et seq.*

† *Op. cit.*, p. 225. Many other examples are given. Wallace (*op. cit.*) gives the interesting case of the acclimatization of wheat north of the Great Wall by the Emperor of China.

‡ Human Hybridity. *Cf.* the case of the creoles in the island of St. Louis, cited in Revue d'Anthropologie, new series, v, p. 30 *et seq.*

Op. cit., p. 231. The superior health of women, due to less exposure, has already been noted.

‖ Verhandlungen der Berliner Gesellschaft für Anthropologie, 1885, p. 258.

△ Ibid., 1886, p. 89.

rility from climate as a single cause in this part of the world, then, can neither be affirmed nor denied, from utter lack of evidence.*

On the contrary, a number of examples of continued fertility might be given. Brace affirms the Jews to be fertile even in Cochin-China,† and Joest says that Europeans in Africa often bear children.‡ The Spanish women in Guayaquil, on the authority of Dr. Spruce, in a climate where the temperature is seldom below 83° F., and in the complete absence of intermarriage with the natives, are the finest along the coast; and the white population is exceedingly prolific.# The experience of Algeria, so far at least as heat is concerned, seems to bear out the same conclusion, the birth-rate being higher even than in France.‖ De Quatrefages, despite his inference of a temporary infertility, certainly takes a hopeful view for the other French colonies.^ Some remarkable examples of fecundity, indeed, are not lacking. Some years ago, an English woman, never out of India, not even taking a vacation in the hills, died at the age of ninety-seven, leaving eighteen children.◊ Tilt, however, denies that the English in general can ever become acclimated there.‡ Sterility, of course, while most important, is not the only element in the acclimatization of the race. Even if we could affirm that sterility did not result, the perpetuation of a people in the tropics would not necessarily follow; for the mother may seldom survive childbirth, as in the East Indies and on the Zambesi,‡ or the children may seldom survive,‡ the age of six being often a critical period.** But these facts have no connection with sterility or the reverse, although they may produce the same negative result in the end. The final word upon this subject awaits more carefully sifted evidence than any we now possess.

COMPARATIVE APTITUDES OF EUROPEAN NATIONS.—The future political destiny of Africa is not unlikely to be dominated by a remarkable fact—namely, the severe handicap against which the Teutonic stock, and especially the Anglo-Saxon branch, struggles in the attempt permanently to colonize the tropics. And

* Verhandlungen der Berliner Gesellschaft für Anthropologie, 1886, p. 92.

† Wallace, *op. cit.*

‡ Verhandlungen der Berliner Gesellschaft für Anthropologie, 1885, p. 473.

Wallace, *op. cit.*

‖ Levasseur, La Population Française, iii, p. 432.

^ *Op. cit.*, p. 231.

◊ Verhandlungen der Berliner Gesellschaft für Anthropologie, 1885, p. 379.

‡ Health in India for British Women.

‡ Peschel, Wallace, Quatrefages.

‡ Jousset, *op. cit.*, p. 314. *Cf.* Verhandlungen der Berliner Gesellschaft für Anthropologie, 1885, p. 258, on Egypt.

** Wallace, *op. cit.*

this is peculiarly unfortunate, since these are the very peoples who find population pressing most severely upon the soil at home.* The Latin nations, of course, are the ones who lay most stress upon this comparative disability of their rivals; but in justice to the French, it must be added that they have generally recognized that the Spaniards and Italians possess as great an advantage over them as they in turn do over the Germans.† The experience of Algeria affords a good illustration of this point. The year 1854 marks the first excess of births over deaths in this colony; and the following table shows the relative disabilities of the Europeans for 1855–'56: ‡

	Births *pro mille.*	Deaths *pro mille.*
Spaniards	46	30
Maltese	44	30
Italians	39	28
French	41	43
Germans	31	56

Dr. Ricoux # gives the following death rates per thousand for children under one year: Spaniards, 180; Maltese, 178; Italians, 194; French, 225·2; and Germans, 273. This disability of the Germans is confessed by all their most able and candid authorities.‖ All writers, even in France, acknowledge that the Mediterranean natives possess a peculiar aptitude in this respect.^

* Levasseur, La Population Française, iii, p. 432.

† Revue d'Anthropologie, second series, viii, p. 190.

‡ Bulletin de la Société d'Anthropologie, 1886, p. 269; *cf.* L'Anthropologie, vi, p. 120. The small number of Germans present weakens the force of the evidence somewhat.

Annales de Demographie, vi, p. 14. *Cf.* Quatrefages, *op. cit.*, p. 230, and Bordier, Colonization, p. 184. The only north Europeans ever successful are the Dutch in South Africa and in the East Indies.

‖ Ratzel, Anthropo-Geographie, i, p. 304; Virchow, Fritsche, and Joest in Verhandlungen der Berliner Gesellschaft für Anthropologie, 1885, pp. 211, 474, etc. It will have been noted that nearly all references in German fall within the years 1885–'87. The question drifted into politics—out of the hands of scientists into those of pamphleteers. *Vide* Max Nordau, Rabies Africana, in Asiatic Quarterly Review, second series, ii, p. 76; and G. A. Fischer, Mehr Licht im dunkeln Welttheil, Berlin, 1886. A blue-book on the subject was promised (Verhandlungen der Berliner Gesellschaft, 1886, p. 87), but the attention of the Colonial Society was for some reason diverted. Tropical hygiene was fully discussed, but the broader scientific aspect of the matter was neglected (Verhandlungen, 1889, p. 732). As late as 1890 no definite government report had been issued except Mähly's work. The Germans apparently do not dare to handle it without gloves, and their views are unique in their optimism (Kohlstock in Science, 1891, p. 3; and Finckelnburg in Handbuch der Staatswissenschaft).

^ Ratzel, *loc. cit.*; Bulletin of the American Geographical Society, 1883, No. 2; Jousset, p. 292; Montano, pp. 444, 446; Felkin, in Scottish Geographical Magazine, ii, p. 52, and in British Association for the Advancement of Science, 1886, p. 730; Levasseur, *op. cit.*, ii, p. 431; and Bordier, Colonization, pp. 185, 493.

Moreover, the French nation is further divided against itself. That the Provençals—the offshoots of the Mediterranean branch of the Aryan stock—succeed better than the people of the Paris basin in the tropics is generally conceded;* and the bulk of French emigration to-day comes from the Rhone Valley, Corsica, and Provence.† This makes the fact still more curious that these same Provençals endured the hardships of Napoleon's Moscow campaign far better than their comrades from Normandy and Champagne.‡ Can it, indeed, be due to an admixture of Semitic blood, as Wallace suggests?

This disability of the Anglo-Saxon stock does not seem to indicate any less vitality, but rather the reverse.# The Crimean War apparently showed that the English possessed a peculiar advantage over the French in their ability to recover speedily from severe wounds.‖ In fact, the mortality after capital operations in English hospitals is only about half that among the French.^ We have already observed that primitive peoples, while showing a relative immunity from septic disorders, still remain peculiarly sensitive to all changes of climate.◊ And the case of the Anglo-Saxon stock is analogous to it in this respect, having a higher recuperative power conjoined to disability in becoming acclimatized.‡ This is undoubtedly in part due to national habits, but it also appears to be rooted in race. In peopling the new lands of the earth, therefore, we observe a curious complication; for it is precisely those people who need the colonies most, and who are bending all their political energies to that end, who labor under the severest disabilities. A popular opinion is abroad that Africa is to be dominated by the English and German nations.↕ If there be any virtue in prediction, it would rather appear that their activities will be less successful as soon as the pioneering stage

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* Quatrefages, *op. cit.*, p. 230; Jousset, p. 192; Montano, p. 449; and Levasseur, ii, p. 431.

† L'Anthropologie, v, p. 253.

‡ Bulletin de la Société d'Anthropologie, i, p. 326; and Revue d'Anthropologie, new series, i, p. 76.

\# Dr. Beddoe, Races of Britain, p. 224, gives some exceedingly interesting observations upon this point.

‖ Revue d'Anthropologie, new series, i, p. 76 *et seq.*

^ Topinard, Elements, p. 412.

◊ The stupendous failure of the project of colonizing the State of Durango in Mexico with negroes from the United States is a case in point. *Vide* letter in Boston Transcript, dated Mexico, August 11, 1895. Dr. Brinton, in Races and Peoples, p. 40, gives some valuable references upon this point.

‡ Dr. Montano, p. 447; Revue d'Anthropologie, second series, v, 74: "The Anglo-Saxon race is least apt of all in accommodating itself to warm climates." This fact is reluctantly admitted by Dr. Felkin and other English authorities as well.

↕ *Vide* typical editorial in Boston Herald, May 2, 1895.

gives way to the necessity for actual colonists, who with their families are to live, labor, and propagate in the new lands.

Summarizing the views of authorities upon this subject, the almost universal opinion seems to be that true colonization in the tropics by the white race is impossible.* The only writers who express themselves favorably are Crawford,† whose hopes for India have certainly not been fulfilled; Armand ‡ and Rattray,# Dr. Livingstone and Bishop Hannington, ‖ and the physicians assembled at the Medical Congress at Berlin in 1890,^ with the Society for the Advancement of Medical Science in the Dutch Indian Settlements.◊ All these authorities may now be classed as antiquated, except the last, and moreover the first one represents that nation which is notoriously unsuccessful in acclimatization. The opinion of the Dutch physicians who have been fairly successful may be met by as good testimony from their own number on the opposite side.

Authorities in favor of the view that complete acclimatization of Europeans in the tropics is impossible might be multiplied indefinitely. Among the earlier writers of this opinion are Knox,‡ Prichard,↕ Dr. Hunt,‡ and Sir Ranald Martin.** The best German authority concedes it, including Virchow, Fritsche, Joest, Fischer,†† with Buchner ‡‡ and Hirsch.## The French, who have studied it more scientifically than any other nation, hold to this opinion with no exception. ‖‖ Jousset declares that recruiting stations never effect a permanent recovery, the only remedy being to leave the tropics altogether.^^ This opinion is also shared by many of the Dutch, who dissent from the favorable views of

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* The most definite as well as the latest expression of expert opinion fully agrees with this. *Vide* Proceedings of the International Geographical Congress at London, 1895.

† Transactions of the Ethnological Society, London, new series, i, p. 89.

‡ Traité de Climatologie, Paris, 1873. # Jousset, p. 426.

‖ Scottish Geographical Magazine, vii, 647.

^ Proceedings of the Royal Geographical Society, January, 1891, p. 30.

◊ Referred to in the Proceedings of the Seventh International Congress of Demography and Hygiene, London, xi, p. 170.

‡ Quatrefages, p. 229. ↕ Jousset, p. 426.

‡ *Loc. cit.*, p. 135; other opinions of early writers are here given as well.

** Encyclopædia Britannica, Acclimatization.

†† Scottish Geographical Magazine, vii, p. 647, and Verhandlungen der Berliner Gesellschaft für Anthropologie, 1885, pp. 210, 257, 474. Prof. Virchow distinguishes between malaria and climate, which is generally a distinction without a difference in the tropics.

‡‡ Correspondenzblatt, xviii, p. 17.

Verhandlungen, 1886, p. 164.

‖‖ Dr. Rey, *op. cit.*; Boudin, Bulletin de la Société d'Anthropologie, 1864, pp. 780 and 828; Legoyt, Jousset, p. 426; Bertillon, Bulletin de la Société d'Anthropologie, 1864, pp. 519 and 578; Bordier, Colonization scientifique, pp. 184, 397, 472; and Revue d'Anthropologie, third series, i, pp. 667, 672.

^^ Jousset, p. 434.

their countrymen already quoted.* The English writers of this opinion include Ravenstein,† Sir William Moore,‡ and Tilt.# Dr. Felkin alone holds to a slightly more favorable view of colonization in Africa, although he qualifies it by requiring an unlimited amount of time; and he finds comfort in the thought that Central Africa is no worse than India. He finally concedes, however, that in this latter colony the hill districts are the only ones where the English can remain in health.‖ For some years the hopes for Africa as a field for colonization were based upon the altitude of the inland plateau. But expert opinion on this seems to show that, with the sole exception of Matabeleland, the country is impossible for European colonists.^ And even Mr. Stanley declares that cautious pioneering is all that can be expected for the future in the Congo basin—that colonization was never anticipated at all.◊ In the face of such testimony there can be but one conclusion: to urge the emigration of women, children, or of any save those in the most robust health to the tropics may not be to murder in the first degree, but it should be classed, to put it mildly, as incitement to it.

It must not be understood that by this is meant that the white man can not live in the tropics. Hygienic precautions and great care can often render a prolonged sojourn in these regions perfectly harmless. But, as Mr. Wallace observes, the Englishman who can spend a summer in Rome in safety only by sleeping in a tower and by never venturing forth at night, can not be truly said to be acclimated. A colony can never approximate even to the civilization of Europe until it can abolish or assimilate the native servile population; and yet, one of the many things which are expressly forbidden to all colonists in the tropics is agricultural labor. It would be a waste of energy to give citations to prove this, for every work on acclimatization insists upon the necessity of this precaution. Let it be understood, then, that a colonial policy in the tropics means a perma-

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* Dr. Van der Burg in Transactions of the Seventh International Congress of Demography and Hygiene, p. 170. After all precautions have been taken, "such a settlement ought to be continually supported by new supplies from the European continent for many, possibly for hundreds of years, in order to have a chance of healthy existence."

† Proceedings of the Royal Geographical Society, January, 1891, p. 31, and Proceeding of the British Association for the Advancement of Science, 1894.

‡ Edinburgh Medical Journal, xxxi, part ii, p. 852.

Transactions of the Seventh International Congress of Demography and Hygiene.

‖ Proceedings of the British Association for the Advancement of Science, 1886, p. 729.

^ Proceedings of the Royal Geographical Society, January, 1891, p. 31, and Transactions of the Seventh International Congress of Demography and Hygiene, p. 178.

◊ Proceedings of the International Geographical Congress, London, 1895. Since this was written new and important evidence to the same end is given in the Scottish Geographical Magazine, xi, p. 512.

nent servile native population, which is manifestly inconsistent with political independence, or with any approach to republican institutions.

Such being our conclusions from a comparison of authorities, what shall we say about the broader question of original racial acclimatization? And what policy, if any, should be modeled upon the theories with regard to the way in which this undisputed operation once took place--for, as we have said, the substantial unity of the human race followed by extensive migrations is an accepted fact. Even in the absence of direct proof, to deny it would be to neglect all the evidence for the same phenomenon among plants and animals so ably set forth by Wallace, Agassiz, Drude, and other writers. Fortunately, however, the researches of ethnologists to-day are continually bringing new evidence to show that such widespread migration has indeed taken place. Two radically different policies are advocated by the adherents of one or the other of the two opposing factions in biological theory. For accommodation to climatic conditions may take place either by variation and natural selection or by habitual adaptation transmitted by inheritance.* Weissmann,† Wallace, Quatrefages,‡ and apparently Dr. Brinton,# rely upon natural selection, which they assert, directly or by inference, takes place in the following way: A large body of men (plants or animals) is transported to the new habitat at once—the larger the number the better—from which by elimination a few fortunate variations survive. Thus, after a long time, and enormous sacrifice of life, a new type, immune to some degree, becomes established. All that the state need do, therefore, is to keep up the supply of immigrants long enough, and leave the climate to do the rest. ‖

What state policy may we adopt if we hold to the biological theory of adaptation and heredity? This school includes Virchow and Buchner,^ who firmly defended it at the Natural Science Congress at Strasburg, and by Jousset.◊ Their policy would be to imitate the operations of natural ethnic migrations; they would rely upon the utilization of the natural aptitudes of various nationalities, which we have mentioned—perhaps themselves the fruit of ages of sojourn in certain climates—until finally a great drifting movement toward the equator would take

* Discussed by Wallace in Encyclopædia Britannica.

† Correspondenzblatt der deutschen Gesellschaft für Anthropologie, xviii, 1887, p. 18.

‡ *Op. cit.*

Op. cit., p. 283, seems to follow De Quatrefages.

‖ This would be the policy outlined by Dr. Van der Burg, quoted in note *ante*.

^ Correspondenzblatt, 1887, p. 18.

◊ *Op. cit.*, p. 245—outlined in his general argument. *Vide* note *ante*.

place.* In other words, the peoples of the Mediterranean basin, learning of their aptitude for a southward migration, would perhaps move to Algeria, displacing the people of the Soudan and the Semitic stocks toward the equator. To fill the place thus left vacant, the people of northern France slowly drift to the Rhone Valley and Provence for a generation or two, and their place is taken by Germans and Belgians.

That this is a tendency at the present time can not be doubted.† Each generation adapting itself quietly would produce succeeding ones with an inherited immunity. Unfortunately, this most reasonable let-alone policy has two fatal objections: in the first place, it requires a policy of noninterference; and, more potent still, it absolutely neglects the political factor. To suppose that France would quietly allow her people to be dispossessed by Germans, even though she aided her colonial policy thereby, or that Germany would quietly leave Africa to her Gallic neighbor, is not to be supposed for a moment. Nevertheless, it will be probably the only policy which will finally produce a new immune type in the regions of the equator. Of course, England is by fate condemned to follow the first policy we have outlined. France, indeed, is the only one of the European states which extends over the two contrasted European climates; a large measure of her success is probably due to that fact; while all the nations north of the Alps must traverse her territory or that of Italy on the way to these newly discovered lands. Great political results are therefore not impossible, if the prognosis we have indicated prove to be correct. At all events, enough has perhaps been said to show that great problems for science remain to be solved before the statesman can safely proceed to people those tropical regions of the earth so lately apportioned among European states.

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† Map of foreigners in France in Bulletin de l'Institut international de statisque, iii trois liv., 1888, p. 36; this fact is noticeably prominent. The destination of French emigrants is given in L'Anthropologie, v, p. 253. *Vide* also Transactions of the International Congress of Demography and Hygiene, p. 131 *et seq.*

‡ Other and more technical articles upon the subject have been referred to in footnotes, such as Archives de Médecine navale, Bulletin de la Société de l'Acclimatement de Paris, Archiv für pathologische Anatomie und Physiologie, etc. Maps of the distribution of certain diseases will be found in Gerland's Atlas der Völkerkunde and in the works of Drs. Chervin, Felkin, Lombard, and Sormani.

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THE SAVAGE ORIGIN OF TATTOOING.

By Prof. CESARE LOMBROSO.

I HAVE been told that the fashion of tattooing the arm exists among women of prominence in London society. The taste for this style is not a good indication of the refinement and delicacy of the English ladies: first, it indicates an inferior sensitiveness, for one has to be obtuse to pain to submit to this wholly savage operation without any other object than the gratification of vanity; and it is contrary to progress, for all exaggerations of dress are atavistic. Simplicity in ornamentation and clothing and uniformity are an advance gained during these last centuries by the virile sex, by man, and constitute a superiority in him over woman, who has to spend for dress an enormous amount of time and money, without gaining any real advantage, even to her beauty. But it is not desirable that so inordinate an accession to ornamentation as tattooing would be should be adopted; for an observation I have made on more than 5,000 criminals has demonstrated to me that this custom is held in too great honor among them. Thus, while out of 2,739 soldiers I have found tattoo marks only among 1·2 per cent, always limited to the arms and the breast; among 5,348 criminals, 667 were tattooed, or ten per cent of the adults and 3·9 per cent of the minors. Baer recently observed tattooing among two per cent of German criminals and 9·5 per cent of soldiers (*Der Verbrecher*, 1893).

CHARACTERISTICS OF CRIMINAL TATTOOING: VENGEANCE.—The minute study of the various signs adopted by malefactors shows us not only that they sometimes have a strange frequency, but often also a special stamp. A criminal whom I studied had on his breast between two poniards the fierce threat *Je jure de me venger* (I swear to avenge myself). He was an old Piedmontese sailor, who had killed and stolen for vengeance. A recidivistic thief wore on his breast the inscription, *Malheur a moi! quelle sera ma fin?* (Woe to me! what will be my end?)—lugubrious words, reminding us of those which Filippe, strangler of public women, had traced on his right arm, long before his condemnation, *Né sous une mauvaise étoile* (Born under an evil star).

Malassen, a ferocious assassin, who became in New Caledonia an executioner of convicts (Meyer, *Souvenirs d'un Déporté*), was covered from his feet to his head with grotesque and frightful tattoo marks. On his breast he had drawn a red and black guillotine, with the words in red letters: *J'ai mal commencé, je finirai mal. C'est la fin qui m'attend* (I have begun evil, I shall end evil. That is the end that awaits me). His right arm, which had inflicted death upon so many human beings, bore the terrible device, very appropriate to his hand, *Mort à la chiourme* (Death to the convict).

The famous Neapolitan camorrist Salsano had himself represented in an attitude of bravado. He held a stick in his hand, and was defying a police guard. Under the figure was his sobriquet, *Éventre tout le monde* (disembowel everybody); then came two hearts and keys connected with chains, in allusion to the secrecy of the camorrists.

We see, then, by these few examples, that there is a kind of hieroglyphic writing among criminals, that is not regulated or fixed, but is determined from daily events, and from *argot*, very much as would take place among primitive men. Very often, in fact, the key in the designs signifies the silence of secrecy, and the death's head vengeance. Sometimes the figures are replaced by points, as when a judicial arrest is marked on the arm with seventeen points, which means, according to the criminal, that he intends to strike his enemy that number of times when he falls into his hands.

Another characteristic of criminals, which is also common to them with sailors and savages, is to trace the designs not only on the arms and the breast (the most frequent usage), but on nearly all the parts of the body. I have remarked one hundred tatooed on the arms, breast, and abdomen, five on the hands, three on the fingers, and three on the thigh.

A certain T——, thirty-four years of age, who had passed many years in prison, had not, except on his cheeks and loins, a surface the size of a crown that was not tattooed. On his forehead could be read *Martyr de la Liberté* (Martyr of Liberty); the words being surmounted by a snake eleven centimetres long. On his nose he had a cross, which he had tried to efface with acetic acid.

A Venetian thief, who had served in the Austrian army, had on his right arm a double-headed eagle, and near it the names of his mother and his mistress Louise, with the strange epigraph for a thief: *Louise, chère amante, mon unique consolation* (Louise, dear loved one, my only consolation). Another thief wore on his right arm a bird holding a heart, stars, and an anchor. On the left arm of a prisoner Lacassagne found the words, *Quand la neige tombera noire, B—— sortira de ma mémoire* (When the snow falls black, B—— will pass out of my memory).

The multiplicity of marks results from the strange liking these curious heroes have of spreading on their body, just after

Fig. 1.

Fig. 2.

the fashion of the American Indians, the adventures of their lives. For example, M—— C——, twenty-seven years old (Fig. 1), who had been condemned at least fifty times for rebellion and assaults on men and horses, who had traveled, or rather wandered, a vagabond, in Spain and Africa with women whom he left suddenly, wore his whole history written on his skin. One design referred to the ship L'Espérance (No. 1), which was wrecked on the coast of Ireland, and on which he had gone as a sailor. A horse's head (No. 2) represented an animal which he had killed with a knife, from simple caprice, when twelve years old. A helmet (No. 7) indicated a policeman he had tried to kill. A headless woman with a heart on her neck indicated his mistress, who was frivolous (No. 8). The portrait of a brigand referred to a robber chief whom he took for his model (No. 9). A lute (No. 3) recalled a friend, a skillful player of the guitar, with whom he traveled over half of Europe. The star, the evil influence under which he was born (No. 4). The royal crown, "a political souvenir," he said, but rather, we say, his new trade of a spy—that is, the destruction of the kingdom (No. 5).

A French deserter who desired to avenge himself against his chief drew a poniard on his breast (Fig. 2, No. 1), to signify vengeance, and also a serpent. He further drew the ship on which he wished to escape, the epaulets which had been taken away from him, a dancing girl who had been his mistress, and then the sad inscriptions which were truly appropriate to his unhappy life.

Dr. Spoto sent me a study of the tattooing of a criminal who had been under his care. He wore all his sad adventures painted on his arm (see *Archivio di Psichiatria*, June, 1889). He had one hundred and five signs on his body, ten of which represented mistresses, nine hearts, eight flowers or leaves, five animals, twenty-eight names, surnames, or descriptions, and thirty-one poniards or warriors (Fig. 3). On his arm he had a figure of a lady winged and crowned; winged, he said, "because I made her take flight" (he had run away with her); crowned, because she had substituted for the crown of virginity the royal crown in becoming his mistress. She held in her hand a heart and an arrow, signifying her parents, to whom her flight had caused great grief. Beneath her were two branches, which signified that she kept herself always fresh. Two other of his loves explained their sad adventures by holding crumpled roses in their hands. In his hand he had an eagle, representing the ship on which he sailed, and beneath it a heart with three points, referring to the sufferings of Christ, whose birthplace he had visited at Bethlehem. A heart on his arm represented a mistress with whom he lived several years. It was pierced with an arrow, because he had abandoned the woman with two little children, who were represented by two bleeding hearts. Two hearts pierced with swords, on his forearm, represented two mistresses who would not yield to his desires except when threatened with death. They were connected by a chain with an anchor hanging from it, which signified that the women belonged to a sailor family, and a Greek cross above them

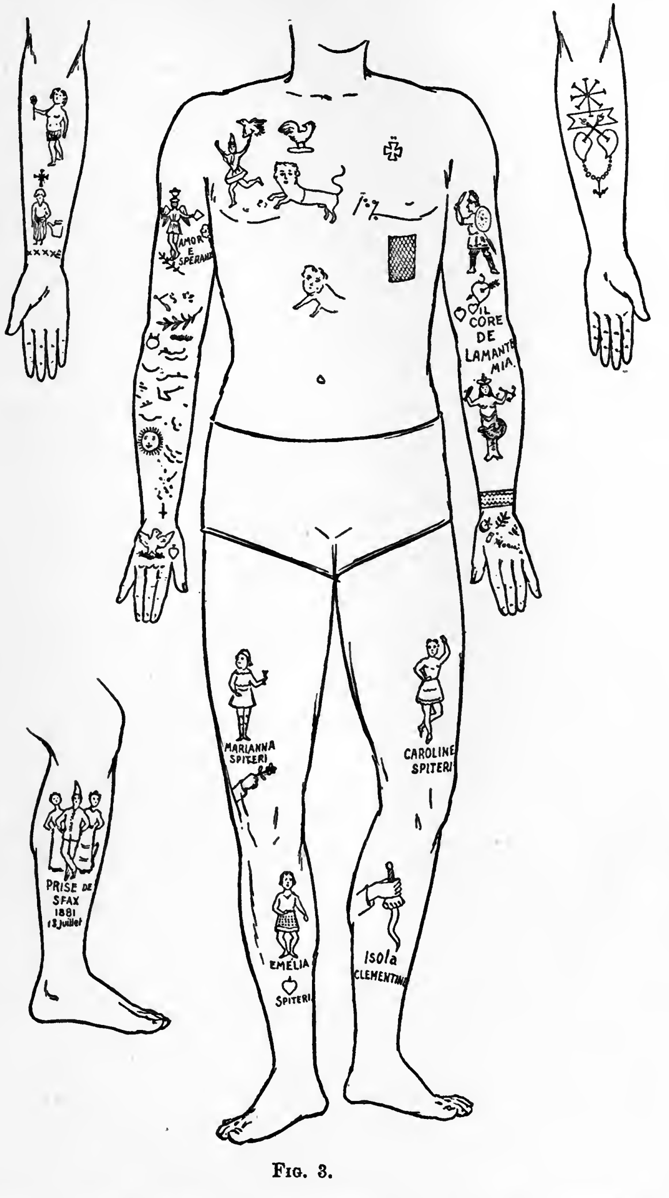

FIG. 3.

indicated that they were Greek. On his breast was a dancing girl carrying a bird, because she bounded like a bird. On his sides were a cock and a lion, the cock corresponding to women who wished to be paid: "When the cock sings, Spiritelli will pay." The lion meant that he felt as strong as a lion. A smaller lion a few centimetres from this meant that even as among lions the stronger gains the victory over the weaker, so he, the stronger, had overcome those who would play the camorrist with him.

Never, I believe, have we had a more striking proof that tattooing contains real ideographic hieroglyphs which take the place of writing. They might be compared to the inscriptions of the ancient Mexicans and Indians, which, like the tattooings we have described, are the more animated history of individuals. Certainly these tattooings declare more than any official brief to reveal to us the fierce and obscene hearts of these unfortunates.

This multiplicity of figures proves also that criminals, like savages, are very little sensitive to pain. Another fact that characterizes tattooing is precocity. According to Tardieu and Berson, tattooing is never remarked in France before the age of sixteen years (excepting, of course, the cases of ship-boys who have borrowed the custom from sailors); yet we have found, even among the general public, four cases in children of from seven to nine years of age; and of eighty-nine adult criminals, sixty-six displayed tattooings which were made between nine and sixteen years.

Some tattoo marks are used by societies as signals of recognition. In Bavaria and the south of Germany the highway robbers, who are united into a real association, recognize one another by the epigraphic tattoo marks *T. und L.*, meaning *Thal und Land* (valley and country), words which they exchange with one another, each uttering half the phrase, when they meet. Without that they would betray themselves to the police.*

What is the origin of this usage? Religion, which has so much power over peoples and which proves so obstinate in preserving ancient customs, has certainly contributed to maintain it among the more barbarous part of our populations; we see a quasi-official proof of it at Lorette. Those who cultivate a devo-

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* Lacassagne has given us a large number of inscriptions tattooed on French criminals, which all contain criminal or obscene allusions. For example, we read:

Eight times: "Son of misfortune."
Nine times: "No chance."
Three times: "Friends of the contrary."
Four times: "Death to unfaithful women."
Five times: "Vengeance."
Twice: "Son of disgrace."
Twice: "Born under an evil star."
Three times: "Child of joy."
Three times: "The past deceives me."
Once: "The m . . . is worth more than all France."
Once: "Vive la France and fried potatoes! Death to brutes."
Once: "The present torments me; the future frightens me."

tion for a saint believe that by engraving his image on their flesh they will give him a proof, a clear testimony, of their love. We know that the Phœnicians marked the sign of their divinity on their foreheads (Ewald, *Judäischen Alterthum,* iii); in the Marshall Islands they have to ask the permission of the gods to tattoo themselves; and the priests alone in New Zealand perform the office of tattooing (Scherzer). Lubbock adds to this that a woman who does not wear a tattoo mark can not enjoy eternal felicity. The women of Britain tattooed themselves in obedience to religion (Pliny, 33).

The second cause is the spirit of imitation. A Lombard soldier answered me laughingly one day when I rallied him on his having spent a small sum to spoil his arm: "See, monsieur, we are like sheep; and when one of us does anything we all imitate him at once, even if we risk doing ourselves harm."

Love of distinction also has its influence. A thief of the most incorrigible sort, who had six brothers tattooed like himself, implored me, although he was half covered with the oddest tattoo marks, to find him a professional tattooer to complete what might well be styled the embroidery of his skin. "When the tattooing is very curious and spread all over the body," he told me, "it is to us other thieves like the black coat of society with decorations; the more we are tattooed, the more we esteem one another; the more a person is tattooed, the more influence he has over his companions. On the contrary, one who is not tattooed has no influence; he is regarded simply as a good fellow, and is not esteemed by the company."

There are also tattooings inspired by vengeance. Bastrenga, the cruel assassin of T——, had various tattoo marks on his arm (a horse, an anchor, etc.). On the advice of his father, who remonstrated with him that they would make him more easily recognizable, he effaced them. But in 1868 he was arrested anew by the police agents, and when he resisted actively one of them struck him so violently on the head that his eye was permanently hurt. Then, forgetting all prudence, he tattooed himself anew on the right arm; engraved there the fatal date of 1868, and a helmet on the arm that was to strike. "I shall keep this mark many years," he said, "till the time comes when I can satisfy my vengeance." This fact is curious, and illustrates one of the causes that induce savages to tattoo themselves—for registration. It shows, too, that with the born criminals the spirit of revenge prevails over the most ordinary prudence, even when they have been put on their guard. Indolence also counts for something. It explains the number of cases of tattooing which we meet among deserters, prisoners, shepherds, and sailors. Among eighty-nine tattooed persons, I saw seventy-one who had been tattooed in prison. Inaction is even harder to endure than pain. The influence of vanity is still greater. Those even who have not studied the insane know how powerful this passion is, which is found in all grades of the social scale, and perhaps even in animals, and can lead to the strangest and most foolish actions, from the chevalier who dotes on a little bit of ribbon to the idiot who struts with a straw behind his ear. For this, savages who go entirely naked wear figures on their breasts; for this, our contemporaries who are clothed tattoo that part of the body which is most exposed to sight, especially the forearm, and more frequently the right than the left. An old soldier told me that in 1820 there was not a man in the army especially not a subordinate officer who had not been tattooed to exhibit his courage in supporting pain. The figures of the tattooing vary in New Zealand as do the fashion styles with us.

The spirit of the organization and the spirit of sect contribute to it. I have been led to this conclusion by the examination of some initials which I studied upon incendiaries at Milan, and of certain signs found on young police prisoners at Turin and Naples. Figures of tarantulas and of frogs appear often. I suspect that some groups of camorrists have adopted this new kind of primitive ornamentation to distinguish their sect, as they formerly adopted rings, pins, chains, and different cuts of the beard.

Lastly, the stimulus of the noblest human passions has had its part. It is very natural that the rites of the village, the image of his patron, the recollections of infancy and of the heart's friend should return to the mind of the poor soldier, and be rendered more lively by the tattooed design, when he is struggling against danger, suffering, and privations.

But the primary, chief cause that has spread this custom among us is in my opinion atavism, or that other kind of historical atavism that is called tradition. Tattooing is, in fact, one of the essential characteristics of primitive man, and of men who still live in the savage state.

Some of those pointed bones which are used by modern savages in tattooing themselves have been found in the prehistoric grottoes of Avignac, and in the tombs of ancient Egypt. The Assyrians, according to Lucian, and the Dacians, according to Pliny, covered their whole bodies with figures. The Phœnicians and the Jews traced lines which they called "signs of God" on their foreheads and their hands (Ewald, *Judäischen Alterthum*, ii, p. 7). This usage was so widespread among the Britons that their name (from Brith, painting), like that of Pict and Pictons, seems to have been derived from it. See Cæsar. "These peoples," he says, "trace, with iron, designs on the skin of the youngest children, and color their warriors with *Isatis tinctoria* (woad) to render them more terrible on the field of battle."

I do not believe there is a single savage people that does not tattoo more or less. The Payaguns painted their faces in blue on feast days, in triangles and arabesques. The various negro tribes distinguished themselves from one another, especially the tribes of Bambaras, by horizontal or vertical lines traced on the face, the chest, and arms. Kafir warriors have the privilege of decorating their legs with a long azure line, which they are able to make indelible.

In Tahiti the women tattoo only the feet and hands or the ear, tracing collars or bracelets; the men, the whole body, on the hairy skin, on the nose, and the gums; and they often produce inflammations and gangrene, especially on the fingers and the gums. On the Marquesas Islands tattooing is a custom as well as a sacrament. Beginning at the age of fifteen or sixteen years, they put a girdle upon the young people and tattoo their fingers and legs, but always in a sacred place. Women, even princesses, have no right to tattoo anything but their hands and feet; grand personages cover their whole body; and while the designs on the lower part are delicate, those on the face lend it a grotesque and horrible aspect, so that enemies may be struck with fear. At Nukahiva, noble ladies are permitted to wear more numerous tattoo marks than the women of the people.

In Samoa, widows, it seems, tattoo the tongue; men paint the body from the girdle to the knees. The bald heads of old men in the Marquesas Islands may be seen covered with tattoo marks.

The fashionable ladies of Bagdad stained their temples and lips with azure, drew circles and rays of the same color on their legs, painted a blue girdle round their waists, and surrounded each of their breasts with a crown of blue flowers.

Tattooing is practiced in Polynesia at the age of from eleven to thirteen years; and is to these natives what the *toga pretexta* was to young Romans. In the Marquesas Islands it serves as a kind of clothing to the men; they might be mistakenly supposed to be covered with armor. Their face is hidden under the marks. The women here are generally but little tattooed, but coquettes wear the marks on their feet, hands, arms, legs, and forearms—designs so delicate that they might be taken for stockings and gloves in the daytime.

In order to please the women and to be able to find a wife, writes Délisle, the Laotian should be tattooed from the navel to below the calf, all round the thigh; while among the Dyacks the women submit to the operation in order to get husbands. Laotian tattooing is very animated, and represents fantastic animals, like those on the Buddhist monuments. Among the aborigines of the Marquesas Islands the tattooing exhibits, on the women, designs of every sort: boots, gloves, bows, suns, and lines drawn with remarkable fineness and perfection; on the men, animals—sharks, crabs, lizards, snakes—or plants, or geometrical figures. Here tattooing constitutes real works of art.

Sometimes tattooing and mutilation are combined, as in the famous chiefs' heads of New Zealand, which are overloaded with curved lines, with deep incisions showing as hollows, and with dark colors, with the intervals colored with dotted tattooing that gives the skin a bluish tinge. These curved lines spare no part of the face, and are closer and more numerous, according to the fame of the bearer of them as a warrior, or the antiquity of the origin of his chiefly dignity. The tattooing of the New Zealanders has found an unanticipated use in their relations with Europeans. Thus, the missionaries having bought a tract of land, the facial tattoo patterns of the vendor were drawn at the bottom of the deed, to serve as his signature.

The skins of all the grand chiefs of Guinea are in effect damascened. In New Zealand tattooing forms a sort of coat of arms. The common people are not allowed to practice it; and the chiefs are not permitted to decorate themselves with certain marks till they have accomplished some great enterprise. Toupes, an intelligent New Zealander, who was brought to London a few years ago, insisted upon a photographer taking pains to bring out his tattoo marks well. "Europeans," he said, "write their names with a pen; Toupes writes his this way. No matter," he said also to Dumont d'Urville, "if the Chonqui are more powerful than I, they can not wear the lines on their foreheads, for my family is more illustrious than theirs." The ancient Thracians and the Picts distinguished their chiefs by their special tattooing. The Pagas of Sumatra add a new color every time they have killed an enemy.

Tattooing is the true writing of savages, their first registry of civil condition. Some tattoo marks indicate the obligation of the debtor to serve his creditor for a certain time. The number and nature of objects received are likewise indicated (Krausen, *Ueber die Tatouiren*, 1873).

Nothing is more natural than to see a usage so widespread among savages and prehistoric peoples reappear in classes which, as the deep-sea bottoms retain the same temperature, have preserved the customs and superstitions, even to the hymns, of the primitive peoples, and who have, like them, violent passions, a blunted sensibility, a puerile vanity, long-standing habits of inaction, and very often nudity. There, indeed, among savages, are he principal models of this curious custom.

A last proof of our position is given by the hieroglyphics which we have found to be so frequent among the tattoo marks of criminals, and upon certain inscriptions which undoubtedly go back to an ancient age. A very interesting specimen of this kind is found in a study of tattooing in Portugal by Dr. Peixotto (*Tatouage en Portugal*, 1893), which I reproduce here:

Sator	S A T O R
Arepo	A R E P O
Tenet	T E N E T
Opera	O P E R A
Rotas	R O T A S

As the reader will see, it is the formula of a square, which reproduces the same words, "Sator," "Arepo," "Tenet," "Opera," and "Rotas," on whichever of the four sides we read it, and in whichever vertical or horizontal direction—one of those magical formulas which, according to Kohler (Anthropological Society of Berlin, 1891), were used to drive away fevers from the age of the Romans, as far back probably, at least, as Cato's time.

The influences of atavism and tradition seem to me to be confirmed by the fact that we find the custom of tattooing diffused among classes so tenacious of old traditions as shepherds and peasants.

After this study, it appears to me to be proved that this custom is a completely savage one, which is found only rarely among some persons who have fallen from our honest classes, and which does not prevail extensively except among criminals, with whom it has had a truly strange, almost professional, diffusion; and, as they sometimes say, it performs the service among them of uniforms among our soldiers. To us they serve a psychological purpose, in enabling us to discern the obscurer sides of the criminal's soul, his remarkable vanity, his thirst for vengeance, and his atavistic character, even in his writing.

Hence, when the attempt is made to introduce it into the respectable world, we feel a genuine disgust, if not for those who practice it, for those who suggest it, and who must have something atavistic and savage in their hearts. It is very much, in its way, like returning to the trials by God of the middle ages, to juridical duels—atavistic returns which we can not contemplate without horror.

O Fashion! You are very frivolous; you have caused many complaints against the most beautiful half of the human race! But you have not come to this, and I believe you will not be permitted to come to it.

HYPNOTIC STATES, TRANCE, AND ECSTASY.

By Prof. WILLIAM ROMAINE NEWBOLD.

I SHALL deal in this paper with abnormal states of several types, all of which, in my opinion, may be grouped under the one concept of disordination. The normal consciousness is in all apparently destroyed or displaced, and very often memory of the abnormal states is lacking. Hence we are often compelled to rely upon ambiguous external indications for our knowledge of the patient's condition during the abnormal state, and any attempt to explain it from the psychological point of view is attended with difficulty and open to attack.

In the first place, I must clear away a prolific source of confusion. All the states which I now have occasion to examine are akin to sleep, and many have in addition a superficial resemblance to sleep: the eyes are closed, the countenance is placid, the breathing regular. In others it is less marked: the eyes may be open, fixed, and staring, the body may be rigid and contorted, the face may express intense emotion, movements may occur, and so on. This distinction is purely accidental, and is of no importance from the theoretical point of view. Yet it has become set in our nomenclature, and we can not well get rid of it. For the first group I shall therefore use the generic word "hypnotic," which means simply "sleeplike." The chief characteristics of hypnotic states are: (1) the closed eyes, expressionless face, and relaxed muscles—in general, absence of any spontaneous sign of mental life; (2) the presence of heightened suggestibility. The chief characteristics of the trance states are: (1) spontaneous evidences of mental life, afforded in talking, writing, emotional expression, movements of other kinds, or by memory after the state is over (2) the absence of suggestibility. But it is needless to say that many states are found which can not be put into either of these classes.

There are many ways of inducing hypnotic states, but all agree in involving an arrest of the flight of thought, concentration of attention upon one element, restriction of the conscious field. In some very susceptible patients any sudden arrest of attention, such as that produced by an intense and unexpected stimulus, may induce a hypnotic state or some other form of disordination. A sudden flash of light, or the clang of a loud gong, has been known to produce this effect. But generally the concentration of attention must last some time, and it is usually necessary that the patient should voluntarily co-operate with the hypnotizer. One of the easiest methods of getting him to do this is to tell him to go to sleep, for we all, in trying to go to sleep, do precisely what we should do in order to be hypnotized. Often the attention is riveted upon a bright spot, upon a sound, a sensation of touch, or even upon a thought. As it is very difficult to hold attention upon an absolutely unchanging thing, it is customary to help the patient by providing some monotonous variation. This is the chief function of the "mesmeric passes" of which we hear so much, of the revolving mirrors, oscillating pendulum, etc.

Whenever the normal flow of consciousness is thus interrupted, there is a tendency for the patient to fall asleep. It would seem as if the other elements—those which are prevented from getting into the upper consciousness—lose their co-ordination and coherence; they no longer faithfully mirror the past or paint the future, they become broken, dislocated, "dreamy," and finally die away altogether. Then the element which has occupied attention also dies away, and the patient has reached the deepest stage of hypnotic lethargy. I asked one of my patients, while he was apparently sunk in a deep lethargy, what he was thinking of. He told me in a halting, broken way that he was in his own home, it was about eight o'clock at night, he was playing cards with So-and-so; I was at a neighboring table, also playing cards, etc. In what respect does this differ from the ordinary dream? But more often the mind seems like a slate erased, and the only thoughts existing are those which the hypnotizer suggests.

It is often possible to trace the stages through which consciousness passes in its progress toward complete disordination and coma, and many have tried to discover some fixed relation between these stages. There is, I think, none, but there are some recurring sequences. Usually the control of movement by thought is first impaired. The patient feels himself becoming weak, his limbs grow heavy, the more delicately co-ordinated muscle groups of the eyelids, lips, and fingers become paralyzed, then the larger groups are affected. Sometimes one side of the body yields before the other; and sometimes, instead of paralysis, rigidity supervenes. I remember one patient who, when commanded to shut his eyes, instantly "went off" like a spring released, becoming as rigid as a log, and we had great ado to "limber him up" again.

If the patient be left to himself he will either awake of himself or fall into a normal sleep, from which all signs of suggestibility, catalepsy, etc., have disappeared. This is most easily interpreted upon the supposition that hypnotic states are in fact only imperfect forms of sleep, and therefore unstable, tending to resolve themselves in either the one direction or the other. The fact that hypnotic states may be produced not only by putting a waking man partly asleep, but also by partly waking a sleeping man, would point to the same conclusion.

The suggestibility which is so characteristic of hypnotic states probably depends upon the persistence of that portion of the patient's consciousness which represents the hypnotizer, while all else has either disappeared, or become much weakened by dissociation from its accustomed re-enforcing elements. The hypnotizer keeps talking to the patient, touching and stroking him. and he has in consequence no opportunity to fall asleep to *him*, R—— told me that even when his consciousness of the position of his own body was almost lost, and the sounds of the outer world seemed dull and muffled, the tones of my voice and my lightest touch remained as distinct as ever. The consciousness of the hypnotizer is a center from which radiate new forces, and sometimes, when memory is preserved, the patient may be able to describe the first collisions between the enfeebled upper consciousness and the foreign element. Take Dr. Cocke's account of his own experiences:

"He then said to me, 'You can not open your eyes.' The motor apparatus of my lids would not seemingly respond to my will, yet I was conscious that while one part of my mind wanted to open my eyes, another part did not want to, so I was in a paradoxical state: I believed that I could open my eyes and yet could not. The feeling of not wishing to open them was not based upon any desire to please the operator. . . . He told me that I was asleep, and placed my hand over my head, and stated that it was rigid, and that I could not put it down. Again, a part of my consciousness wanted to put it down and another part did not. He stroked my arm and told me that it was growing numb, that it was growing insensible. He told me that I had no feeling in it. He said, 'You have no feeling in it, have you?' I said 'No,' and I knew that I said 'No,' yet I knew that I had feeling in it, and yet believed that I had no feeling in it. . . . I was not conscious of my body at all, but was painfully conscious of the two contradictory elements within me. I knew that my body existed, but could not prove it to myself. I knew that the statements made by the operator were, in a measure, untrue. I obeyed them voluntarily and involuntarily."

As a brief outline of the salient features of typical hypnotic states the above must suffice, but one must remember that many anomalous states are found to perplex the student. Sometimes one meets with profound lethargy with no suggestibility; at others, the patient becomes extremely suggestible without a sign of sleep, and is afterward found to have no memory of the suggestible stage. Occasionally the attempt to produce a hypnotic state throws the patient into a trancelike nightmare, from which it is very difficult to rescue him. Sometimes it is difficult to get the patient entirely awake, or, even if awake and conscious, some disordinated elements may persistently refuse to effect union with the upper consciousness. A friend of mine, on awaking a patient, found her unable to speak or swallow, and some anxious hours slipped by before he succeeded in restoring her power over the paralyzed muscles. Altogether hypnosis is decidedly a dangerous thing to meddle with.

Many typical trance states are brought about, it would seem, by what may be described as the hypertrophy of some perception or sensation or system of ideas. This abnormal growth may be in either or both of two directions. In the first place, it may be an actual increase in intensity and complexity. This is not uncommon in all forms of disordination; thus, Dr. Cocke says that when he tried to hypnotize himself, he first noticed a ringing in the ears, then this "noise in my ears grew louder and louder. The roar became deafening. It crackled like a mighty fire. . . . I heard above the roar reports which sounded like artillery or musketry. Then, above the din or the noise, a musical chord. I seemed to be absorbed in this chord. I knew nothing else. The world existed for me only in the tones of this mighty chord." But the development of the state may be not merely a development in intensity and complexity, but also in its importance considered as an element of consciousness. I have shown in my previous papers that consciousness tends to assume a certain form in which some one group is more clear and distinct than the others. This is what we call the "center of attention" or "focus" of consciousness. I have also shown that when any one group becomes focal all others become less clear and distinct, and may even be driven out of consciousness altogether. Now, in trance states this seems often to happen. In the hypnotic states the element upon which attention is fixed itself disappears; in trances, it and its associated states take possession of the focus, drive out all other states, and serve as the starting point for dreams, hallucinations, and visions of the most complex kind. For the same reason, suggestibility is seldom found in trance. There is no awareness of the hypnotizer to serve as a center of activity and the hypertrophied state usually proves strong enough to resist interference from without.

The close relation between hypnosis and trance is well shown by the case of M——. He is about twenty-five years of age; by profession a bookkeeper, he has proved himself capable and efficient, and, although he has always been of somewhat delicate health, he is quiet in his demeanor, and not in the least hysterical in the vulgar sense of the word. Once, when a child, he was playing with a toy locomotive; the alcohol used to generate steam was spilled upon the floor and caught fire; in great terror he ran away, seized the doorknob, and then became fixed and motionless, unable to cry for help or to run. At another time, when about twelve years old, his grandfather died. He stole unobserved into the room where the body lay and lifted the shroud. No sooner had his eyes fallen upon the dead face than he lost all power of thought and of movement and remained fixed, the shroud uplifted in his hand and his eyes staring at the corpse, until some one came in and drew him away. As soon as I heard this account it struck me that he would probably prove to be a good hypnotic patient. Although himself very skeptical, he allowed me to try, and in three minutes I had him in a deep lethargy in which he was almost absolutely suggestible. It did not occur to me at the time to look for signs of incoördination, but two years later I found that his visual field was much restricted—that is, he was blind to its outlying portions—and also that his sensation of touch was more or less impaired. I have no doubt that the facility with which his upper consciousness was both accidentally and intentionally displaced sprang from the same conditions of which these symptoms of sensory incoördination gave evidence.

Hypertrophy of these two kinds may be the lot of any mental state. When it is a percept that usurps the conscious field, we speak of the patient as being "fascinated"; if the percept is attended by great emotional disturbance, we use such phrases as "spellbound with horror," "drunk with joy," etc. When the hypertrophied states are chiefly ideas without marked emotional accompaniments, we speak of the patient as being "in trance," "seeing a vision," or simply as "dreaming." If the visions are accompanied by intensely pleasurable emotions the state is termed "ecstasy." In the higher grades of ecstasy the concrete visions disappear and clear consciousness is lost in a flood of emotions of an intensely pleasurable character. The types of trance in which the emotion is acutely disagreeable—grief, terror, remorse—are usually classed as diseases, partly because they unfit the patient to a greater degree for the duties of life, and partly because they often spring from organic disease, especially of nutrition. The disordered physiological processes give rise to floods of vague but intensely disagreeable sensations, and these in turn generate the horrible and terrifying visions. Many trance states are revealed in the patient's movements, but for the present I shall speak only of those which are remembered and described afterward.

The attainment of ecstasy has been the aim of many religious sects in ancient and modern times, by whom it is conceived to be a direct union with the Divine; these form an important branch of the group of religious mystics, all of whom believe that the human soul is capable of direct union with God during this present life. But our information as to the various possible types of ecstasy is very defective. The essential element is the flood of pleasure, but the sensory elements may be of any and all kinds.

One form is characterized by the appearance of a beautiful light, far more pure and brilliant than any commonly experienced. It is probable that this light is due to the hypertrophy of the vague visual sensations which we always experience in darkness—what the Germans call the eye's *Eigenlicht*. Plotinus, the Neo-Platonic philosopher (*circa* 204–269 A. D.), seems to have experienced this type of ecstasy, and has left us many descriptions of it, and of his methods of attaining it, albeit couched in rather obscure language. "Often," he says (Ennead IV, book viii, chap. 1), "I awake from the body to myself, I come to be outside all else but within myself, I see a great and wonderful beauty. Then am I most assured of the supreme happiness of my lot, for I have entered into the best life and am become one with God. . . . After thus abiding in the Divine, I descend from intuition to thought, and while descending I can not tell how I descend, or how my soul has got within my body." He thus describes his method (Ennead VI, book ix, chap. 7): "In your contemplation cast not your thought without, for God is not in any one place, depriving other things of himself, but is present *there* to him that can touch him, and to him that can not he is not present. As in other cases one can not think anything while thinking and attending to something else, but must add nothing to that which is thought, that it alone may be that which is thought; so also here one must know that he can not, while he has the image of anything else in mind, apprehend God, that other image being active the while, nor can the soul, while possessed and controlled by other things, receive the image of their opposite. . . . Every soul must let go all without and turn within, must not be attracted toward any outer thing, but must lose consciousness of all such, first of her condition and then of her thoughts, and after losing consciousness of herself also must be given over to the vision of God." In another passage (Ennead V, book v, chap. 7) he draws a distinction between light proper and that which is illumined by it; usually we see the latter only, but we can become conscious of the former also. For example, with closed eyes and in total darkness we see a pure light which is generated by the eye itself. "So also the mind, wrapping itself about from other things, and withdrawing within, seeing nothing, will behold light, not here and there, but pure light alone, of itself suddenly shining, so that" (chap. 8) "it can not tell whence it shone, whether from without or from within, nor can one say, after it has departed, that it was within or not within. One should not ask whence, for there is no whence; it does not come, nor does it go anywhither, but shines, and then ceases to shine. One should not therefore seek it, but quietly wait until it shines, first preparing one's self to behold it, as the eye awaits the rising of the sun. The sun appearing above the horizon—out of the ocean, as the poets say—presents itself to our eyesight. But this other light, of which the sun is an imitation, whence is it to rise, and above what is it to appear? It rises above the contemplating mind, for the mind fixes itself upon the contemplation." Again (Ennead VI, book ix, chap. 9), "There the soul beholds God and herself in the only way permitted, herself radiant, full of intelligible light, nay rather herself all pure light, weightless, buoyant (κοῦφον), becoming God—nay, already become God."

The sect known in the eleventh century as Hesychasts, and later the Omphalopsychics of Mount Athos, claimed to have, and doubtless did have, the same experience. Prof. Preyer, in a note to his *Hypnotismus*, has given an interesting account of them. Their method was to drop the chin upon the breast, fix the eyes upon the navel, and wait for the light to burst upon them. A great ecclesiastical controversy arose over these practices. The language which George Fox and the early Quakers use of the "inner light" seems to point to the same thing. One of my graduate students, while under ether, had a similar experience, which makes an excellent commentary upon Plotinus's statement that the soul is "pure light." "I took form, I was a body of light in an abyss of ethereal gray; in form I was, as memory reproduces size, eighteen inches by eight, a rounded disk: I was not *looking* at myself, but I knew and *saw* myself." Such experiences would seem, from my own inquiries, to be far from uncommon, and I would be grateful to any of my readers who can give me more cases.

Among the monks and nuns of the mediæval Church ecstatic states were common. The constant fasting and loss of sleep to which many of these saints condemned themselves are known upon independent evidence to be fruitful sources of hallucinations, and prolonged meditation upon a given topic determined the general form of the vision. The enforced celibacy of the monastic life and the practice of self-torture were further conditions of the greatest importance. Enforced celibacy frequently gives rise to reflex neuroses, and self-torture is in many neurotic individuals a direct stimulus to the very passions which the celibate most desires to repress. It is not surprising, therefore, that the religious ecstasies of the ascetic frequently assume a highly erotic form, although expressed in the most chaste language, and alternate with apparitions of the devil in the forms of *incubi* and *succubœ*. Prof. Mantegazza has given interesting accounts of some of these religious ecstatics and visionaries, and I shall abbreviate a few of them.

Margareta Maria Alacoque was possessed by a desire to emulate the sufferings of Jesus, and inflicted upon herself such horrible tortures that her Mother Superior felt called upon to interfere, although some were inflicted by the express command of God. Is it surprising that she passed much of her time in a state of delirious love for her "heavenly bridegroom," constantly seeing visions and receiving revelations?

Anna Katharina Emmerich has described for us most vividly a condition of ecstatic trance in which the consciousness of the real world was not wholly lost. It is analogous to the above-quoted experience of Dr. Cocke. "I see this not with my eyes, but rather, as it seems to me, with my heart here in the midst of my breast. This causes perspiration to break out on that spot. At the same moment I see the persons and objects about me, but do not trouble myself about them; I do not even know who they are—and even at this moment, as I speak, I *see*. . . . For some days I have been continuously in a supernatural vision. I have to use compulsion upon myself, for in the midst of my conversation with others I see entirely different pictures before me and hear my own voice and the voices of others sounding dull and muffled as from an empty vessel. . . . My reply to what is said to me falls from my lips easily, and often with more vivacity than usual, although afterward I do not know what I said, yet I speak coherently and intelligibly. It is very hard for me to keep myself in this double state. With my eyes I see my surroundings dimly, enshrouded in a veil, as one does when trying to fall asleep and just beginning to dream. The inner vision desires to sweep me away with violence, and is far more clear and brilliant than the natural, but it makes no use of my eyes."

But St. Theresa has left us, perhaps, the best account of ecstasy that we possess. One should note the complex hallucinations of all the senses which served to bring about the true ecstasies.

"One day, after I had prayed and besought the good God that he would help me to do his will in all things, I began the song of praise, and as I invoked him there came to me an ecstasy that almost put me beside myself. . . . I heard these words: 'Henceforward it is my will that thou shalt speak no more with men but with angels only.'" "These inner addresses of God to the soul consist of quite clear and plain words, but are not heard with the bodily ear. . . . One day, as I was praying, God vouchsafed to show me his hands only; their beauty was so great that I have no words with which to describe them. A few days later I saw his divine countenance also, and was, I think, entirely absorbed in it. . . . While he spoke to me, I beheld that majestic beauty, and the words which that beautiful, divine mouth spoke to me breathed an infinite sweetness. In those happy moments I felt an intense desire to see the color and size of his eyes, that I might tell of them afterward, but this favor I never won. All my efforts only caused the vision to disappear." "As the clouds draw to themselves the vapors of earth, so does he draw our souls to himself, ravishes them out of themselves, brings them upon the clouds of his majesty to heaven with him, and begins to reveal to them the mysteries of the kingdom which he has prepared for them. . . . In these ecstasies the soul seems to leave the body. Hence the natural warmth diminishes, the limbs slowly grow cold, although one feels the while most comfortable. In the prayer of union, in which we find ourselves already in our native country, we can almost always resist the divine attraction, though it be with difficulty and with great effort, but not in ecstasy; all resistance is then usually impossible. Before one thinks there comes a shock so sudden and mighty that one sees and feels as if that cloud from heaven, or that divine eagle, had swept one away and borne one off in flight." "This condition is a sleep of the mental powers, in which they, without being wholly merged in God, yet can not tell how they work. The pleasure, the bliss, is incomparably greater than in the preceding state of prayer. The soul is overflowed with the water of God's grace, which flows full to the banks. She can not and will not go either forward or backward, and only glows with the desire to enjoy such transcendent majesty. . . . My state then seems to me an absolute death to all worldly things and a ravishment in God. I know no fit simile for what the soul then feels. She no longer knows what she does, whether she talks, is silent, laughs, or weeps. It is like a blissful delirium, a heavenly madness, in which one learns true wisdom; in short, it is a sort of most exquisite bliss."

With these few illustrations I must turn from the forms of trance which appear to result from the hypertrophy of some mental state to a very different type. From the theoretical point of view we would expect to find the lines of cleavage—so to speak—in disordination taking different directions in different people. In the cases of which I have been speaking the mental co-ordination would seem to be pretty much dissolved or displaced. In other cases, to which I shall return later—those of so-called secondary personality—we shall find the lines of cleavage relatively few, and constant in their direction and location. But to the trance states proper belong those forms of disordination in which the inner life of thought is left intact while dissociated from movement, from sensation, or from both. The chronic cases in which some movements or some sensations only are lost are grouped under hysteria rather than under trance; the more complete and transitory forms properly belong to trance.

Of the second of these three conceivable cases, in which all sensation is lost while the power of movement remains, I know of no illustration. But the earlier experience of Ansel Bourne comes very near it. He was walking down a road and felt slightly dizzy; went and seated himself upon a stone. "In an instant, . . . it seemed as though some powerful hand drew something down over his head, and then over his face, and finally over his whole body; depriving him of his sight, his hearing, and his speech, and rendering him perfectly helpless. Yet he had as perfect power of thought as at any time in his life." In his case all was gone except touch and the power of voluntary movement with the exception of speech. The details of this classical case can be found in Dr. Richard Hodgson's article, in the Proceedings of the Society for Psychical Research, vol. vii, page 221.

The converse, loss of movement without loss of sensation, is not uncommon; indeed, is probably only too common. A case is given by Alexander Crichton, M. D., in his work on Mental Derangement, vol. ii, page 87: "A young lady, an attendant upon the Princess of ——, after having been confined to her bed for a great length of time with a violent nervous disorder, was at last, to all appearance, deprived of life. Her lips were quite pale, her countenance resembled the countenance of a dead person, and her body grew cold. She was removed from the room in which she died, was laid in a coffin, and the day of her funeral was fixed upon. The day arrived, and, according to the custom of the country, funeral songs and hymns were sung before the door. Just as the people were about to nail on the lid of the coffin, a kind of perspiration was observed to appear on the surface of her body. It grew greater every moment, and at last a kind of convulsive motion was observed in the hands and feet of the corpse. A few minutes after, during which time fresh signs of returning life appeared, she at once opened her eyes and uttered a most pitiable shriek. Physicians were quickly procured, and in the course of a few days she was considerably restored and is probably alive at this day. The description which she herself gave of her situation is extremely remarkable, and forms a curious and authentic addition to psychology. She said it seemed to her, as if in a dream, that she was really dead; yet she was perfectly conscious of all that happened around her in this dreadful state. She distinctly heard her friends speaking and lamenting her death at the side of her coffin. She felt them pull on the dead-clothes and lay her in them. This feeling produced a mental anxiety which is indescribable. She tried to cry, but her soul was without power, and could not act upon her body. She had the contradictory feeling as if she were in her own body and yet not in it, at one and the same time. It was equally impossible for her to stretch out her arm or to open her eyes as to cry, although she continually endeavored to do so. The internal anguish of her mind was, however, at its utmost height when the funeral hymns began to be sung, and when the lid of the coffin began to be nailed on. The thought that she was to be buried alive was the first one that gave activity to her soul, and caused it to operate upon her corporeal frame."

This account, being anonymous, is not as well authenticated as one could wish, but to me it seems credible because I have not only known several persons who have had analogous experiences, but I have had one or two myself. My experiences belonged however to the third type, in which both movement and sensation are dissociated from thought. The first was in March of 1892. I was staying at a *pension* in Florence. I had arrived the preceding evening and was in excellent health. I came to consciousness after a dreamless sleep, to find myself paralyzed, I think anæsthetic also, but am not sure of that, and I felt as if I were struggling with an alien and hostile personality for the possession of my own body. With a violent effort I regained control of myself, turned over with the thought, "What a horrible dream!" and tried to go to sleep. The same thing recurred. Again I shook it off. This happened three or four times, and the last time it was only with the greatest difficulty and after the most desperate struggles that I expelled, as it seemed to me, my enemy, got out of bed, and opened the shutters. I was somewhat frightened, but knew enough of such phenomena to interpret it much as I have here done. Four or five times in the next four months I had similar experiences. The last was in July. I was at a hotel in Liverpool, and awoke to find myself absolutely paralyzed and absolutely anæsthetic, but with no consciousness of the alien personality. I was vividly conscious; a little alarmed, I remembered the previous occurrences of the same state, remembered writing to a friend about it, speculated about its cause, tried frequently in vain to break it. Finally, as I thought, I succeeded. With a great effort I sat upright in bed, still in total darkness, and at that moment the spell was broken. I was lying flat on my back. It was a bright summer morning and the sunlight was streaming in through the windows. Two of my friends —one an artist and the other a professor of law in a well-known university—have told me of the same experience, and both had noted that the execution of the least movement, as of the little finger, would break the spell.

We must conceive of such states as due to an imperfect awakening. The normal co-ordination of waking life is not yet fully restored. Very often in cases of this sort the patient's consciousness seems to be separated from his body, sometimes appears to visit distant parts of the earth and at others to go into the other life and have communion with angels and spirits, occasionally it even sees God himself. In many such hallucinatory experiences there is a curious constancy of type which, with our scanty information, we can not at present explain, and I would be glad to receive authentic accounts of any cases known to my readers.

THE NEW GEOGRAPHY.

By ALBERT PERRY BRIGHAM.

THE doctrine that land forms have had a history chiefly distinguishes the new geography from the old. Geography, indeed, takes account of sea as well as land, of the phenomena of the atmosphere, the distribution of organisms, including man, of economic products and political divisions. But the new phase of geography, which is sometimes known as physiography, and later, as geomorphology, is not an isolated and formal element of the science; it rather underlies the whole, modifying or, more truly, controlling climate, organic distribution, and the history of man. The new geography can not, therefore, be charged with infringing upon the rights of the old, for it contributes vitality, unity, and continuity to the whole range of geographic fact and theory; it rejects absolutely the category of the author of one of our textbooks in physical geography, that the air, the water, and the land are "the three dead geographic forms."

Geography is sometimes defined as a description of the earth as it is, without reference to its past. One author has called it the science of distribution, but well adds that because it is a science it can not rest in a mere record, but must have the causes. The new movement has simply applied the evolutionary principle to geography, giving it the life and freedom which this doctrine has imparted to all other sciences in our day. It has been seriously asked whether the new notion of geography does not confuse it with geology. Thus the minority report of the Conference on Geography to the Committee of Ten criticises the majority report as bearing too plainly the marks of the geologist's hand. It may as well be frankly admitted that geography and geology overlap. All sciences transgress each other's boundaries, and all bounds in Nature are largely matters of convenience. Geology never truly interpreted terrestrial history until, with Hutton and Lyell, it took to studying geography. Nor will the geographer understand the earth which he sees until he takes account of geology. Land forms can not be truly seen or faithfully described until seen and described in the light of their origin. Such forms will hide themselves from the student who thinks they are dead. For him they might nearly as well be buried. The geologist who seeks, for example, the causes of volcanism, will find help in his study of the distribution and relative action of existing volcanoes—in other words, he can not keep from geography. The geographer, in his turn, needs the perspective of ancient volcanic history, if he would appreciate his own facts. Because he has commonly had no such vista, he has burdened generations of boys with the solemn blunder that a volcano is a burning mountain. Thus we may vindicate for each science its own center while granting a generous measure of common facts. The difference is in the point of view, the aim, and method of treatment; the geologist seeks largely that which has been, the geographer that which is, and each must be known in the light of the other. It is precisely the case with two biologists, one of whom studies living, the other fossil, forms. The day is past when they can work apart; yet none would deny that their fields are reasonably differentiated.

The new geography is a recent growth. Its facts and principles are little diffused and have not found their way into text-books. Thus it came about that the Conference report on geography is characterized as the most revolutionary of all those received by the Committee of Ten on secondary-school studies. Even scientific surveys of the several States do not yet show much impress of the new doctrines. Prof. Davis, the geographer of Harvard University, affirms that his students search, with meager reward, for accounts of physical features in the literature of the several States. As the same writer has truthfully said, systematic study of topography is largely American, and for the reason that the broad object lessons of the Appalachians and of the West gave our scholars the opportunity and the stimulus to lead in such researches.

The central principle of the new geography established by Powell, Dutton, Gilbert, Davis, and other American geographers and geologists is the doctrine of a base level of erosion as the goal of the destructive processes. Given an early "constructional" land surface, such as a newly raised sea bottom, and it will pass through what is called a cycle of development. Youth, with extended uplands and steep, narrow valleys, is followed by a much dissected, highly diversified topography marking the stage of maturity, whence is a gradual passage to the low reliefs, slight gradients, and quiet monotony of old age. During this cycle all forms of scenery have place, and in untrammeled variety, dependent upon climate and the constitution and structure of the mass upon which this land sculpture is wrought. Thus the horizontal beds of the Catskills give one type, the folded sediments of the Appalachians another, and the crystalline masses of the Adirondacks a third. Before such a cycle is completed in an actual base level, a new cycle is often introduced, by massive uplifts or depressions of the region concerned. All these principles are illustrated in infinite detail on our Atlantic seaboard from New England to Georgia, and the new method is fast becoming a master key for unlocking both the geological history and present meaning of all continental areas. McGee goes so far as to say that "nearly as much information concerning the geologic history of the Atlantic slope has been obtained from the topographic configuration of the region within two years (1887 and 1888) as was gathered from the sediments of the coastal plain and their contained fossils in two generations." Davis urges the co-operation of State surveys in such advanced and rational geographic work, and with a view to reports which shall be of immediate service to the public and to the schools. A large element in this geographic advance has been the emphasis laid upon geographic work by Major Powell as Director of the United States Geological Survey, a policy with which Mr. Walcott, the present director, appears to be in fullest accord. A good map reveals more land history to a trained geographer of the modern school than most others can find out in the actual field. The geologists, teachers of geography, and indeed all citizens of New York are losers by the failure of our legislators to provide more liberally and promptly for the study of our geography by new methods. A great commonwealth, which Prof. Hall and his associates made classic geologic ground for all time, finds the knowledge of its geography in a backward state as compared with its neighbors, Massachusetts, Connecticut, New Jersey, and Pennsylvania.

What place is the new geography to have in our system of education? This just now is the question of importance and the center of much discussion. Geography in the lower schools has served to impart a group of facts about the world, which respectability and convenience require a youth to have. Cultural value has not been enough considered, and from the higher schools the subject has more often been absent. With the tendency of the times, geography has of late been taught to the child more from out-of-door and local facts, and so has come nearer the new geography in its spirit. But the teaching yet lacks breadth and strength, because the principles of the subject have not yet become available to teachers, except in favored centers. That geography of the new type lends itself to the training of the reason there can be no question. The causes of geographic forms arouse inquiry in nearly all persons. Minds of all grades become alert when the origin of soils, rocks, fossils, valleys, terraces, lakes, swamps, hills, waterfalls, mountains, and continents is explained in common language. A discreet teacher, at home in the subject, has no difficulty in bringing the main doctrines of geographic development within the comprehension of children. It is not hard to conceive a country of hills and valleys as a surface partly worn toward a goal of lowland denudation, and then to find in the forms visible from the schoolhouse window ever-varying episodes in this history. It is not to be understood that this larger conception will be put upon the pupil at the outset; he will rather proceed from the minor passages of the land history to its main and grand movement. The brook, gravel bank, ravine, and hillock will lead to a mental picture of the township, county, State, and continent. And it is not to be forgotten that the animals and plants, clouds and storms, climate and productions, highways, cities, and all other material of geography will have their place in the teaching; it is only held that they will gather new meaning as they take their places in a comprehensive scheme of geographic development. It is of small account that the new teaching has what may be called a geologic aspect; names matter little when the only rational knowledge of geography is concerned.

Prof. W. B. Powell has given in the National Geographic Magazine an elaborate outline of the progress in the public schools of Washington toward such a rational understanding of the geography of the United States, beginning with the particular and working toward the general, in the field and by laboratory methods, as with specimens, maps, drawing, and sand modeling. The fullest pedagogical statement of the meaning and needs of the new geography for schools below college grade is contained in the Conference report on geography, to which reference has been made. The names appended to it stamp it as a representative utterance, and it is enough here to refer the interested reader to the document itself, only citing the final paragraph of the discussion of it by President Eliot's committee: "They (the Conference) recommend a study of physical geography, which would embrace in its scope the elements of half a dozen natural sciences and would bind together in one sheaf the various gleanings which the pupils would have gathered from widely separated fields. There can be no doubt that the study would be interesting, informing, and developing, or that it would be difficult and in every way substantial."

Geography is winning its way to a place in the college and the university. Objection has been raised for the reason tersely stated by some one that the subject is "a graphy and not a logy." But we have seen that the new geography is not only a descriptive and distributive body of truth; it is historical and causal. The older geography has allied itself, so far as it has had place in the university, chiefly with history. The new geography offers a yet larger contribution to history, but will ally itself more closely with the sciences of Nature, particularly geology. At the same time it will gain in its philosophical aspects, bringing it into harmony with Krapotkin's definition as "in its higher stages a philosophical review of knowledge acquired by different branches of science."

I have recently compared the catalogues of fifty of the better-known American colleges and universities. Thirty-three of these documents afford no reason to suppose that geography receives systematic attention in their respective institutions. Of the remaining seventeen, Harvard University and the University of Chicago give the fullest measure of instruction, and wholly, it scarcely need be added, of the most progressive type. In both, geography makes part of the department of geology. Harvard has, as is well known, a thoroughly equipped geographic laboratory, and offers largely attended elementary and advanced courses in meteorology and physical geography. Among the subjects of research by advanced special students last year were: the topographical development of shore lines, the flood plain of the Mississippi, the Great Plains of the West, the effect of local topography on general winds, and the features of arctic climate. In Chicago we find courses in physiography or genetic geography; in geographic geology, treating the origin, development, and destruction of geographic features and the significance of landscape contours, or geophysiognomy. There are laboratory work in geographic geology, and a course in what is called dynamic geography, inclusive of the agencies involved in geographic evolution. Yale offers one course in physical geography, embracing the elements of dynamic geology and natural history; also one course of twelve lectures on physical geography in relation to political history. Princeton has two courses, physical geography proper, based on Guyot's text-book, and physical geography in relation to history. Cornell has one course, with emphasis on development of topographic forms, and also a course in glacial geology. Michigan does not offer the subject formally, but the development of topography is taught under geology. Vassar, Hamilton, Rochester, Wesleyan, and North Carolina give instruction in physiography. Leland Stanford, Jr., has a course in topographic geology, and Oberlin a course in quaternary geology. At Amherst the subject is treated briefly with historical geology, and at Colgate seminary and field courses are given in the history of topography and in glacial geology.

In many of the above institutions, but not in all, the new geography evidently has place, though the variety of nomenclature and method shows how new the subject is to the higher schools. In several cases its presence is directly traceable to the influence of Harvard. As a whole it may be said that geography is not yet considered a necessary theme in American colleges. When present, it is often due to the appreciation or special tastes of instructors in geology. In England, geography was recognized as a university study by Oxford and Cambridge first in 1887 and 1888. In Germany it fares better, as would be expected, though there late in recognition as compared with other subjects. In 1893, as stated by Prof. H. Wagner, there were twenty-eight professors and teachers at eighteen of the twenty-one universities of Germany, but without unanimity of conception, in some the relation to history prevailing, while in others geology and biology were the companion themes.

In America, the recently organized National Geographic Society, while most active in discovery, has done much to take geography from the field of mere exploration and build it into a science, and it has now provided, through one of the large publishing houses, a series of monographs for teachers, in which certain great geographic units in our own country are described by accomplished scholars. It is also a cheerful fact that a considerable body of pedagogical literature has grown up in this field during the last five years.

It can scarcely be needful to urge the value of the new geographic study. The sources of intellectual satisfaction are greatly multiplied, and ennobling means of recreation may be placed in the way of every intelligent person, largely apart from the expenditure of money or the possession of special opportunity. Familiar landscapes take on fresh interest, because they become vital and are for the first time really observed. Travel becomes delightful rather than, as to so many, irksome, and otherwise dreary hours are made into a fascinating opportunity for true culture. Every reader knows how much of Parkman's charm is due to his geographic sense and facile photography of locality. H. J. Mackinder, of Oxford, has remarked that "John Richard Green's Making of England is largely a deduction from geographical conditions of what must have been the course of the history." Prof. Powell suggests the ideal teaching, in saying of geography in the schools of Washington, "North America is studied physically, in which connection it is studied historically also, so that national lines or divisions are seen to move back and forth and finally become fixed by physical causes when such exist, as is the case frequently." General A. W. Greely has recently quoted the amusing remark, "It is fortunate that great rivers run by so many great cities!" Geographic study soon supplies the real logic of such connections and of those less evident, and illumines historic and economic research at every turn. The reconstruction of the geographies of geologic time must surely shed floods of light upon the development and distribution of existing organisms, including man himself. Glacial geology also, with its vast contribution to our knowledge of the earth, past and present, supplies one of the best illustrations of the new geography in its fellowship with geology. Glaciation is mainly a matter of climate and topography, with perhaps a measure of cosmic influence; in short, it is an affair of geography. Of that keen scrutiny of surface forms carried on by glacial science the new geography has largely been born. Some will ask what economic value accrues with this vast devotion to scientific geography which the next generation will see. Surely no field of science will yield a larger intellectual harvest, and the economic significance of pure science, though sometimes out of sight, is never far away.

QUACKS AND THE REASON OF THEM.

By Dr. A. CARTAZ.

THE story is told in Joubert's Popular Errors concerning Medicine, published at Bordeaux, France, in 1579, that one Gonelle, a jester at the court of the Duke of Ferrara, insisted once upon a time that the trade which had the most followers was that of doctor. To prove his assertion, he left his home one morning to go to the palace with his nightcap on and his jaws wrapped up. The first person he met stopped him with the question, "What is the matter with you, Gonelle?" "A terrible toothache." "Oh, is that all? I'll tell you what will cure it." And every person he met had some advice to give him. When the jester reached the duke's chamber, the same question and answer were repeated. "Ah," said the prince, "I know of something that will take the pain right away." Gonelle instantly threw up his kerchief, saying: "And you too, monseigneur, are a doctor; I have only passed through one street in coming from my house to you, and have counted more than two hundred of them. I believe I could find ten thousand in the city." Whether the story is true or false, it could be told again in our days, and Gonelle would win his wager without dispute. Everybody has had opportunities to try the experiment; and there is probably no one who has not permitted himself to give friendly counsel to an ailing person in passing—good advice: "Such a person was cured by such a remedy; try it"; and to jeer at the doctors, who know nothing about the matter.

It is not strange, in view of this instinctive tendency to sympathize in the sufferings of another and to assist as far as possible in curing them, that false doctors, charlatans, should have had their day, even if only briefly at a time, in all ages and in all quarters of the world. We can find examples of them as far back in the world's history as we have a mind to go; but the typical quacks date from the end of the sixteenth century. Beginning with this period, reputations have been established the remembrance of which has been sent down to us. Charlatans have also had their times of trouble, but the species has been preserved and perpetuated from generation to generation, from century to century, and still flourishes. Quacks still invest themselves with embroidered cloaks, wigs, and indescribable hats, or something like them, and with the help of the most astonishing blandness sell their wares, which are warranted to cure all diseases. It is not easy to learn to gain the ear of the throng, but some persons are marvelously skillful at it. Some quacks engage exclusively in special lines of practice, while others will offer a balm sovereign against all diseases. I recollect that when I was a child one Zozo passed regularly from one village to another at the time of the rural festivals, selling a vermifuge, the praises of which he sounded in a speech whose eloquent persuasiveness I have never heard excelled. The tradition is preserved also in Paris of Dr. Napolitano, who used to make his perorations in 1815, dressed in a magnificent scarlet cloak trimmed with gimp and gilt; of Duchesne, who inclosed himself in a sack and pulled a tooth with one hand and fired a pistol with the other; of Lartaud, chiropodist to the Emperor of Morocco, etc.

The type of the plumed charlatan, such as is represented in Gerard Dow's picture in the Munich Museum and Du Jardin's in the Louvre, is declining, and is now met less frequently in the large cities. It is giving place to another type, more modest in its bearing, and less noisy—the empiric, or quack doctor. He, too, lived in the former centuries, as is shown in an eighteenth-century picture of a wandering surgeon torturing a poor fellow for some trouble in his shoulder (Fig. 1). Another picture (Fig. 2) represents Michel Schuppach, known as the mountain doctor, giving a consultation in his rustic apothecary shop to a lady of the court who has two lords attending her. The corpulent old fellow is calmly looking at the flask containing the potion he is preparing, while a servant is waiting to give him the flasks he will require for completing the mysterious remedy.

Stories of these empirics of the seventeenth and eighteenth centuries might be cited by hundreds. The memoirs of the time are full of recitals of their prowess, and sometimes of their failures. Ducerf had an oil of guaiacum which, whether taken internally or rubbed on, would cause the disappearance of any disease; Caretto, an Italian who pretended to be a marquis, sold a wonderful remedy for two louis d'or per drop. A doctor of Chaudrais, near Mantes, a peasant of much good sense, who sold simples and roots, was extraordinarily popular for a few years, and then lost his constituents one by one. Every region has had some great man of this sort. The Zouave Jacob was all the fashion in Paris under the empire, and his office was never without patients from morning till evening. A Moorish doctor of Frais Vallen, Algeria, was consulted with almost incredible faith by his countrymen and by Europeans, and gave, with his limited list of remedies—a few herbs, purgatives, and extract of cresses—some really philosophical advice, and manifested fine qualities of intelligence. Not long ago a practitioner of these arts took rooms in the best hotel in Havre and advertised by every channel the wonderful merits of the dynamotherapeutic institute. All diseases were cured by the application of plates. The innocents flocked to him, but when they found that they were hoaxed the joker had gone.

Fig. 1.—A Quack Surgeon of the Eighteenth Century. (From an engraving of the time.)

Besides these false doctors and surgeons without diplomas, like the bone-setters, there is a whole class of amateur doctors, such as met Gonelle, ready to give advice, some in pure philanthropy, others less disinterested. The members of the French Academy of Medicine have an hour or two of fun every year at the reading of the report on secret remedies. An ingenious schemer fancies he has some potent remedy and sends the receipt to the academy; or, perhaps, it gets there indirectly. I will not venture to assert that the formula may not be indorsed sometimes—recommendations are so cheap. Among these authors of cures are illiterate persons, shepherds, furriers, country ministers, teachers, and nurses. Here, for instance, is a previously unknown recipe taken from an old notebook; here is a remedy brought down from father to son, the composition of which has been kept in the family for generations. This one will cure every disease; that one, of more discreet pretensions, is only good for some particular disorder, generally an incurable one. A court bailiff prescribes an infallible remedy for epilepsy, consisting of a cat's skin applied to the back, rubbing the belly with ointment, and old brandy in the loins. All are made out after a model like this, and can be judged from it. A vast number of popular errors are built on the advice of these pretended specialists. A whole inventory of medicines, each more absurd than the others, may be found in books on madness. Do

Fig. 2.—Rustic Pharmacy. An exact representation of the room in which Michel Shappach, known as *Médecin de la Montagne* (the mountain doctor), held his consultations. Drawn from life by G. Locher in 1774. Engraved at Basle by Barthélemy Hubner in 1775. (Reduced from an engraving in the collection of M. Gaston Tissandier.)

not dispute us, say the authors; we have the facts to prove the reliability of the doctor and the sureness of the remedy.

It is certain that, whatever we may say or do, the tendency to these superstitions is not changed. The spread of instruction and of the knowledge of hygiene is of little avail in the contest against inveterate prejudices. Matters are much worse in the field of medicine proper.

There is a story of a doctor who recognized an old servant in a quack who was doing a large business, and asked him how he accounted for his success. "How many of these fifty persons passing by," the quack said, "do you suppose are sensible persons?" "Six or seven," said the doctor. "I will give you ten of them for your clients, the rest are mine." This is not complimentary to four fifths of the human race.

I believe that we can explain how even educated and intelligent people can place credence in the virtue of strange remedies and the knowledge of absolute ignoramuses. Medicine is not, as is commonly said, the art of healing; it is the art of usually mitigating and sometimes healing. There are too many incurable diseases, or those which become so with age, by fatigues of all sorts, or by excess, for a doctor to be able to pretend to do anything but soothe and reduce the pains. A patient afflicted with such troubles can not bring himself to believe that he is condemned without remedy; and he will at any price try the possible and the impossible in the hope of finding a cure. The impotency of medicine as against his trouble induces the unhappy man to cast himself in time into the hands of any quack who can insinuate himself into his confidence. "My remedy is infallible," the quack will tell him; "try it." The spirit grows weak and gives way under the suffering that tortures and yields not; the animal, we might say, resumes its rights; and the patient abandons himself to one who will promise a wonderful cure without reserve. Then there have been wonderful cures. At the time when little was known or knowledge was imperfect about nervous affections, so curious, various, and manifold in their manifestations, what seemed like resurrections, almost miracles, sometimes took place. Such facts are satisfactorily explained now, but they were formerly astonishing and surprising. The crowd hurrahed as over a prodigy, and gave absolute confidence to it. It could not be otherwise. Whatever may happen, there will always be credulous people and always men disposed to deceive them.—*Translated for the Popular Science Monthly from La Nature.*

A CLASS in botany, under the direction of Prof. Charles E. Bessey, formed a part of the Colorado Summer School at Colorado Springs last summer. The city is situated at the foot of Pike's Peak, and within easy reach of the vegetation of the plains, the cañons, the foothills, and the strictly Alpine regions. The numerous brooks and mountain streams supplied an abundance of aquatic forms, while the damp cañons furnished all kinds of fungous growths. Lichens, mosses, and ferns were plentiful, so that every section of the vegetable kingdom was well represented. The course included lessons on the structure, physiology, classification, and distribution of plants; the lower water plants, the degenerated plants, the mossworts, and the naked and covered seeded plants. The work was divided into an elementary and an advanced course. The attendance, exceeding one hundred, was mainly composed of teachers of maturer years, in all departments of school work.

THE WAYS AND MEANS OF ANTS.

By NORMAN ROBINSON.

A FEW days since I witnessed an engineering feat on the part of a company of ants that interested me greatly. A Florida chameleon (*Anolis principalis*) had wandered into my laboratory and taken refuge under a newspaper which was lying in a chair. Some one had evidently occupied the chair without taking up the paper, with the result, of course, of crushing out the life of the unfortunate little anolis. Having occasion to use the chair, I removed the paper, and discovered the flattened-out body of the little lizard, around which a company of ants were evidently holding a consultation as to the best method of utilizing the game thus accidentally provided for them.

The particular species of emmet that was thus engaged I am not able to identify. Our Florida ants have not been very carefully studied, and I think it quite possible that this is an undescribed species. Popularly he is known here as the "racehorse" ant, and the name is certainly appropriate. Of all the fast and fussy little runabouts that his omnipresent family affords, he is far and away the supreme. It would be hard to find even among the marvels of the insect kingdom any such concentrated bundle of nerves and muscles and brains. He is a little black mite of a fellow, three millimetres (about an eighth of an inch) in length, and it takes one hundred and sixty-two of him to weigh one grain. His ordinary walk is a fast trot, but when he really gets down to business even that kangaroo among insects, the flea, can not beat him in getting over the ground or being in a dozen places apparently at the same moment. Naturally he is a terrible nuisance to housekeepers; borax, corrosive sublimate, Cayenne pepper, and all the other warranted prophylactics against the plague of ants simply amuse him. Not long since I tried all the devices I had ever heard of, and which do often prove effective with other species of ants, in a vain effort to keep this active little rogue out of a new barrel of sugar. A strong solution of corrosive sublimate was poured in a circle on the floor around the barrel. He simply waited for the floor to get dry and calmly trotted over to the alluring barrel of sweets. Three hours after trying this "poison guard" I found a colony of a hundred or so comfortably regaling themselves upon the coveted treasure. Caustic potash dissolved and used in the same way served a little better purpose, but this soon solidified into a carbonate, and its usefulness was at an end. I next procured some freshly ground and pure Cayenne pepper, which some "scientific" newspaper correspondent had recommended as an infallible protection against these little pests.

"They can not possibly walk over it," this sapient scientist declared. I spread it in liberal measure around the barrel, but, alas! for newspaper science; it is a positive fact that before I had finished my circling wall of Cayenne pepper these little black imps were racing over it by hundreds. I gave it up. There was nothing to do but to build a low table, put the legs in cans of kerosene oil, and keep on it the barrel of sugar and all other provisions that I wished to protect against these cunning little marauders. Since then I have had no further trouble with them, save in one or two instances where the kerosene was allowed to evaporate. So far as I know, this particular species of ant is rarely found—at least, gives no trouble—here in the country. It seems to be especially partial to "city life."

But to return to the ant conference over the dead body of the anolis. When I first saw them, a hundred or so of these little "racehorse" ants were scampering about in the most fussy and excited way. Two little fellows would meet, cross antennæ, and start off at a lightning pace, to repeat the performance with the next one they met. No doubt they had some plan and were really talking over the matter; but apparently it was just an indistinguishable jumble of black imps racing up and down without rhyme or reason. After watching for a moment this curiously involved but seemingly aimless dance, I left to attend to other matters. Returning in the course of half an hour, I saw to my surprise that the dead chameleon had apparently come to life, and was crawling over the edge of the chair seat. A little closer inspection, however, showed that the revival was only apparent, and that these little Sandows were actually dragging off the dead body of the anolis. This was so astonishing that I naturally gave the matter a little closer attention. It was very much as though a score of men should be caught picking up a big church and walking off with it, or half a dozen fishermen should shoulder a whale and carry it to market!

In order to estimate as nearly as possible what these ants were really doing, I placed the body of the dead lizard on the scale pan of a Becker analytical balance, and found that it weighed eight hundred and ninety-six milligrammes. Ten of the ants weighed exactly four milligrammes and a half. This, of course, gave a weight of nine twentieths of a milligramme for each ant. Thus it will be seen that these little insect Samsons were actually dragging off an animal almost two thousand times as large as themselves (exactly nineteen hundred and ninety-one times)!

How did they do it? To test the matter, I placed the dead anolis back in the wooden chair seat where I first found him. Watch in hand, I awaited events. Not an ant was in sight. One minute passed, nearly two, when a solitary scout made his appearance, and, by a series of little hesitating, jerky, zigzag trots, made his way up within about an inch of the chameleon. Either by sight or smell, or in some other way, this ant evidently recognized the lost treasure. Without a second's delay he turned sharply about and ran down the chair leg and disappeared somewhere under the matting with which the floor was covered. In a little less than a minute four ants made their appearance on the scene and carefully reconnoitred the field; this time two of them came and felt the body of the anolis, executed a few little zigzag trots, touched antennæ, and started back again for the chair leg. By this time a dozen or more had climbed on to the chair seat and were running about the dead body. Any further attempt to keep watch of individual ants was of course abandoned. Most of them did not go near the object of their gathering, but simply ran back and forth over the chair bottom in seemingly the most aimless way. After ten minutes had passed, and probably a hundred more or less of the little fellows were assembled and plenty were coming, they began to gather around the body, first four or five, then ten, twenty, thirty. There appeared to be no captain or leader, and seemingly very little concert of action. Those that came up would give a little tug, and then away possibly to some other part of the body, or may be to scamper over the chair bottom among the crowd of apparent idlers. I found it very difficult to count those that were at any moment pulling or pushing—both were evidently being done as they worked from either side—but as near as I could count, forty ants were the most that at any one time were tugging at this, to them, relatively enormous load. After trying various points with very little success, they finally gathered, about thirty of them, at the tail. This they readily swung around. They had at last "got the hang of it." Perhaps I imagined it, but it seemed to me I could see the added enthusiasm with which they now tugged away at their burden. Then the tail moved faster, then the head was pulled and pushed forward; and so, by swinging first one end and then the other, the, to them, gigantic mass was moved steadily toward the edge of the chair. I think here is a clear case of thought, afterthought, contrivance, the abandonment of one plan that proved a failure and the adoption of another that proved a success. They tried at first to move the whole weight, and found it too much for them; they then tried swinging it around one end at a time, and succeeded. What human engineering skill without tools could have done better?

One curious fact that I observed was that these ants do not fancy steady work. Most of them would come up and give a little push or pull and scamper off to join the crowd that was racing about on all sides. Occasionally one would tug away for two or three seconds. This seemed about the extreme limit of their endurance. Possibly the muscular activity they exhibited was too intense for prolonged exertion.

And now let us make a little calculation as to the amount of force that each ant must have exerted. As before stated, here was a company of them dragging over a wooden chair seat a weight nineteen hundred and ninety-one times that of each individual engaged in the task! Supposing that forty ants were at one time at work (which is the largest number that I could count), and that the force exerted was evenly distributed (which in point of fact could not have been the case), each ant must have done at least one fortieth of the work. In other words, each of these tiny workmen was dragging or pushing forward nearly fifty times his own weight (exactly 49·75). A man of medium build weighs, we will say, one hundred and fifty pounds. Fifty times this is seven thousand five hundred pounds, or three tons and three quarters. So that even Sandow in relative strength is a long way inferior to these curious little "racehorse" ants.

THE SOCIAL FUNCTION OF WEALTH.

By M. PAUL LEROY BEAULIEU.

WEALTH—concentrated to a high degree in the hands of an individual—has a mission, a social function, which is derived from its very nature and which it alone can properly fulfill. Wealth has the power of commanding production and labor, and consequently of giving a direction to both; indirectly, without show, but very effectively, more intimately, and more familiarly, a rich man, like a politician, is a leader of men. Fortune, which is abundant wealth in the hands of an individual, constitutes a power of administration. This power of administration, whether acquired or inherited, can not be used while affairs dependent on one's self are allowed to drift; for the fortune will in that case probably be dispersed and will escape the hands that are holding it. One may try using it in a purely selfish interest; he will be likely to become richer and richer, accumulating capital and making himself useful to society by new expenditures; but he will not fulfill the social function of fortune. One may, on the other hand, place himself at a high general point of view in using this power without excluding his personality.

The gospel precept, repeated in all Christian morals, that the wealthy are the administrators of the goods of the poor, or the economists of the poor, is a pious maxim not wholly practicable from the human point of view; but it embodies the principles of the matter, particularly in its second phrase. According to Mr. Frederic Harrison's inquiry, in The Forum of 1894, into the habits of wealthy men in a republic, the first duty of fortune, as of capital in general, is to take care of itself. The prime error, whether individual, or of the family, or social, is to let one's property diminish in value; that property being a fund, susceptible of being perpetuated, useful for the production and development of enterprises, destruction, waste, or depreciation of it, whether by prodigality or by imprudent generosity, is a misdemeanor. In the interest of society, as well as of the family and the person, every one ought to respect and maintain his fortune.

Only income can be legitimately consumed. In using this, a liberal mode of living is permissible, and involves nothing opposed to morals. It is, in fact, generally commendable, provided the expenditure is within the receipt. Judicious luxury, the artistic decoration of life, without vain ostentation and frivolous arrogance, is also legitimate; but it is better to let the expenditure bear upon objects that will endure; that the generations should leave lasting traces of the elegancies of their career is legitimate. An economical obligation—and one he certainly owes to his family, if not a moral one—lies upon the wealthy man to maintain a reasonable increase of his fortune. He should continue to save a certain proportion and to create capital in order to procure for society, as a whole, the means of applying new inventions and discoveries, and to augment the productive fund with which to assuage the troubles and increase the conveniences of mankind. To save continues to be a duty in whatever situation of fortune, if only to guard against the accidents that are always possible. While the danger of such accidents has been proved to be real by past experience, which has shown that few fortunes can exist without depreciation for more than a few generations, the amount to be laid up need not absorb all the surplus beyond that sum needed to maintain a liberal and comfortable style of living. The duty of making judicious investments imposes on the man of wealth the necessity of exercising a degree of boldness without going into rashness, and of giving much reflection and study to his business. This furnishes an additional reason for prudence in saving, in order to compensate for the mistakes that may be made in investing.

The social function of wealth comes into play when the disposition is to be determined of the surplus that is left after a comfortable style of living with judicious luxury is provided for, and a proper amount has been put away.

Persons of great wealth have large opportunities for usefulness in associating themselves with and participating in efforts which seem useful, but the results of which are uncertain. Many discoveries and inventions have to pass through a period of incubation, as recently electric lighting and the transmission of force by electricity, and now the division and dispersion of motive force into small shops, experiments in photography of colors, etc. Numerous costly efforts are necessary in seeking advance in such matters which we see to be possible and even near, but which are still far from the practicable period. Outside of the professional and technical ranks the persons who can make these experiments are not of the class who are simply at ease. At most they can only devote insignificant and insufficient sums to them. Such persons may be set to their work and kept at it by the private aid of the really wealthy, who are not asked to risk a fraction of their capital, but only a small portion of their surplus income, after all its other applications have been provided for. Wealth is thus put in the way of fulfilling its social function of assisting progress; and much more is accomplished by it in this way than the multitude think. A similar field of usefulness is found in giving assistance to agricultural experimentation. The great English lords, according to Thorold Rogers in his Economical Interpretation of History, achieved much in this direction in the seventeenth century; and Arthur Young has cited the cases of numerous gentlemen and industrial proprietors in France who improved their opportunities of thus doing good. A large estate is a free school, a field of experiments in novelties from which the neighboring small property derives a full share of benefit. The trial of new cultivations, of selected seed, of improved implements, of methods suggested by science, is the task of the opulent large proprietor or of the rich manufacturer or merchant spending his vacation or his leisure on his country estate. So these large proprietors have a mission to perform in the choice of good breeders for reproduction or selection, and in the improvement of vegetable species.

A second social function of wealth is found in enterprises requiring patronage and remunerative philanthropy. The term "remunerative philanthropy" may have an odd sound to some persons. It is, however, true that rich men render great social services by the performance of the kind of work which we have designated thus. A portion of the revenue of the wealthy might well be devoted to enterprises of general and public utility, which would also, if well directed, produce a modest but respectable remuneration. There are a number of kinds of businesses capable of returning a small profit, but in which the chances of gain, though not absent, are too limited to attract private speculators, careful only of their personal interest, which might be undertaken by wealthy men satisfied to put out a part of their revenues for low interest. An investigation made about fifteen years ago by the Industrial Society of Upper Alsace brought to light several enterprises of this character, inspired by a philanthropic feeling, and yet giving a modest indemnification for the capital invested in them. Among them are societies of Popular Credit, of which Schulze-Delitsch and Raiffeisen have described admirable types, consumers' co-operative societies, workingmen's insurance under a variety of forms, baths and lavatories for workingmen or for the small middle class, workingmen's lodgings, cheap dining houses, and other establishments of similar character. All these organizations that concern the people are usually despised by professional speculators and by capitalists.

Wealthy men might well apply a part of their disposable revenues to enterprises of this sort, not as alms, but on the score of general utility; and there would be no impropriety in their deriving a modest interest from them. Many organizations of this kind have been formed during the past quarter of a century in England, the United States, and France, and have demonstrated the applicability of the method. Associations formed for such objects should rigorously maintain the self-supporting principle, or aim to pay their own way.

Besides the numerous examples furnished by Alsace since 1850, there are many others in demonstration of the practicability of the plan we have sketched. Some, in the shape of dwelling houses for men of small means, have been described by M. Arthur Raffalovich, in his book, *Le Logement du Pauvre* (The Housing of the Poor Man). Some very successful enterprises which might have come under this head have been carried out in the United States, England, and France. There are in England 2,372 building societies, the most of which are based on this principle, which comprised 587,856 members at the end of 1892, and had the disposal of £40,641,000, of which £24,729,000 were paid in by shareholders and £14,911,000 by depositors. Their profits amounted to £1,897,000, or five per cent of the capital devoted to the construction of convenient dwelling houses for the poor. In a very successful experiment made by a number of practical philanthropists at Lyons, France, ninety houses, containing a thousand simple but convenient and healthful suites, returned a profit of five and a half per cent, of which the investors received four per cent, the statutory maximum, while the rest went to increase the reserves. The objections which have been alleged against these enterprises are not really of great importance. It does not follow that because they are not of advantage to every one or to the poorest class they are not useful to a very considerable class of workmen and small clerks. And while there is danger that in the course of time—say after fifty or seventy-five years—they will deteriorate or become corrupt, we have no right to conclude that they will not have rendered good service in the meantime. It only proves that nothing is lasting, and that types and methods will have to be modified, every half century, for example. These establishments foster a taste for neatness and hygienic conditions in the house, and provide models which private builders may imitate. What has thus been done in reference to the house may also be done with relation to food. In this, Lyons again has given an instructive example, in the provision that has been made there of popular restaurants with low-priced dishes, which yet pay a very convenient interest of from three to four per cent. In association with enterprises of this kind wealth performs its social function without suffering depreciation.

A third social function of wealth lies in the gratuitous patronage of unremunerative works, a sympathetic way of giving help where it will be worthily bestowed and thankfully received.

Next are great foundations of general interest, such as a few millionaires, whose names are honored and perpetuated by their deeds, have taken pleasure in making. The finest examples of this kind of benevolence have been found among the Americans and in the little states of ancient Greece; museums, schools, observatories, public parks, churches, orphanages, hospitals—institutions with which every man possessing a fortune of the first class might deem it a privilege to have his name associated. No considerable curtailment of the amount to be transmitted to heirs or gradual transformation after death of private fortunes into collective fortunes need be contemplated in these foundations. Such transformation would be of mischievous economical effect; for money, except in a few rare exceptions, is better administered by individuals who possess it than by collective organizations of any kind. Many fortunes, however, are large enough to afford considerable sums for these foundations. There are many other beneficent works that might tempt millionaires. Among objects worthy of attention are African and Asian exploration, experiments in acclimatization of animals and plants, subventions of scientific and medical investigation, and others. Under the triple form we have pointed out, the social function of wealth, as distinguished from its economical function, is to be initiative and auxiliary. This function can not be imposed by law, but must be promoted by tradition, conscience, and a taste for useful and sympathetic activity. It would be well if it were supported by a compliant public opinion, but the absence of that condition affords no reason for ignoring it.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

SKETCH OF BENJAMIN SMITH BARTON.

OF the three professions formerly distinguished as "learned," that of medicine is the only one connected with natural science. Hence it is not surprising that, in the times when scientific research could seldom be pursued except as an avocation, it was frequently joined to his vocation by the physician. The history of medicine in the Old World is adorned with the names of many profound students of Nature, and in America the name of Dr. Barton stands at the head of a considerable list of eminent investigators who either followed or at least entered upon the medical profession.

BENJAMIN SMITH BARTON was one of the younger children of the Rev. Thomas Barton, an Episcopal clergyman, and was born at Lancaster, Pa., February 10, 1766. His mother was a sister of David Rittenhouse, the astronomer. He received, therefore, a double inheritance of intellectual ability, but the benefits of parental care and training were lost to him at an early age. His mother died when he was eight years old, and his father when he was fourteen. Early in the fall of 1778 Mr. Thomas Barton had left Pennsylvania, intending to go to Europe, but was taken sick before he could conveniently set sail, and died without returning to his home, May 25, 1780, at the age of fifty years.

Before leaving Lancaster Mr. Barton had placed his younger children in the care of a friend in the country near by, where they remained until after their father's death. During this period young Benjamin devoted much of his time to reading, showing considerable fondness for the subject of civil history. Being a studious boy, he naturally took less interest than boys generally do in athletic sports. His predilection for natural history, especially for botany, appeared early, and very likely had received some encouragement from his father, who is known to have been a student of Nature. In a note to his Observations on the Desiderata of Natural History Dr. Barton speaks of the "fine collection of North American minerals, which was made by my father near forty years ago, at a time when he paid more attention to this part of natural history than, so far as I know, any other person in the (then) colonies." It appears also that the Rev. Thomas Barton was a member of the American Philosophical Society, and corresponded with Linnæus on botanical subjects.

Young Benjamin early displayed a notable talent for drawing, and afterward became also remarkably skillful in etching. His artistic ability was of great service to him in sketching objects of Nature and in criticising the illustrations prepared by others for his books. He is said to have maintained that "no man could become a nice, discriminating, and eminent botanist without possessing that acumen in perception of proportion, color, harmony of design, and obscure differences in the objects of the vegetable world which alone belong to the eye of a painter." He insisted on strict accuracy in details that even most careful naturalists would disregard. To mention an extreme instance of his exactness, he had every protuberance on the back, tail, and legs of a horned lizard counted, and required the precise number found to be represented in the drawing made for him.

In the spring of 1780 Benjamin, with one of his brothers, was placed in an academy at York, Pa., where he remained nearly two years, pursuing a course of classical study. When he was sixteen years of age his elder brother, who was living in Philadelphia, took him into his family, where he remained about four years. During this period he attended for a time the College of Philadelphia, and afterward, at the beginning of his eighteenth year, took up the study of medicine under Dr. William Shippen.

In the summer of 1785 he accompanied the commission, of which his uncle, Mr. Rittenhouse, was a member, that was engaged in running the western boundary line of Pennsylvania. Young Barton was absent from Philadelphia five months, and it was on this expedition that he gained his first acquaintance with the Indians and began his researches into their medicines and pathology, their general customs and history, which received a share of his attention for the rest of his life.

In order to obtain a thorough medical training it was at that time necessary to go abroad. Accordingly, young Barton repaired to Edinburgh in the autumn of 1786, where he studied for two years, with the exception of a few months spent in London. Having become a member of the Royal Medical Society at Edinburgh, he won the Harveian prize of that association for a dissertation on the *Hyoscyamus niger* of Linnæus (black henbane). Barton's first book was issued while he was in London, in the early part of 1787. It was a little pamphlet, entitled Observations on some Parts of Natural History: to which is prefixed an Account of some Considerable Vestiges of an Ancient Date, which have been discovered in Different Parts of North America. Considering his youth—he was only twenty-one years of age—and the fact that he was afflicted with ill health when he wrote it, this production is very creditable; but it contained some ill-founded theories and other crudities that he readily and candidly acknowledged only a few months later. For a number of reasons —among them the failure of two professors to show him courtesies that he had reason to expect—he left Edinburgh and took his degree at Göttingen, returning to America toward the close of the year 1789. He began to practice his profession in Philadelphia, where his knowledge of science soon caused him to be looked upon as one of the rising young men of the day.

The trustees of the College of Philadelphia having instituted a professorship of Natural History and Botany, appointed Dr. Barton, then only twenty-four years of age, to the chair. This appointment was confirmed in the following year, when the college united with the University of Pennsylvania, and was held by him for the rest of his life. Dr. Barton thus became the first instructor in natural history in Philadelphia, and probably was the first in any American college. Five years later the professorship of Materia Medica in the university became vacant, and this chair also was assigned to Dr. Barton and was held by him until he succeeded to that of Dr. Rush. On January 28, 1798, he received an appointment as one of the physicians of the Pennsylvania Hospital, which position he held for the rest of his life. Dr. Barton was a man of high ambition, and being deeply impressed by the well-deserved fame of Prof. Rush, spared no exertions to equal it. When the latter died, he very naturally desired to obtain his professorship, and his application was followed in a few months by his appointment.

Dr. Barton had been from early life subject to hæmorrhages and to attacks of gout—his period of illness while a student at Edinburgh was due to these causes—and he had further weakened his health by too great application to his scientific and professional labors. He had sustained a severe hæmorrhage just before undertaking the labor of preparing for his new position. He had delivered but two courses of lectures on the practice of medicine when his increasing ill health decided him to try the effect of a sea voyage. He accordingly sailed for France in the spring of 1815, and returned in November of that year, but without gaining the benefit hoped for. Hydrothorax came on soon after he landed in New York, and it was three weeks before he was able to reach home. His condition became rapidly worse, and on the morning of December 19, 1815, he was found dead in bed.

Only three days before his death he wrote a memoir on a genus of plants which had been named in honor of him, and requested his nephew, Dr. W. P. C. Barton, to make a drawing to accompany it. The latter did so, and read the memoir at the next meeting of the American Philosophical Society. Dr. Barton was elected to this society January 16, 1789, before his return from his medical studies abroad, and had been one of its vice-presidents since January 1, 1802. The printed Transactions of the society afford abundant evidence of his activity as a member and as a man of science. For three years in succession, beginning with 1797, he was chosen to deliver the annual oration.

In his youth Dr. Barton had suffered the discomforts and hindrances of poverty and the persecutions of those who bore him ill will. But it was not many years before the income from his lectures and his books had lifted him above the influence of want.

Being prevented by his professional engagements from making explorations in search of plants and other objects of natural history, he employed others to collect for him, advancing his favorite sciences by this means. Frederick Pursh, in his *Flora Americæ Septentrionalis* (London, 1814), describes an excursion that he was enabled to take by the aid of Prof. Barton. Starting in the beginning of 1805, he went along the mountain chain of Virginia and the Carolinas, and returned through the coast lands, reaching Philadelphia late in the autumn. Similar assistance was extended to Thomas Nuttall, "whose zeal and services," to use the words of Dr. Barton, "have contributed essentially to extend our knowledge of the northwestern and western flora of North America, and to whom the work of Frederick Pursh is under infinite obligations." Pursh himself gives due credit for Nuttall's contributions. A genus of plants (resembling cactus), first described by them, was named *Bartonia*, in honor of "their mutual friend Dr. B. S. Barton." In a paper written by Dr. Barton, a few days before his death, he says of Nuttall:

"I became acquainted with this young Englishman in Philadelphia several years ago; and observing in him an ardent attachment to and some knowledge of botany, I omitted no opportunity of fostering his zeal, and of endeavoring to extend his knowledge. He had constant access to my house, and the benefit of my botanical books.

"In 1810 I proposed to Mr. Nuttall the undertaking of an expedition entirely at my own expense and under my immediate direction, to explore the botany, etc., of the northern and northwestern parts of the United States and the adjoining British territories." Dr. Barton further relates that Nuttall set out on this journey in April, 1810, but he deviated from the route which had been pointed out to him, having been prevailed upon to ascend the Missouri with other travelers, whose objects were principally traffic. Returning, he reached St. Louis in the autumn of 1811. "In the latter end of the year 1811, Mr. Nuttall returned to England by the way of New Orleans. Previously to his departure he transmitted to me a number of the dried specimens and seeds which he had collected." It was on this trip that Nuttall found two species of the genus that he named *Bartonia*, descriptions and specimens of which he furnished to his patron.

Among the early printed works of Dr. Barton was a Memoir concerning the Fascinating Faculty which has been ascribed to the Rattlesnake and other North American Serpents, published in 1796. He issued a supplement to this memoir four years later, and a new edition in 1814. The original paper had been read before the American Philosophical Society. He also undertook a work on the materia medica of the United States, issuing an opening part in 1798, a second part in 1804, and an edition of the two combined in 1810. His most important publication was his Elements of Botany, a work of 508 pages, octavo, illustrated with thirty plates, which first appeared in two volumes in 1803. A second edition of the first volume was issued in 1812, and of the second volume in 1814, with forty plates. After the author's death, Dr. William P. C. Barton published, in 1836, a revised edition in one volume, condensed by omitting the quotations from Latin and English poets, certain tabular views that had become antiquated, and the index. To this edition is prefixed a biographical sketch, prepared by Dr. W. P. C. Barton at the request of the Philadelphia Medical Society, of which Dr. B. S. Barton had been president from February, 1809, till he died, and read before that society February 24, 1816. The Elements of Botany was republished in London, and was translated into Russian.

Another considerable work was his New Views of the Origin of the Tribes and Nations of America, which appeared in 1798. Other subjects on which he published more or less fully were the natural history of Pennsylvania, the disease of goiter, the generation of the opossum, the principal desiderata in natural history (read before the Philadelphia Linnæan Society), *Siren lacertina*, the hellbender, the bite of the rattlesnake, the honeybee, the jerboa, and the stimulant effects of camphor upon vegetables. He issued also the first part, sixty-four pages, of a work on paleontology, entitled *Archæologiæ Americanæ Telluris Collectanea et Specimina*. In the preface to this fragment he says, "I at one time, indeed for some years together, flattered myself that I should have found leisure to have devoted a considerable portion of my life to the study of organic geology," but adds that his recent succession to the chair of Dr. Rush would prevent any extensive or systematic attention to this subject. An ardent thirst for literary fame, which was present in Prof. Barton throughout his life, made him an indefatigable student and writer. Several ambitious undertakings were left unfinished by him. The following three papers that he had read before the American Philosophical Society remained unpublished at his death: a eulogy on Dr. Priestley, with whom Dr. Barton had been acquainted; a geographical view of the trees and shrubs of North America; and a memoir (which gained the Magellanic premium) concerning a considerable number of pernicious insects of the United States. Prof. E. A. W. Zimmerman, of Brunswick, translated into German and published the memoir on the fascinating faculty of serpents and that on the bite of the rattlesnake.

In 1797 Dr. Barton married a daughter of Mr. Edward Pennington, of Philadelphia, who, with their only children, a son and a daughter, survived him. He named his son after Mr. Thomas Pennant, an English naturalist and author of Arctic Zoölogy, with whom he became acquainted while a medical student.

Dr. Barton was extremely cautious about accepting human testimony in matters of science, and in one of his publications he declares that "credulity is the most injurious feature in the character of the naturalist as well as that of the historian. Its influence in one individual is often felt and propagated through many ages. Unfortunately, too, it has been the vice of naturalists, or those who have touched on questions relative to natural history."

In a general description of Prof. Barton his nephew says: "As a medical teacher he was eloquent, instructive, and when occasion called for it quite pathetic. His voice was good, though attenuated, penetrating, and sometimes rather sharp—his enunciation clear and distinct—his pronunciation constrained, and his emphasis, owing to his remarkable kind of punctuation, and a desire to be perspicuously understood, was studied, forced, and often inappropriate. In his lectures his diction was cacophonous and unpleasant.

"As a writer he is ingenious, rich in facts, profound in research, and always abounding in useful information. He wanted, however, in a great degree, a talent for generalizing. Hence his various works are characterized by an egregious want of method or perspicuous arrangement. His style, it must be confessed, is always diffuse, inelegant, and frequently tautological. As he never corrected what he once wrote, or at least but rarely, these defects in his composition were the natural consequences of his vehemence in writing. His punctuation is truly remarkable, and, for a man of his discernment and extensive reading, singularly incorrect.

"As a physician, he discovered a mind quick in discriminating disease, skillful in the application of appropriate remedies, though he certainly was a very cautious if not timid practitioner. No man read more extensively on the subject of diseases—in fact, he was deeply versed in pathological knowledge derived from books. As, however, his medical practice was never very extensive, his practical observations delivered in his lectures were strikingly marked with the evidences of overweening caution. Hence he recommended to his pupils, and always employed himself, unusually small doses of medicine. He was, however, in the main, an observing and intelligent practitioner, and was remarkably assiduous in his attentions and soothing in his behavior to his patients.

"In figure he was tall and exceedingly well formed; in middle life he might be considered as having been handsome. His physiognomy was strongly expressive of intelligence, and his eye was remarkably fine and penetrating.

"In temperament he was irritable and even choleric. His spirits were irregular, his manners consequently variable, impetuous, vehement. These repeated vacillations between equanimity and depression were generally owing to the sudden and repeated attacks of his continual earthly companion—irregular gout.

"In familiar conversation he was often elegant, remarkably facetious, but never witty.

"As a parent he was kind, tender, and indulgent to a fault.

"He possessed some high virtues; among the most elevated of them was his unaffected love of country. Indeed, his patriotic feelings were not only strong, but frequently expressed with unreserved warmth."

A sketch of Barton, extracted from that by his nephew, was published in The Portfolio for April, 1816 (Philadelphia), and in an editorial note prefixed to it occurs this statement: "Our estimate, too, of the character of the deceased is somewhat different from that which has been formed by the author of this 'Sketch.' Dr. Barton was a very industrious man in the pursuit of science, and though we do not think that he has contributed much to enlarge its bounds, we are willing to believe that his collections will facilitate the labors of the student, to whom he has left a laudable example of active diligence and unwearied perseverance."

Dr. Barton was in correspondence with many prominent naturalists and physicians both at home and abroad. He established an enviable foreign reputation, as is attested by his membership in the Imperial Society of Naturalists of Moscow, the Linnæan Society of London, the Society of Antiquaries of Scotland, the Danish Royal Society of Sciences, and the Royal Danish Medical Society.

Speaking of travel as a means of learning, and of the great expansion that has been given to it of late years, Dr. B. W. Richardson calls such a mode one in which the surface of the earth becomes a living map, and the spoken languages the living grammars—a mode that must extend day by day as the mind yearns for more knowledge and the power that springs from it. No end is visible to him of the line of travel now inaugurated, and he has visions of university ships manned and supplied, instead of guns and fighting men, with professors, laboratories, observatories, and libraries, and in which voyages of research shall be made by all classes round the world.

PROFESSIONAL INSTITUTIONS.

XII.—EVOLUTION OF THE PROFESSIONS.

By HERBERT SPENCER.

THE saying that we can not put old heads on young shoulders, figuratively expresses, among other truths, the truth that the beliefs which in youth result from small information joined with undisciplined thought and feeling, can not, until after long years, be replaced by the beliefs which wider knowledge and better balanced mental powers produce. And while it is usually impracticable to ante-date the results of mental development and culture, it is also usually impracticable to arouse, during early stages, any such distrust of convictions then formed, as should be caused by the perception that there is much more to be learned.

This general remark, trite in substance though it is, I am prompted to make *à propos* of the profound change which study of many peoples in many places and times causes in those ideas of social organization which are current—ideas entertained not only by the young but also by the majority of the old, who, relatively to the subject-matter to be investigated, are also young. For patient inquiry and calm thought make it manifest that sundry institutions regarded with strong prejudices have been essential institutions; and that the development of society has everywhere been determined by agencies—especially political and ecclesiastical—of characters condemned by the higher sentiments and incongruous with an advanced social ideal.

One in whom aversion to autocratic rule is strong, does not willingly recognize the truth that without autocratic rule the evolution of society could not have commenced; and one to whom the thought of priestly control is repugnant, can not, without difficulty, bring himself to see that during early stages priestly control was necessary. But contemplation of the evidence, while proving these general facts, also makes it manifest that in the nature of things groups of men out of which organized societies germinate, must, in passing from the homogeneous to the heterogeneous, have first assumed the form in which one individual predominates—a nucleus of the group serving as a center of initiation for all subsequent steps in development. Though, as fast as society advances, and especially as fast as the militant type yields place to the industrial type, a centralized and coercive control, political and ecclesiastical, becomes less needful, and plays a continually decreasing part in social evolution; yet the evidence compels us to admit that at first it was indispensable.

This generalization, which we saw variously illustrated by political institutions and ecclesiastical institutions, we now see again illustrated by professional institutions. As the foregoing chapters have shown, all the professions originate by differentiation from the agency which, beginning as political, becomes, with the apotheosis of the dead ruler, politico-ecclesiastical, and thereafter develops the professions chiefly from its ecclesiastical element. Egypt, which, by its records and remains, exhibits so well the early phases of social progress, shows us how at first various governmental functions, including the professional, were mingled in the king and in the cluster of those who surrounded the king. Says Tiele:—

"A conflict between the authority of priest and king was hardly possible in earlier times, for then the kings themselves, their sons, and their principal officers of state were the chief priests, and the priestly dignities were not dissevered from nor held to be inconsistent with other and civil functions."

And again—

"The priestly offices were state functions . . . which did not differ at all in kind from that of commander of the troops, governor of a district, architect, and chamberlain. In fact, both kinds of office were, for the most part, filled by the same persons."

And since, as Brugsch tells us, "Pharaoh's architects (the Murket) . . . were often of the number of the king's sons and grandsons," we see that in the governing group the political, ecclesiastical, and professional functions were united.

No group of institutions illustrates with greater clearness the process of social evolution; and none shows more undeniably how social evolution conforms to the law of evolution at large. The germs out of which the professional agencies arise, forming at first a part of the regulative agency, differentiate from it at the same time that they differentiate from one another; and, while severally being rendered more multiform by the rise of subdivisions, severally become more coherent within themselves and more definitely marked off. The process parallels completely that by which the parts of an individual organism pass from their initial state of simplicity to their ultimate state of complexity.

Originally one who was believed by himself and others to have power over demons—the mystery-man or medicine-man—using coercive methods to expel disease-producing spirits, stood in the place of doctor; and when his appliances, at first supposed to act supernaturally, came to be understood as acting naturally, his office eventually lost its priestly character altogether: the resulting physician class, originally uniform, eventually dividing into distinguishable sub-classes while acquiring a definite embodiment.

Less early, because implying more developed groups, arose those who as exhibitors of joy, now in the presence of the living ruler and now in the supposed presence of the deceased ruler, were at first simultaneously singers and dancers, and becoming specialized from the people at large, presently became distinct from one another: whence, in course of time, two groups of professionals, whose official laudations, political or religious, extended in their range and multiplied in their kinds. And then by like steps were separated from one another vocal and instrumental musicians, and eventually composers; within which classes also there arose subdivisions.

Ovations, now to the living king and now to the dead king, while taking saltatory and musical forms, took also verbal forms, originally spontaneous and irregular, but presently studied and measured: whence, first, the unrhythmical speech of the orator, which under higher emotional excitement grew into the rhythmical speech of the priest-poet, chanting verses—verses that finally became established hymns of praise. Meanwhile from accompanying rude imitations of the hero's acts, performed now by one and now by several, grew dramatic representations, which little by little elaborated, fell under the regulation of a chief actor, who prefigured the playwright. And out of these germs, all pertaining to worship, came eventually the various professions of poets, actors, dramatists, and the subdivisions of these.

The great deeds of the hero-god, recited, chanted or sung, and mimetically rendered, naturally came to be supplemented by details, so growing into accounts of his life; and thus the priest-poet gave origin to the biographer, whose narratives, being extended to less sacred personages, became secularized. Stories of the apotheosized chief or king, joined with stories of his companions and amplified by narratives of accompanying transactions, formed the first histories. And from these accounts of the doings of particular men and groups of men, partly true but passing by exaggeration into the mythical, came the wholly mythical, or fiction; which then and always preserved the biographico-historical character. Add to which that out of the criticisms and reflections scattered through this personal literature an impersonal literature slowly emerged: the whole group of these products having as their deepest root the eulogies of the priest-poet.

Prompted as were the medicine-men of savages and the priests of early civilized peoples to increase their influence, they were ever stimulated to acquire knowledge of natural actions and the properties of things; and, being in alleged communication with supernatural beings, they were supposed to acquire such knowledge from them. Hence, by implication, the priest became the primitive man of science; and, led by his special experiences to speculate about the causes of things, thus entered the sphere of philosophy: both his science and his philosophy being pursued in the service of his religion.

Not only his higher culture but his alleged intercourse with the gods, whose mouthpiece he was, made him the authority in cases of dispute; and being also, as historian, the authority concerning past transactions and traditional usages, or laws, he acquired in both capacities the character of judge. Moreover, when the growth of legal administration brought the advocate, he, though usually of lay origin, was sometimes clerical.

Distinguished in early stages as the learned man of the tribe or society, and especially distinguished as the possessor of that knowledge which was thought of most value—knowledge of unseen things—the priest of necessity became the first teacher. Transmitting traditional statements concerning ghosts and gods, at first to neophytes of his class only but afterward to the cultured classes, he presently, beyond instruction in supernatural things, gave instruction in natural things; and having been the first secular teacher, has retained a large share in secular teaching even down to our own days.

As making a sacrifice was the original priestly act, and as the building of an altar for the sacrifice was by implication a priestly act, it results that the making of a shelter over the altar, which in its developed form became the temple, was also a priestly act. When the priest, ceasing to be himself the executant, directed the artificers, he continued to be the designer; and when he ceased to be the actual designer, the master-builder or architect thereafter continued to fulfill his general directions. And then the temple and the palace in sundry early societies, being at once the residence of the apotheosized ruler and the living ruler (even now a palace usually contains a small temple) and being the first kinds of developed architecture, eventually gave origin to secular architecture.

A rude carved or modeled image of a man placed on his grave, gave origin to the sculptured representation of a god inclosed in his temple. A product of priestly skill at the outset, it continued in some cases to be such among early civilized peoples; and always thereafter, when executed by an artisan, conformed to priestly direction. Extending presently to the representation of other than divine and semi-divine personages, it eventually thus passed into its secularized form.

So was it with painting. At first used to complete the carved representation of the revered or worshiped personage, and being otherwise in some tribes used by the priest and his aids for exhibiting the tribal hero's deeds, it long remained subservient to religion, either for the coloring of statues (as it does still in Roman Catholic images of saints, etc.), or for the decoration of temples, or for the portraiture of deceased persons on sarcophagi and stelæ; and when it gained independence it was long employed almost wholly for the rendering of sacred scenes: its eventual secularization being accompanied by its subdivision into a variety of kinds and of the executant artists into correlative groups.

Thus the process of professional evolution betrays throughout the same traits. In stages like that described by Huc as still existing among the Tibetans, where "the Lama is not merely a priest; he is the painter, poet, sculptor, architect, physician," there are joined in the same individual, or group of individuals, the potentialities out of which gradually arise the specialized groups we know as professions. While out of the one primitive class there come by progressive divergences many classes, each of these classes itself undergoes a kindred change: there are formed in it subdivisions and even sub-subdivisions, which become gradually more marked; so that, throughout, the advance is from an indefinite homogeneity to a definite heterogeneity.

In presence of the fact that the immense majority of mankind adhere pertinaciously to the creeds, political and religious, in which they were brought up; and in presence of the further fact that on behalf of their creeds, however acquired, there are soon enlisted prejudices which practically shut out adverse evidence; it is not to be expected that the foregoing illustrations, even joined with kindred illustrations previously given, will make them see that society is a growth and not a manufacture, and has its laws of evolution.

From prime ministers down to plow-boys there is either ignorance or disregard of the truth that nations acquire their vital structures by natural processes and not by artificial devices. If the belief is not that social arrangements have been divinely ordered thus or thus, then it is that they have been made thus or thus by kings, or if not by kings then by parliaments. That they have come about by small accumulated changes not contemplated by rulers, is one of those open secrets which only of late have been recognized by a few and are still unperceived by the many—educated as well as uneducated. Though the turning of the land into a food-producing surface, cleared, fenced, drained, and covered with farming appliances, has been achieved by men working for individual profit not by legislative direction—though villages, towns, cities, have insensibly grown up under the desires of men to satisfy their wants—

though by spontaneous co-operation of citizens have been formed canals, railways, telegraphs, and other means of communication and distribution; the natural forces which have done all this are ignored as of no account in political thinking. Our immense manufacturing system with its multitudinous inventions, supplying both home and foreign consumers, and the immense mercantile marine by which its products are taken all over the globe and other products brought back, have naturally and not artificially originated. That transformation by which, in thousands of years, men's occupations have been so specialized that each, aiding to satisfy some small division of his fellow citizen's needs has his own needs satisfied by the work of hundreds of others, has taken place without design and unobserved. Knowledge developing into science, which has become so vast in mass that no one can grasp a tithe of it, and which now guides productive activities at large, has resulted from the workings of individuals prompted not by the ruling agency but by their own inclinations. So, too, has been created the still vaster mass distinguished as literature, yielding the gratifications filling so large a space in our lives. Nor is it otherwise with the literature of the hour. That ubiquitous journalism which provides satisfactions for men's more urgent mental wants, has resulted from the activities of citizens severally pursuing private benefits. And supplementing these come the innumerable companies, associations, unions, societies, clubs, subserving enterprise, philanthropy, culture, art, amusement; as well as the multitudinous institutions annually receiving millions by endowments and subscriptions: all of them arising from the unforced co-operations of citizens. And yet so hypnotized are nearly all by fixedly contemplating the doings of ministers and parliaments, that they have no eyes for this marvelous organization which has been growing for thousands of years without governmental help—nay, indeed, in spite of governmental hindrances. For in agriculture, manufactures, commerce, banking, journalism, immense injuries have been done by laws—injuries afterward healed by social forces which have thereupon set up afresh the normal courses of growth. So unconscious are men of the life of the social organism that though the spontaneous actions of its units, each seeking livelihood, generate streams of food which touch at their doors every hour—though the water for the morning bath, the lights for their rooms, the fires in their grates, the bus or tram which takes them to the City, the business they carry on (made possible by the distributing system they share in), the evening "Special" they glance at, the theater or concert to which they presently go, and the cab home, all result from the unprompted workings of this organized humanity, they remain blind. Though by its vital activities capital is drafted to places where it is most wanted, supplies of commodities balanced in every locality and prices universally adjusted—all without official supervision; yet, being oblivious of the truth that these processes are socially originated without design of any one, they can not believe that society will be bettered by natural agencies. And hence when they see an evil to be cured or a good to be achieved, they ask for legal coercion as the only possible means.

More than this is true. If, as every parliamentary debate and every political meeting shows, the demands for legislation pay no attention to that beneficent social development which has done so much and may be expected to increase in efficiency, still more do they ignore the *laws* of that development—still less do they recognize a natural order in the changes by which society passes from its lower to its higher stages. Though, as we have seen, the process of evolution exemplified in the genesis of the professions is similar in character to the process exemplified in the genesis of political and ecclesiastical institutions and everywhere else; and though the first inquiry rationally to be made respecting any proposed measure should be whether or not it falls within the lines of this evolution, and what must be the effects of running counter to the normal course of things; yet not only is no such question ever entertained, but one who raised it would be laughed down in any popular assemblage and smiled at as a dreamer in the House of Commons: the only course thought wise in either the cultured or the uncultured gathering being that of trying to estimate immediate benefits and evils.

Nor will any argument or any accumulation of evidence suffice to change this attitude until there has arisen a different type of mind and a different quality of culture. The politician will still spend his energies in rectifying some evils and making more—in forming, reforming, and again reforming—in passing acts to amend acts that were before amended; while social schemers will continue to think that they have only to cut up society and re-arrange it after their ideal pattern and its parts will join together again and work as intended!

ACCORDING to the account of one of their days given by Mr. S. E. J. Clarke, the women of India lead as busy, useful, and responsible lives as any of those of Anglo-Saxon lands. As soon as a woman awakes, this author says, she recites her prayers, reverently salutes the pictures or sacred images in the room, and then kisses, in honor of Lukhi, the gold bangle on her wrist or the golden amulet on her arm, and, having done this, is ready to leave her bed. Next, she anoints her body with oil specially prepared for the purpose, and often delicately scented. The hair is then dressed and treated with oil, which among respectable people is prepared in the house by the women themselves, and by processes which they keep to themselves. The lady is then ready for her bath, prior to which she uses *manjam*, a dentifrice often prepared from betelnut and finely aromatic. This also must be prepared at home; and the ingredients and scents used are never taken at haphazard, but are such as have a well-earned reputation for fitness for the uses to which they are applied. The bath having been taken, the ladies dress themselves, according to the season, in silken or woolen cloth; sprinkle Ganges water, or water made holy by an admixture of Ganges water, on their heads, and also on their beds. This part of the morning's duty is concluded by an obeisance to the sun. The serious part of the day's work begins after this. The cook room and household room are visited and the appointed prayers recited in them; the children and sick members of the family, if there are any, are attended to; the store room is opened and the kitchen utensils and other articles needed are issued to the servants; the special dishes to be made for the family, the sick, and the children are looked after; articles required from the bazaar are sent for; the stock of provisions on hand is examined; and a close watch is kept on all the operations of the household. A good housewife will often prepare some special favorite dish for her husband with her own hands; and, although she does not eat with him, will attend to his meals to see that he is well served. If they find any leisure after attending to their religious exercises and their duties, they are at liberty to occupy themselves according to their liking. Many of the elder women read in the Hindu classics, and the younger ones engage in fancy work. There are now, as there were in the olden times, women poets and writers whose work is of high merit, but not recognized by us because it is in the native languages. A fashion is setting in of spending some time at the piano or harmonium. Much attention is paid to the toilet and to the changes of dress for the various occasions of the day; and the day closes with evening worship and readings.

In the course of his experiments on the psychic development of a litter of puppies, Prof. Wesley Mills remarked that these animals, as well as those of several other kinds, even on their first day would not creep off from a surface on which they were resting if it was elevated a little distance above the ground. "When they approach the edge, they manifest hesitation, grasp with their claws or otherwise attempt to prevent themselves falling, and it may be cry out, giving evidence of some profound disturbance of their nervous system." But a water tortoise he had had for some years would at any time walk off from a surface on which it was placed. Prof. Mills accounts for the difference by supposing that land animals, depending on a firm substratum beneath them, have inherited "a sense of support"; while the amphibious tortoise is accustomed frequently to drop off from logs into water, and has not, or but little, "sense of support." Then, again, he finds the sense of support "well marked in birds that drop themselves into 'thin air.'" Birds, however, need the "sense of support" when depending on their feet quite as much as land animals.

The instruments used in the observations of the British Association's committee on earth tremors are so delicate that an angle can be detected corresponding with that subtended by a chord an inch long of a circle one thousand miles in radius.

Editor's Table.

A MODERN LIBERAL EDUCATION.

SUCH is the title of an exceedingly interesting, well-considered, and, in our opinion, weighty article contributed by Prof. Ladd, of Yale, to a late number of our excellent contemporary the Educational Review. The writer well remarks at the outset that the word "liberal" applied to education must imply some sort of differentiation. That differentiation, he shows, is not quantitative but qualitative. A "liberal education" does not mean a liberal supply of education; it means a liberalizing education, or, as he defines it, "that which makes the free mind, which furnishes the liberalizing culture of the trained gentleman." Prof. Ladd is quite aware that such a definition may strike not a few as invidious, but he is not disposed upon that account to alter the terms in which it is expressed.

We think he is right. There is an education which is imparted and accepted with a main, if not exclusive, view to its practical utility to the individual in enabling him to receive a better share than he otherwise might of the goods' which society has to divide. And there is an education which aims at expanding his mental and moral powers, and fitting him to profit by the best that has been or is being thought and imagined and expressed in the world. The first, while imparting a measure of efficiency for everyday purposes, not infrequently instills an absolute distaste and repulsion for all higher uses of the intellect. The second develops both capacity and desire for intellectual and æsthetic pleasures, raises the mind above vulgar prejudices, and places the whole life of the individual on a higher level. The education that produces the latter effect even partially is so far a liberal education; and if the word "gentleman" is to have a real as opposed to a purely conventional significance, we may apply it with much propriety to one whose mind has undergone this liberalizing influence, and whose tastes and sympathies have thus been arrayed on the side of whatever helps to elevate and refine society. We fail to see that, in the true sense, there is anything antidemocratic in this; but if any think otherwise they are, of course, entitled to their opinion. Meantime, we feel sure that the higher education which we have thus imperfectly described, but which Prof. Ladd maps out for us in a very satisfactory and instructive manner, is a matter of vast importance for the progress of national culture and the right direction of our national life.

"A truly liberal education," Prof. Ladd observes, "includes as essential to it the prolonged and scholastic pursuit of three subjects or groups of subjects. These three are language and literature, mathematics and natural science, and the soul of man, including the products of his reflective thinking. Any culture," he continues, "which is markedly defective on any one of these three sides comes, so far, short of being liberal; of being, that is to say, the kind of culture which sets the mind most truly free, and which is most worthy of the cultivated gentleman in the nobler meaning of the latter word." It is an extremely wide scheme of education that is here laid out; and we may say of it, as is said of the strait gate and narrow way, that "few there be that find it." We fully agree, however, with the writer that each of the groups of studies which he mentions contributes important and strictly indispensable elements to a truly liberal and humane education.

It seems hardly necessary to enforce the claims of language and literature as elements of culture. It is one of the chief triumphs of the human mind to have converted language, which primarily, no doubt, was merely a crude means for the expression of material wants, into a source—at least a possible source—of intellectual and æsthetic pleasure; and a great part of education may properly be directed to awakening the minds of the young to a sense of this great fact. The ancients fabled, and wisely, we think, that the Muses were daughters of Memory; in other words, that literature only arises when man has become able, through language, to contemplate his own thought, and live over again his past experience. It should therefore be a distinct aim in education to vindicate the claim of language to be something more than the servant and drudge of mankind, the minister to his lower necessities, or at best a buffoon for the amusement of his hours of hilarity. We should be taught to regard language as an associate, a friend, an equal, from whose intercourse we can gain refinement of thought, and almost every other form of intellectual benefit. We have sometimes thought that a certain classification might be made among people accordingly as they treat language as a menial, or as a friend and equal. With the former, language takes on the degraded form that might be expected from the rank to which it is relegated; and the work that it does is of the crude and inferior kind which might also be expected in such a case. To this class of persons those distinctions of thought which make up the pleasure and interest of intellectual life are nonexistent. In the most ordinary matters it is often difficult to get a definite statement from them, simply because they do not know what is definite and what is not; they have never put language to any sufficiently fine use to become conscious of the difference.

Prof. Ladd emphasizes the fact that it is the study of *language*, not of *languages*, which he holds to be essential in any system of liberal education. "It is undoubtedly," he says, "a very convenient thing in these days to speak in several of the principal forms of human speech; but it is not an essential, it is not even a very vital and impressive part, of a truly liberal education. The empty-headed hotel clerk, the boorish globe-trotter, the frivolous boarding-school miss, may have this accomplishment and not have the first rudiments of a liberal culture in language." Very much to the same effect does Ruskin express himself in his Sesame and Lilies. "If," he says, "you read ten pages of a good book, letter by letter—that is to say, with real accuracy—you are forever, in some measure, an educated person. The entire difference between education and non-education (as regards the merely intellectual part of it) consists in this accuracy. A well-educated gentleman may not know many languages, may not be able to speak any but his own, may have read very few books, but, whatever language he knows, he knows precisely. An uneducated person may know, by memory, many languages and talk them all, and yet not truly know one word of any—not even a word of his own." This is strongly said, but we are hardly disposed to dissent from it.

The principal value, in Prof. Ladd's opinion, to be derived from the study of the classical languages, especially Greek, is that it facilitates and increases the enjoyment of all good literature. This is moderately stated and constitutes a more defensible position than the extreme advocates of classical studies sometimes take up. It seems to us to be greatly a question of time and opportunity. If one can grapple with a scheme of education including an accurate knowledge of the Greek language without being compelled to omit lines of study more necessary to place him — where every modern man should be—at the modern standpoint, we should say by all means let him study Greek and have his sense of beauty quickened by living intercourse with its wonderful literature, and his logical and critical faculties strengthened by investigation of its linguistic elements and grammatical forms. But we think it must be recognized that, as the claims of *modern* culture become greater, the number of those who will find time and opportunity for this will become more and more restricted.

On the subject of mathematics and the physical and natural sciences, the professor's views are eminently reasonable. He does not claim too much for mathematics as a training in deductive reasoning; he considers that its educational value lies rather in the alertness it bestows in attacking and solving problems. "For is not life," he asks, "one prolonged succession of problems that demand to be solved? To be sure," he adds, "most of the problems are not of the mathematical order; but it is a thoroughly good thing for a man not to be a coward or a sluggard when he is brought face to face with any hard problem." Before the liberalizing power of mathematics can be fully experienced, it is necessary to have attained in the first place "a certain amount of free and joyful movement in the handling of mathematical symbols and formulæ"; and, in the second, "a certain grasp upon the beautiful ideas and the wonderful laws which these symbols and formulæ represent." Mathematics, however, deals only with abstract truths: for that knowledge of the laws of Nature which is an essential and most important part of modern liberal culture we must have recourse to natural science. Here Prof. Ladd makes a distinction similar to that which he made in speaking of language. He postulates a training in *science* rather than in sciences. This training, he explains, "implies such a course of study as will impart a conception of what is now understood by the term science, and of the recognized method of scientific investigation common to all the natural sciences." A remark which follows contains much truth: "How often does one meet men of fine literary culture who show no little bigotry, and commit not a few important mistakes, because they simply do not know what science really is!" In answer to the question how much of scientific knowledge is necessary for a liberal education, Prof. Ladd replies: "Enough to give the student a firm grasp on those fundamental physical principles upon which the world of things is built, and enough of the pursuit of some form of descriptive natural science to impart the training of the powers of observation and the habit of properly connecting newly observed natural objects with groups of similar objects known before." We should be disposed to add—though perhaps the professor might claim that it is implied in what he himself has said: Enough to bring clearly and effectually home to the mind what is understood by scientific evidence, and to produce a proper attitude of mind—according to the evidence proffered—toward every proposition or doctrine presented for acceptance.

We can not follow Prof. Ladd into the third division of his subject, namely, the claims of a scientific psychology to be regarded as a necessary part of a liberal education; we can only say that here too he seems to us to be on solid ground. We agree with him also when he says that "the condition of public education in the United States is far from satisfactory at the present time." There are many useful thoughts in his article on which we have not touched; and if we leave it for today it is "without prejudice" in case we should wish to return to it on some other occasion.

NECESSITY.

Among the ancient Greeks the idea of necessity, or as they called it *ananké*, assumed a certain religious character. It might bring evil and pain, but, in so far as it was an integral part of the order of things, it claimed a pious submission. We sometimes think that there is room for a similar conception in modern times. It is not uncommon to find people railing at the world as evil, because this or that is not arranged according to ideas of what is right, because *necessity* sets limits to human action and happiness. What the Greeks felt was that *ananké* could not be got rid of, and that the best thing we could do was to agree with it, and in a manner reverence it. The Greek was right: get rid of necessity in one form, and it immediately reappears in another; in some form man must face it and submit to it.

Socialist writers do not appear to be at all of this way of thinking. They have a noble zeal for remedying evils, but they do not seem to allow anything for the conditions which Nature itself imposes. Thus Prof. Albion Small, of Chicago, finds much to object to in the fact that "if a weaver or switchnan loses his job, no law compels another employer to hire him." He adds that "few men outside the wage earning class have fairly taken in the meaning of this familiar situation." What we should like Prof. Small or some one else to do is to figure out a situation in which, a weaver or a switchman having lost his job, somebody else *would be* obliged to hire him. It would really be interesting to have this worked out; our impression is that Prof. Small, or whoever undertook the task, would find himself bumping up against old "ananké" in an altered phase. Everybody in that case would want to be the man who could get a situation—of course, a satisfactory one—for the asking; nobody certainly would care to be the provider of situations to his fellow-citizens. We are far from saying that there is not a vast amount of hardship in the world, and much of it of a kind which in no way benefits those who have to endure it, as of course some hardship undoubtedly does. But we want to see a way out that will not cut the nerves of industry and make self-reliance a forgotten virtue. We want to see a way out that will not lessen the sense of individual responsibility or make a man less a man. Show us such a way, and we shall gladly lend every effort in our power toward its realization.

Prof. Small seems to think that the occupation of the land under private tenure is largely responsible for the helpless condition of a portion of society; but has he or has any one else ever worked out in all its details a different scheme? Would poverty always be alleviated by a gift of land, especially if the land so bestowed could not be sold? If it was agricultural land it would have to be either improved or unimproved: in either case capital, not to mention industry, would be required to work it; and in the second case to give away the improvements would be to give away the labor of other men. Make land absolutely unsalable, and the economic operations of the world would be impeded in the most serious manner. The more, for our own part, we look into these questions, the more we are driven back to the conviction that the way out which is so much desired lies in the improvement of individual character with consequent increase of individual power and better adaptation to surrounding conditions. As it is, we find that the well-developed individualities can take care of themselves pretty well; they have the power of adapting themselves to their surroundings, and taking so useful a part in the world's work that, even under the much-abused capitalistic system, they thrive very well. The problem is to make more sound individuals; and that problem does not seem to be in its nature insoluble—therein differing from some that are set by social reformers.

Then, is this your way, some one may ask, for getting rid of *ananké*? By no means: it is our way for making the best of it. In every well-balanced mind the thought of necessity is habitually present, calling forth efforts of self-restraint which tend to conserve and consolidate the individual's happiness and well-being. We contemplate, therefore, a constant recognition of necessity, but a recognition which enables a man to meet it on ground more or less of his own choosing, and not as the Nemesis of error and weakness or the ironic destroyer of futile schemes and baseless visions.

RÖNTGEN TO THE RESCUE! OR, A NEW CHANCE FOR ABSURDITY.

Our thoughtful contemporary, The Nation, is quick to point out the abuse which absurd people of all kinds will make of Prof. Röntgen's discovery of the peculiar action of the so-called X rays. "The stubborn power," it says, "of ignorance to wrest every new scientific scripture to its own destruction is already beginning to display itself in connection with the wonderful Röntgen discovery. Quack doctors are quick to say, 'Aha! this shows that our electric rings and mesmeric belts and psychic brushes and combs are just what we claim them to be.' The mysterious cathode rays, invisible but powerful, will doubtless renew the faith of many a despairing brother who carries a potato in his pocket for rheumatism. What the theological apologists will argue from the apparent need of readjusting the theory of light, those of our readers who are skilled in their methods of reasoning can guess. The Mosaic authorship of the Pentateuch, the reasonableness of prayer for rain, the duty of instantly subscribing both to the creed and for the religious weekly of the able editor making the argument, will be among the very least of the things conclusively proved by the new photography."

Such is the penalty for every new discovery of Science. By one of the oddest perversions of the reasoning faculty which it is possible to conceive, the very advances made by Science are converted into so many reasons for disparaging her authority, and drawing conclusions in favor of notions for which there is no evidence at all. Science did not know this before: *ergo*, Science is fallible; *ergo*, this or that shaky doctrine is so far confirmed. Such is the logical process, and possibly there is some mysterious benefit in it for a certain class of minds. If it pleases them, it does not do much harm to Science, which, as The Nation says, has such an army of workers at its disposal as the world never saw before.

Scientific Literature.

SPECIAL BOOKS.

We often see allusions to the triumphs of the inventor, and descriptions of single achievements are constantly being presented by the periodical press, but it is a long time since a goodly number of them have been brought together systematically as in the volume now before us.* The author has undertaken to present in popular language the chief results obtained within recent years by the arts of engineering and mechanics, together with suggestions as to what the future may bring forth, these suggestions being based upon the lines of research on which great minds are known to be pushing forward. When one stops to enumerate the notable inventions which the average city dweller makes use of in his daily life, a feeling of wonder at their array can not be repressed. On his breakfast table is sugar which has been extracted and purified by machinery; if it is warm weather, perhaps some of his food has been kept overnight by machine-made ice; either during or after the meal he reads a newspaper that may have been put in type and was certainly stereotyped and printed by machinery; he sees by a watch whose parts have been turned out by delicate machines that it is time to take a car propelled by a machine in a power house several miles away or by a storage battery and ride to the towering steel structure in which his office is. If he is a suburban dweller, he may cross a bridge of imposing span, and wish for the time when flying machines are practicable enough to shorten his journey. He ascends by an electric elevator to the 'teenth or twentieth story of the office building, which is perhaps partly lighted through glass containing wire netting. His business involves the sending and receiving of many telegrams which are printed by the receiving instruments. He goes home in the afternoon early enough to take a spin on his stanch nineteen-pound bicycle, or a trial ride with the agent of a motor carriage, or a sail in his electric launch; for a submarine boat he does not yearn. In the evening he reads his magazine, illustrated with photo-engravings, by light from electricity, or from enriched coal gas in an improved burner, or possibly from the product of the oil well. Other inventions, with which he does not come into immediate contact, prepare articles for his use or aid in transporting them to him. Among these may be mentioned mining, ore-concentrating, and coal-handling machinery, the steel converter, the spectroscope, the testing machine, various machine tools, compressed-air mechanisms, the plant utilizing power from Niagara, tunnels, canals, and the ocean steamer. All these and more are described in Mr. Cochrane's book, and the author is quite resigned to the idea of a reader of some future gen-

* The Wonders of Modern Mechanism. By Charles Henry Cochrane. Pp. 402, 8vo. Philadelphia: J. B. Lippincott Company. Price, $2.

eration smiling at the smallness of the achievements which he is able to chronicle at the end of the nineteenth century. The volume is well illustrated and printed, but lacks an index.

As "down East" recedes before him who journeys toward the rising, so does "out West" elude him who follows the setting sun. The district long known as the West is east of the present geographical center of the United States, and the name must now be applied to a region far beyond. In order to preserve a knowledge of the real West a series of books under the general title of The Story of the West has been planned by Mr. Ripley Hitchcock, which will present the typical characters who made the life of this wonderful region what it was. It is fairly safe now to locate the West, for the Pacific Ocean forms a barrier which it can not pass. Eastward Mr. Hitchcock places its limit at the Missouri River. The first book of the series is devoted to the aboriginal inhabitant.* Its prime object is to show to the reader the Indian's daily life. As the editor of the series truly says: "Mr. Grinnell takes us directly to the camp fire and the council. He shows the Indian as a man subject to like passions and infirmities with ourselves. He shows us how the Indian wooed and fought, how he hunted and prayed, how he ate and slept—in short, we are admitted to the real life of the red man, and as we learn to know him we discard two familiar images: the red man of the would-be philanthropic sentimentalist, and the raw-head-and-bloody-bones figure that has whooped through so many pages of fiction." Mr. Grinnell's style is far removed from that of the dry-as-dust piler-up of facts. For vividness and movement his book is well termed a "story," but it gives a much more realizing sense of the Indian's ways than half a dozen tales of Indian adventure of equal length. Thus, in telling about the Indian's recreations, it describes the scene in and about a camp on a day when no serious work is in hand, giving the amusements of the men, the women, the boys, and the younger children, even down to the mischief of whacking the sleeping dogs. In telling of his war customs, Left Hand or Four Bears is followed upon the trail, and tales of battle told to the author by Indians are freely used. The same method is followed in describing the red man's home life, modes of subsistence, marriage customs, hunting, religion, etc. There is also an interesting chapter showing how the Indians were impressed by the coming of the white man, and in an appendix the distribution of the Indian tribes of North America is set forth. It will thus be seen that the book has no small anthropological value. The volume is fully illustrated and is attractively printed and bound. Future volumes in the same series may be expected to depict the life of the explorer, the soldier, the miner, the trapper, the cowboy, and perhaps other characteristic western types.

Mr. *Percival Lowell*, who once told us about An Unexplored Corner of Japan, now has something to tell about a still less explored region. He has been making a polar expedition and other explorations on *Mars*,† not quite at the usual long range, for his observations were made during ten

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* The Story of the Indian. By George Bird Grinnell. Pp. 270, 8vo. New York: D. Appleton & Co. Price, $1.50.

† Mars. By Percival Lowell. Pp. 228, 8vo. Boston: Houghton, Mifflin & Co. Price, $2.50.

months of 1894 and 1895, which included the time of the latest opposition of the planet. These observations were made from the Lowell Observatory, which was established at Flagstaff, Ariz., and Prof. W. H. Pickering and Mr. A. E. Douglass were associated with Mr. Lowell in making them. In this book Mr. Lowell gives first the general appearance of Mars, its size, orbit, etc. From measurements made at Flagstaff, the diameter of the planet was determined as 4,215 miles, and its polar flattening as $\frac{1}{190}$ of its equatorial diameter. The presence of an atmosphere is well established, and good fortune enabled measurements of it to be obtained. It appears that the atmosphere is thinner by half than the air upon the summit of the Himalayas, and in constitution does not differ greatly from our own. The ice cap about the south pole gradually dwindled away as the Martian summer advanced, and finally disappeared altogether. This was the occurrence—the first on record—which enabled the planet's atmosphere to be measured, and which gave additional information as to the presence and distribution of water upon its surface. Mr. Lowell gives us a notably full exposition of areography, or the geography of Mars, based upon a series of twelve views made by him, and reproduced in the book, which together represent the whole surface of the planet visible on the first of August. He describes its continents and peninsulas, its seas and gulfs, and especially its famous canals, which make Mars a very Holland of planets. These straight or evenly curved lines he deems it very probable are irrigating ditches, made to control the water from the annual melting of the polar ice caps, for there seems to be no other way of distributing the planet's scanty supply of moisture. Various other features of the present and probable future condition of Mars are set forth in this attractive volume. At the end we have a map of its whole surface on the Mercator projection, followed by a list of areographic names and a general index.

The second volume of Messrs. *Groves* and *Thorp's Chemical Technology** consists of chapters by various authors on the fats and oils used for illuminating, and on the lamps in which these substances are burned. The first section, in which the animal and vegetable illuminating substances are described, and the modes of testing them are given, is by William Y. Dent. The attitude of the uncultivated Britisher toward the United States is unpleasantly evident in several of this writer's remarks about American products. The methods and apparatus employed in the extraction of stearin from various fats, and for distilling and pressing it, are described by John McArthur. His text is accompanied with figures of the autoclaves of de Milly, Morane, and Droux, the apparatus of Tilghman, Hugues, and Michel for the decomposition of fats by water, two forms for the distillation of fatty acids, a hydraulic press for cold pressing, and one for hot pressing. L. Field and F. A. Field describe the making of candles from the material thus prepared, giving many illustrations of the machines employed in the industry. The largest contribution to the volume is made by Boverton Redwood, who furnishes the sections on petroleum and lamps, and, in conjunction with D. A. Louis, that on miners' safety lamps. Mr. Redwood gives brief accounts of the rise of the petroleum industry in the

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* Chemical Technology. Edited by Charles Edward Groves and William Thorp. Volume II, Lighting. Pp. 398, large 8vo. Philadelphia: P. Blakiston, Son & Co. Price, $4.

United States, Russia, and other countries, and describes at some length the methods of drilling and operating wells in the United States, with notes on the practice followed elsewhere. The American and the Russian methods of refining petroleum, the distilling of shale oil, which is an important industry in Scotland, and the manufacture of paraffin, are then described. All these accounts are fully illustrated by figures of apparatus, and many tables of production, analyses, etc., are given. In this section there is an interesting sketch of ozokerite mining in Galicia. Mr. Redwood's chapters on lamps are of much popular as well as technical interest. His treatment is largely historical, a few lamps of the ancients being included, and the dates and numbers of the patents issued for the modern forms being given. Sponge lamps, blast lamps, and lamps for railroad cars and ships are described, as well as the more familiar forms. In this section something about the making of oil gas and air gas is also told. The subject of miners' safety lamps is treated in much the same way. These two sections contain over two hundred of the three hundred and fifty-eight figures in the volume. Gas and electric lighting are left for the next volume of the series.

GENERAL NOTICES.

Under the editorial care of Prof. C. Lloyd Morgan has appeared the second volume of the work upon which Prof. *Romanes* * was engaged at the time of his death. The present volume is mainly devoted to a consideration of those post-Darwinian theories which involve fundamental questions of heredity or utility. The chapters dealing with heredity are almost exclusively concerned with Prof. Weismann's views as to the inheritance of acquired characters. Prof. Romanes presents evidence both for and against such inheritance, and while he agrees with Galton in largely diminishing the potency of the Lamarckian principles, he can not go so far as to abolish it as Weismann does. In the chapters grouped under the head of utility he vigorously opposes the doctrine that all species must necessarily be due to natural selection, and therefore must severally present at least one adaptive character as held by Huxley, and he finds still less tenable the more extended form of the same doctrine held by Wallace. Regarding the question as purely one of reasoning, he combats it by argument without appeal to facts. In an appendix he discusses some side issues connected with the principle of panmixia, and in another he states more fully than in the body of the book the opinions of Darwin and Huxley on characters as adaptive and specific. The volume contains a portrait of the author as frontispiece and several figures in the text.

* Darwin and after Darwin. By the late George John Romanes. Vol. II. Pp. 344, 12mo. Chicago: The Open Court Publishing Co. Price, $1.50.

Prof. *Tarr's* new book on physical geography * has the character of those recent treatises which have appeared under the title of physiography. It is not a description of the topographical features, climate, animal and vegetable productions, etc., of the several regions of the earth in the familiar atlas form, accompanied by large maps, but rather a depiction of typical forms assumed by land and water, with accounts of the processes that have produced them. It is thus largely devoted to the dynamic side of its field. After a short description of the earth as a planet, the author sets forth the usual and the occasional phenomena of the atmosphere, and shows how these conditions affect the geographic distribution of animals and plants. Three chapters are given to the form and characteristics of the ocean, leaving about half of the book to the land. In this last part especial attention is given to such agencies of change as weather, streams, glaciers, waves, and the internal heat of the earth,

* Elementary Physical Geography. By Ralph S. Tarr. Pp. 488, 12mo. New York and London: Macmillan & Co. Price, $1.40.

and to the various features of the land produced by them. There is also a chapter on the reciprocal influences of man and Nature, and one on economic products. Most of the examples are drawn from the United States. There are four appendixes devoted respectively to meteorological methods, topographic maps, suggestions to teachers, and questions on the text. The volume is copiously illustrated with photo-engravings of varying degrees of distinctness, maps and diagrams, and a list of reference books is given at the end of each chapter.

In his *First Year in French*, designed for young pupils (American Book Co., 50 cents), *L. C. Syms* has aimed to unite the conversational and the translation methods of teaching the language. Directions for the use of the book are given, and French-English and English-French vocabularies are appended.

The same publishers have issued the first part of a series of simple French readings under the title *Contes et Légendes* (60 cents), by *H. A. Guerber*, author of Myths of Greece and Rome, etc. With the exception of the first one of the series these stories are not likely to be known to American pupils. There is a vocabulary.

The technique of the organic chemical laboratory is a considerable and somewhat intricate body of knowledge. Through oral instruction the student becomes acquainted with those devices and forms of apparatus required for common operations, getting, where there is a choice of processes, the one which his instructor has had the best success with. When he comes to practice his profession he gathers others as he has occasion for them from the various journals for the publication of chemical researches, and sometimes fails to find what he wants at the right time. In order to make such knowledge conveniently accessible, Dr. *Lassar-Cohn*, of Königsberg, several years ago prepared a *Laboratory Manual of Organic Chemistry*, from the second edition of which Prof. *Alexander Smith*, of Chicago, has made a translation (Macmillan, 8*s.* 6*d.*, $2.25). It groups processes generally applicable under such heads as crystallization, distillation, extraction, determination of melting points and of molecular weights, sealed tubes, and sublimation. In this part of the work a large number of pieces of apparatus are described and some forty are figured. About three fourths of the volume is devoted to special processes of condensation, the preparation of esters, halogen compounds, nitro-derivatives, and other substances, oxidation, reduction, saponification, etc. There is also a chapter on organic analysis. The volume is indexed and has a table for finding the year of any volume of the chief chemical journals.

From the Department of the Interior we have received Volumes XXIII and XXIV, consisting of monographs from the United States Geological Survey. The first of these deals with the *Geology of the Green Mountains in Massachusetts*. The general structure and correlation is first considered, and then Hoosac Mountain and Mount Greylock are taken up individually. There are many valuable plates and maps to illustrate the text. Volume XXIV is entitled *Mollusca and Crustacea of the Miocene Formations of New Jersey*. The work seems to have been done with care, and the relation of the paleontology of New Jersey to the structural conditions prevailing in other parts of the United States makes it of national interest. Unusually good illustrations are numerous.

Volume XIV, for 1894, of *The United States Fish Commission Bulletins*, contains, as these publications regularly do, the results of a large number of careful observations on the life history and habits of American fish in all parts of the country. Among many interesting papers we especially note the following: Notes on Two Hitherto Unrecognized Species of American Whitefishes, by Hugh M. Smith, M. D.; On the Appliances for collecting Pelagic Organisms, with special reference to those employed by the United States Fish Commission, by Z. L. Tanner, United States Navy; Feeding and Rearing Fishes, particularly Trout, under Domestication, by William F. Page; and A Statistical Report on the Fisheries of the Middle Atlantic States, by Hugh M. Smith, M. D.

The Stark Munro Letters, by *A. Conan Doyle*, is an attractive little volume of 385 pages (Appletons, $1.50). It is an account of the troubles and difficulties which a young physician, Dr. Stark Munro, had to overcome at the outset of his career. The story is told in a series of letters from the young doctor to one of his school-fellows who has emigrated to America. The central figure in the tale is a man named Cullingworth, who was a schoolmate of the two correspondents, and whose career is followed to the end of the book, at which point he is on the eve of departing for South America with a shipload of spectacles for the natives. His strange, almost paradoxical character makes a curious picture, and leads to some surprising performances, both in connection with his private life and in his profession of medicine, where he comes to be considered by his associates a mere charlatan.

Under the title *The Forces of Nature*, brief popular accounts of the solar system, the air, sound, light, heat, and electricity have been brought together in a volume by *H. B. Harrop* and *Louis A. Wallis* (the authors, Columbus, O., $1.25). It is not a book for study, but is intended rather to give an understanding of the chief laws and phenomena of science to persons who have been occupied with their respective callings to the exclusion of scientific reading.

Something widely different from the ordinary text-book is the *Working Manual of American History*, by *William H. Mace* (Bardeen). It consists, first, of a list of topics, extending in time from the opening up of America to Europe down to the reconstruction of the South, with references to standard historical works. This matter, which occupies about one third of the volume, is followed by extracts from documents covering about the same period, accompanied by questions.

A text-book for normal schools, under the title *Psychology in Education*, has been prepared by Prof. *Ruric N. Roark* (American Book Company, $1). The author arranges the mental faculties in classes and subclasses, and bases his descriptions on this classification. In accordance with the purpose of the book he points out the importance of training each of the faculties, and shows how knowledge of the operations of the mind can be applied in education. Prof. Roark is not one of those instructors who leaves his students to balance conflicting views, even in so young a science as psychology. All his statements are definite and decided. He does not hesitate even to set bounds to the further progress of knowledge, nor to state his view in certain controverted matters as if there were no other. Thus, in the chapter which he gives to the "physical basis" of mind he says: "All that is *known* regarding the subject may be stated fully in one paragraph: Mind, as we know it, rests upon a physical basis, which acts upon mind, and upon which mind acts. What the connection is between mind and that physical basis, or how this connection is made and maintained, is not known, and most probably never will be known." Here and elsewhere he shows that he expects little from the "new school" of physiological psychologists. He has much more sympathy for child-study, and points out methods of pursuing it. His views as to the comparative worth of many of the usual school studies are also freely expressed.

The recently published account of the Myths of Greece and Rome, by *H. A. Guerber*, has been followed by *Myths of Northern Lands*, by the same author (American Book Company, $1.50). The ancient tales which are the common heritage of the English and other branches of the Germanic stock are here simply told, with the embellishment of poetical quotations and of engravings from paintings representing the personages and scenes of the myths.

The several Webster's School Dictionaries have been revised to conform to the International. The largest of the four, *Webster's Academic Dictionary* (American Book Company, $1.50), now contains 736 pages, being 150 more than in the last edition, while the illustrations have been increased from 350 to over 800. The body of the book is now arranged in two columns, instead of three, and the supplementary matter comprises a guide to pronunciation, rules for spelling, lists of affixes, abbreviations, proper names, words and phrases from foreign languages, and arbitrary signs, a classification of languages, and a brief mythological dictionary.

The University of Chicago Press has undertaken the issue of *The American Journal of Sociology*, a bimonthly magazine, to be edited by Prof. *Albion W. Small* and his associates in the department of sociology in the University of Chicago. The journal starts in a quiet and dignified way. There was evidently no effort to go far afield for conspicuous contributors to the first number, six of its seven articles being contributed by Chicago professors. It is announced, however, that some of the most eminent sociologists in the United States and Europe will be advisory editors and contributors. We are glad to see the lack of a journal for America in this field supplied. The new magazine can be productive of much good, both to its readers and to its contributors—to the latter, by forcing them to state their ideas so as to be proof against the criticism which never dares raise its head in the professor's lecture-room.

Two pamphlets on American currency, either of which may be taken as an antidote to the other, have come to hand within the same month. In one, *The Financial Question*, a large number of considerations adverse to the free coinage of silver are presented by *Charles S. Ashley* in short, disconnected discussions or quotations (the author, Toledo, O.). A feature of the publication is a series of diagrams, in which many of the author's facts and estimates are presented in a graphic way. Various considerations on the opposite side of the question are presented by *Mason A. Green* under the title *Are we Losing the West?* (C. E. Brown, Boston, 10 cents). If the Ohio man can be taken as speaking for the West, the anxiety of the Massachusetts man is misdirected.

Among the bulletins issued by the University of the State of New York in 1895 was a revision of the *Academic Syllabus*, or statement of the requirements for the examinations conducted by the university. It contains the changes determined upon since the last revision, in 1891, the most important of which tend toward more thorough work in English and history. Another bulletin is devoted to the *Tenth Annual Conference of Associated Academic Principals*, in which discussions on a number of subjects interesting to teachers are reported. Extension Bulletin No. 9 consists of brief descriptions of the *Summer Schools* of the United States and of a few abroad.

Guides to genuine science teaching are steadily increasing in number. A little manual which well embodies the spirit of such instruction is *Practical Proofs of Chemical Laws*, prepared by *Vaughan Cornish*, of Owens College (Longmans, 2*s*., 75 cents). It is a course of some twenty experiments on the combining proportions of the chemical elements, with full working directions, and a statement in each case of what the results mean. The results of historic experiments and of students' work are frequently cited to show what approximation to accuracy should be expected.

A Naturalist in Mexico, by *Frank C. Baker* (David Oliphant, Chicago), is the account of a winter's trip to Cuba, northern Yucatan, and Mexico. The expedition was undertaken under the auspices of the Academy of Natural Sciences of Philadelphia, its object being to collect data and specimens illustrating the fauna, flora, and geology of Yucatan and southern Mexico. The text is a combination of narrative, science, and history. Some of the descriptive writing is very well done, and while the book is perhaps not exhaustive, the whole trip only lasting a trifle over three months, it is extremely interesting. Illustrations from photographs, taken by the party, together with sketches made by the author, are quite numerous; and there are also figured a number of new species of mollusks which were discovered by the expedition.

A Laboratory Course in Experimental Physics, by *W. T. Loudon* and *J. C. McLennan* (Macmillan, 8*s*. 6*d*., $1.90), was prepared, say the authors, to assist them in handling large laboratory classes in which they had found it very troublesome and slow to give the necessary detailed explanation of the experiments to each individual orally. The book contains a series of elementary experiments adapted for students who are not familiar with higher mathematical methods, which have been arranged as far as possible in order of difficulty. There is also an advanced course of experimental work in acoustics, heat, and electricity, which is intended to follow the elementary course.

The *Eleventh Annual Report of the Commissioners of the State Reservation at Niagara* contains, besides the detailed account of the work of the commission for the year 1893–'94, an interesting paper on the Duration of Niagara Falls and the History of the Great Lakes, by J. W. Spencer. The computation of the age of the river is made by the measured rate of recession of the falls during forty-eight years, and leads to the conclusion that the falls are 31,000 and the river 32,000 years old. At the estimated rate of terrestrial elevation in the Niagara district, it will require between 5,000 and 6,000 years for a sufficient rise to divert the waters of Lake Erie through the divide at Chicago, and thus end the falls. Mr. Spencer's paper has been reprinted separately. In the commissioners' report considerable space is given to an account of the efforts which they have made to protect the beauty of the falls and its surroundings from destruction through commercial enterprise. They have not as yet been able to influence the State Legislature in any effective way, and, while the water privileges on the Canadian side are a source of revenue to Canada, the American privileges are being legislated away for nothing, and, what is far worse, there seems great danger of serious injury to the natural features of the falls and the park.

A picturesque sketch of *Constantinople*, has been written by *F. Marion Crawford* and copiously illustrated by Edwin L. Weeks (Scribners, $1.50). The author finds much that is attractive in this unique city and its environs while the Turk appears to him a much better specimen of humanity than the wily Greek or Armenian will admit.

The *Outline Study of United States History*, prepared by *Harlow Godard* (Bardeen, 50 cents), consists of a list of topics extending from the discovery of America to Cleveland's second administration, with directions for studying, lists of reference books, and reviews.

The *Report of the United States Life-saving Service for 1894* presents the usual record of laborious and often heroic service. The year was one of violent tempests and many disasters, while timely warning signals were given to over two hundred vessels, a large portion of which undoubtedly would have otherwise met with destruction. An examination of this record should convince any one that the maximum pay of sixty-five dollars a month ought not to be withheld from those surfmen who are employed for more than eight months in the year. The report contains a list of life-saving medals awarded by the Secretary of the Treasury since 1874. Several names of New York policemen appear in this list, but none of those of any other city, which apparently gives support to the claim that New York's force is "the finest."

Reconstruction during the Civil War, by *E. G. Scott* (Houghton, $2), is a political history of the so-called period of reconstruction. The years during which the process of renewal of the former Confederate States was taking place are called in popular speech the reconstruction period, and this name refers somewhat indefinitely to the time occupied by the single term of President Johnson and the succeeding two terms of President Grant. The author begins in Revolutionary times and, roughly sketching the origin, growth, and history of the various political parties up to the time of the civil war, gives the reader a clear notion of the causes, both immediate and remote, which led up to this event. Then he takes up the proposed methods of reconstruction, and gives an account of the disagreement between Congress and the President on this question. The last five chapters contain accounts of reconstruction as carried out in Tennessee, Arkansas, and Louisiana, and a discussion of what constitutes a State of the American Union.

Dr. *M. L. Holbrook* has issued a volume on the *Physical, Intellectual, and Moral Advantages of Chastity* (Holbrook & Co., New York, $1), in which he exhorts his readers to live a chaste life, and depicts the beauty and nobleness of chastity with the aid of many quotations from poets and essayists. He also denies the reality of alleged disadvantages of chastity.

Weather and Disease, by *A. B. MacDowall* (The Graphotone Co., London, 2*s.* 6*d.*), is the title of a book on the influence of weather on health. This is a subject which has received too little attention from physicians, and yet every one knows how immediately a sudden change in the weather affects even a healthy person's spirits and bodily well-being; how much more susceptible must a broken-down, or even an only temporarily weakened system, be to such changes! The primary object of this book is to give an idea of the way in which certain elements of our weather and the mortality from some well-known diseases have varied in recent years. The mode of exposition adopted is that of graphic curves. For instance, on page 57, a whooping-cough table is given which covers the period from 1837 to 1894. A curve is plotted from a careful study of the mortality statistics, thus giving a picture which accurately represents the variations of the death-rate in this disease during practically the last fifty years; this table can then be compared with a similarly constructed one, representing the variations in temperature and rainfall for the same period, and the relation between the two series made out.

The sudden rise into prominence of massage as a therapeutic agent has already caused the growth of a quite extensive literature on the subject. The last volume to reach us, *The Practice of Massage*, by *A. Symons Eccles* (Macmillan, 7*s.* 6*d.*), is in a general way a treatise on the more recent as well as the earlier contributions to our knowledge of the effects, uses, and limitations of massage, so far as they have appeared to be fairly well established by actual results. The author has besides, however, set down the record of his own personal observation and practice. The appropriate manipulations for the various diseases are given in detail, and the book is closed with a very good bibliography of the subject.

With the beginning of the new year and of its fourteenth volume, the *Pharmaceutische Rundschau* became the Pharmaceutical Review, and was removed to Milwaukee. It will also henceforth be printed chiefly in the English language, although articles from German contributors that would suffer by translation will continue to appear in German, and sometimes in both languages.

The embodiment of a vivid narrative and the dress of a handsomely printed and illustrated volume have been provided by *John Uri Lloyd*, of Cincinnati, for the philosophical reflections and scientific hypotheses that a lifetime has matured in his mind. In a preliminary statement Prof. Lloyd says that his study of the material (he ranks high among American pharmaceutical chemists) has discredited materialism for him, and the leading ideas of his book, to which he has given the anagrammatic title *Etidorhpa*, are that "force and spirit are neither less real than the other, and that matter is not more substantial than either," while pure and noble love is man's highest good, whether here or hereafter. The story reminds one strongly of Jules Verne. It describes a journey underground in the care of an eyeless guide, among colossal fungi, monstrous cubical crystals, hideous reptiles, and beautiful flowers, over crags and precipices and across a crystal lake, until the "end of earth" is reached. At one point Etidorhpa, with a train of other beautiful beings, comes before the pilgrim and asserts her sovereignty. The results of the author's reflections upon gravitation, matter, force, life, volcanoes, intemperance, and future life are incidentally introduced. The illustrations, by J. Augustus Knapp, deserve high praise. Prof. Lloyd has issued a limited edition of the book at a subscription price of $4.

Except a few pages occupied by administrative reports the fourth volume of the *Report of the Iowa Geological Survey* is devoted to descriptions of the geology of six counties —Allamakee, Linn, Van Buren, Keokuk, Mahaska, and Montgomery. The stratigraphy and economic products of each county are given with considerable fullness, and the physiography more briefly. There are good beds of coal in one or two of these counties and more or less building stone, brick clay, lime, etc., but so few deposits of metals as to afford little inducement for prospecting. The volume is handsomely printed and contains illustrations and county maps.

We have received a copy of the second edition of Prof. *Sadtler's Handbook of Industrial Organic Chemistry* (Lippincott, $5), the first edition of which we noticed in our January issue for 1892. "The fact that a large edition of the book has been exhausted in about three years and a half, and that it has been temporarily out of print, leads me to think," says the author, "that the plan of treatment adopted was an acceptable one, and that such a book was needed." In the present edition the bibliography has been rewritten and brought carefully up to date. While the body of the text has not been altered, numerous corrections have been made.

In the appendix two new tables are added, giving the physical and chemical constants of the oils, fats, and waxes classified for reference and comparison. This work contains so much valuable information of a character otherwise inaccessible to the general reader, even if he possess a good cyclopædia, that we have been much pleased at the opportunity of noticing a second edition.

Compressed Air, by *Frank Richards* (Wiley, $1.50), is a little treatise on air compression, and the transmission and application of compressed air. The main portion of the book consists of a series of articles which have appeared during the last few years in the columns of the American Machinist. They treat of the various practical details in the shape of machinery, methods of distribution, etc., which have had to be solved in the use of compressed air as a means of power distribution and application. There is an interesting chapter comparing compressed air with electricity, and another which discusses the numerous ways in which the former may be utilized.

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Fragments of Science.

Seven Years of Strikes.—Mr. Wright, the Commissioner of Labor, gives some interesting information in his last report. During the past seven years and a half the number of persons thrown out of employment by strikes was 2,391,203. His tabulation by States shows that the majority of these disturbances took place in five States—Illinois, Massachusetts, New York, Ohio, and Pennsylvania. These States contained fifty-one per cent of all the manufacturing establishments and employed fifty-six per cent of the capital invested in the mechanical industries of the country. Out of a total of 10,488 strikes for the entire country, more than fifty-six per cent occurred in twenty-six cities. The total wages loss in these twenty-six cities, Mr. Wright estimates, was in round numbers $35,000,000, and the loss to employers was something less than $29,000,000. Twenty-five per cent of these strikes were for an increase of wages, thirteen per cent were for reduction of hours, eight per cent were against reduction of wages, seven per cent were sympathetic, six per cent were for increase of wages and reduction of hours, four per cent were against the employment of non-union men, and three per cent for a recognition of the union. A study of the great effort and loss which these struggles present, says Architecture and Building, will compel the conclusion that some method of arbitration should be adopted.

The Nose as a Germ Filter.—It would seem, from the researches of St. Clair Thompson and R. T. Hewlett (London Lancet, January 11th), that the human nose is a nearly perfect filter for micro-organisms. These experimenters calculated that under very favorable conditions the lowest number of organisms contained in the inhaled air of an hour was fifteen hundred, and that oftentimes in the air of a great city there must be as many as twelve or fourteen thousand drawn into the nose during the same period of time. The fate of the thousands of microbes which thus enter the human body is a question of great pathological interest, and this increases when it is remembered that the expired air is practically free from germs. The fact that inspired organisms do not, as a rule, reach the air cells, was first pointed out by Lister. Later, Tyndall showed by his experiments with a ray of light in a dark chamber that expired air—or, more exactly, the last portion of an expiration—was optically pure—i. e., that respiration has freed it from the particles of suspended matter with which it was laden. Since then numerous experiments have been made by bacteriologists, which show expired air to be free from germs. Grancher has made many experiments with the expired air of phthisical patients, and has never found in it the tubercle bacillus or its spores. "Now, as the air is practically freed from all germs by the respiratory act, we have to consider where and how the thousands of organisms are arrested in the air passages. The experiments of Hildebrandt would tend to prove that the air is entirely freed from all germs before reaching the trachea. In verifying this we have examined the mucus from the trachea of all animals recently killed in the laboratory, and up to the present have found the mucus to be quite sterile. We therefore commenced with the nasal fossæ, and found that the mucous membrane of the healthy nose only exceptionally shows any micro-organisms whatsoever. The interior of the great majority of normal nasal cavities is perfectly aseptic. On the other hand, the vestibules of the nares, the *vibrissæ* lining them and all crusts found there, are generally swarming with bacteria. These two facts seem to demonstrate that the *vibrissæ* act as a filter, and that a large number of microbes meet their fate in the moist meshes of the hair which fringes the vestibule. Germs which have penetrated into the nose are rapidly ejected by the action of the ciliated epithelium." The nasal mucus is an unsuitable soil for the growth of organisms, and hence is an important factor in that it does not further their multiplication. A pure culture of the *Bacillus prodigiosus* was prepared, and a sterilized loopful deposited at a distinct point on the nasal septum well within the vestibule. Cultures were made from this spot every few moments for two hours, with the result of a continually diminishing growth in the culture medium, the sample taken at the end of two hours producing no growth whatsoever. The foregoing facts emphasize the importance of nose-breathing, and the great danger which arises from the habit of breathing through the mouth, and the resultant unfiltered stream of bacteria which is drawn through the pharynx into the trachea and bronchi.

Deteriorating Effects of Alcohol.—In the Fifth International Congress against the Abuse of Alcohol, held at Basel, Switzerland, in August, 1895, Prof Gauls, of Zurich, and Drs. Smith, of Marbach, and Fürer, of Heidelberg, read papers on the influence of alcohol on the cerebral substance and its deteriorating effects even in moderation on the memory and reasoning faculties. Drs. Smith and Fürer contended that intellectual work is always better during periods of abstinence than when strong drink is even sparingly indulged in. The reports presented by directors of lunatic asylums pointed to the conclusion that lunacy increases in direct proportion to the abuse of alcohol. On this point the preponderance of the sympathies of the meeting was evidently in favor of total abstinence. The influence of alcohol in fostering crime was dwelt upon by MM. Kohlinski, of Düsseldorf, and Marthaler, of Berne, penitentiary chaplains, and was made prominent by M. Denis, who endeavored by elaborate statistical returns to show the length to which European countries had gone in combating this source of criminality. France and Belgium, where no serious attempt has been made to restrain the spread of alcoholism, have, he said, the worst record in regard to crime. Switzerland and Holland, he contended, where the restrictive movement had already begun, had rendered crime "stationary," preluding a reduction in its prevalence as the movement became more energetic. Norway and Sweden, as already indicated, could boast of a distinct diminution in their criminal population, thanks to their control of alcoholism.

A Correction.—

Editor Popular Science Monthly:

Sir: On page 575 of your issue for August, 1895, is the statement, "Prof. Simon Newcomb has been elected by the French Academy of Sciences an associate academician as successor to the late Prof. Helmholtz." As this fact is apparently ignored in the article on page 561 of the February issue (1896), where it says, "As yet the name of no citizen of the United States has been inscribed on the roll of the foreign associates of the institute, although it is understood that in a recent election to fill the vacancy occasioned by the death of a member the name of Prof. Simon Newcomb, of Washington, lacked but a few votes of receiving this honor," it is perhaps well to say that the former item is the correct one, and that Prof. Newcomb was elected a foreign associate of the French Academy of Sciences on June 17, 1895. Very truly yours,

Marcus Benjamin.

Washington, D. C., *February* 25, 1896.

Prof. Röntgen's X Rays.—The recent experiments of Prof. Röntgen on the so-called cathode rays from a Crookes, Lenard, or Hittorf vacuum tube, described by him in the Sitzungsberichte der Würzburger physikalische-medicinische Gesellschaft, 1895, and translated for Nature, are really only a continuation of the work of Hertz and Lenard, who experimented with these rays several years ago, and determined their curious property of passing through substances opaque to the ordinary light rays, and the latter of whom obtained photographic images quite similar to those of Prof. Röntgen. The rays with which the latter works, and which he calls the X rays, are chiefly seated at the place of most brilliant phosphorescence on the walls of the discharge tube; "that is, the X rays proceed from the front where the cathode rays strike the glass. If one deviates the cathode rays within the tube by means of a magnet, it is seen that the X rays proceed from a new point—i. e., again from the end of the cathode rays." The X rays, Prof. Röntgen says, differ from the cathode rays in two important particulars. Air absorbs the X rays much less than it does the cathode rays; and while the cathode rays are sharply deflected by a magnet, the X rays are apparently not at all affected by a magnet. The X rays could not be deflected by the use of ordinary prisms, but with prisms of ebonite and aluminum images were obtained on a photographic plate which point to a possible deviation. Lenses apparently have no effect in concentrating the X rays. The transparency of a great number of substances to these X rays, such as ebonite, glass, wood, cardboard, platinum, and many others, was tested, as also the effect of the thickness of the substance, and led to the conclusion that the density of the bodies is the property whose variation mainly affects their permeability, but that this alone does not determine the transparency. Increasing thickness increases the hindrance offered to the rays by all bodies. "The justification for the term 'rays' applied to the phenomena lies partly in the regular shadow pictures produced by the interposition of a more or less permeable body between the source and a photographic plate or fluorescent screen." The rays have the property of producing fluorescence in various substances, as barium platino-cyanide, calcium sulphide, uranium glass, Iceland spar, rock salt, etc., as well as of acting on a dry plate. "The retina of the eye is quite insensitive to these rays." Prof. Röntgen says in reference to their refraction: "Since I have found no evidence of refraction at the surface of different media, it seems probable that the X rays move with the same velocity in all bodies, and in a medium which penetrates everything and in which the molecules of bodies are imbedded. . . . It is known that Lenard, in his investigations on cathode rays, has shown that they belong to the ether, and can pass through all bodies. Concerning the X rays, the same may be said." Prof. Röntgen closes his paper with the following paragraphs: "A kind of relationship between the new rays and light rays appears to exist; at least, the formation of shadows, fluorescence, and the production of chemical action point in this direction. Now it has been known for a long time that besides the transverse vibrations which account for the phenomena of light, it is possible that longitudinal vibrations should exist in the ether, and according to the view of some physicists must exist. It is granted that their existence has not yet been made clear, and their properties are not experimentally demonstrated. Should not the new rays be ascribed to longitudinal rays in the ether? I must confess that I have in the course of this research made myself more and more familiar with this thought, and venture to put the opinion forward, while I am quite conscious that the hypothesis advanced still requires a more solid foundation." The most striking of the pictures accompanying the article are the photograph of a compass card and needle completely inclosed in a metal case, and a cut of the human hand showing quite beautifully the bones and joints.

The Incubator Bird (Megapodius Tumuli).—An account in the Geographical Journal of a trip to the little island of Niuafou, in the South Pacific, describes a native bird called the *malau*, which is apparently of the same order as the *Megapodes;* it makes no nests, but buries its eggs in the soft, hot sand of this volcanic island. It is about the size of a small domestic fowl. Its eggs are large and of a dull reddish color. The strange nesting habit and the large size of its eggs recall that curious bird the jungle fowl of Australia (*Megapodius tumulus*). Great numbers of high and large mounds exist in some parts of Australia, which were for a long time thought to be the tombs of departed natives; the natives, however, disclaimed the sepulchral character, saying that they were artificial ovens in which the eggs of the jungle fowl were laid, and which, by the heat that is always disengaged from decaying vegetable substances, preserved sufficient warmth to hatch the eggs. The size of some of these mounds is quite marvelous. One which was measured proved to be fifteen feet high and sixty feet in circumference. The whole of this enormous mass was made by the jungle fowl. If the hand be inserted into the interior of the heap it will always be found quite hot. In almost every case the mound is placed under the shelter of densely leaved trees. This precaution is probably taken to prevent the rays of the sun from evaporating the moisture. The bird seems to deposit its eggs by digging holes from the top of the mound, laying the egg at the bottom, and then making its way out again, throwing back the earth it had scooped away. The holes are not dug perpendicularly, so that although they are six or seven feet in length they may be only two or three feet from the surface. The *leipoa*, or native pheasant of Australia, like the preceding, lays its eggs in a mound of earth and leaves, but the mound is not nearly so large. Another bird having this curious nesting habit is the brush turkey of New South Wales. In the Guide to the Gardens of the Zoölogical Society of London an interesting account of the construction of the mound by some captive birds is to be found. "On being removed into an inclosure with an abundance of vegetable material within reach, the male begins to throw it up into a heap behind him by a scratching kind of motion of his powerful feet, which projects each footful as he grasps it for a considerable distance in the rear. As he always begins to work at the outer margin of the inclosure, the material is thrown inward in concentric circles until sufficiently near the spot selected for the mound to be jerked upon it. As soon as the mound is risen to a height of about four feet, both birds work in reducing it to an even surface, and then begin to excavate a depression in the center. In this in due time the eggs are deposited as they are laid and arranged in a circle about fifteen inches below the summit of the mound at regular intervals with the smaller end of the egg pointing downward. The male bird watches the temperature of the mound very carefully; the eggs are generally covered, a cylindrical opening being always maintained in the center of the circle for the purpose of giving air to them, and probably to prevent the danger of a sudden increase of heat from the action of the sun or accelerated fermentation in the mound itself. In hot days the eggs are nearly uncovered two or three times between morning and evening. On the young bird chipping out of the egg it remains in the mound for at least twelve hours without making any effort to emerge from it, being at that time almost as deeply covered up by the male as the rest of the eggs. On the second day it comes out. Early in the afternoon it retires to the mound again and is partially covered up for the night by the assiduous father. On the third day the nestling is capable of strong flight."

Indiana Academy of Science.—The eleventh annual meeting of the Indiana Academy of Science was held in the State House at Indianapolis December 27th and 28th. The meeting was one of the best ever held. Over forty new members were elected. The address by the retiring president, Mr. A. W. Butler, on Indiana: A Century of Changes in the Aspects of Nature, was intensely interesting and very profitable. A poem by Mr. W. W. Pfrimmer, the "Kankakee poet," on The Naturalist, was a novel yet a pleasing feature. Many of the papers were worthy of special mention if space permitted. The Recent Earthquakes East of the Rocky Mountains, by A. H. Purdue, and Unconscious Mental Cerebration, by C. E. Newlin, were perhaps two of the most interesting. The report of the Biological Survey on Turkey Lake deservedly attracted much attention. The spring meeting will probably be held in joint session with the Ohio Academy near the State line. Officers for next year are as follows: President, Stanley Coulter, Purdue University; Vice-President, Thomas Gray-Rose, Polytechnic; Secretary, John S. Wright, Indianapolis; Assistant Secretary, A. J. Bigney, Moore's Hill College; Treasurer, W. P. Shannon, Greensburg.

A. J. Bigney,
Assistant Secretary.

Dirt-Eating.—The habit of dirt-eating among children is the subject of an interesting paper by Dr. John Thomson. He finds that it occurs in two classes of children: (1) In cases of ill health from tuberculosis, etc., anæmia being almost always a prominent symptom; and (2) in healthy children, the habit being formed in infancy and disappearing spontaneously when the children are about three years old. Dr. Thomson regards the habit in this latter class as analogous to thumb-sucking, perpetual rocking to and fro, or constant rolling in bed, in which some children find delight and which they lose when they pass out of infancy. The materials selected are chiefly wall plaster and cinders. One child varies the latter by pushing the hearth brush into the ashes and then licking the dust off as a great delicacy. The habit, as is well known, is common among imbeciles and idiots; but Dr. Thomson's cases were free from mental disorder. Dirt-eating may lead to serious consequences when the material eaten contains harmful matter. The native Egyptians, who, observing the marvelous fertilizing power of Nile mud, imagine it must be equally nutritious for men, habitually eat it, with the result of infecting themselves with the ova of anchylostoma, bilharzia, and other parasites.

Piano Touch.—When a certain point of perfection has been attained in piano-playing it becomes very hard to distinguish inequality of touch; yet, owing to the varying strength of the fingers, it is only with much practice that perfect equality is possible. An account of an apparatus for graphically registering these inequalities is given in a recent issue of Nature. The instrument was devised and used for experimental work by MM. Binet and Courtier. It is said to be simple in construction and very accurate. The advantages claimed for the instrument are threefold: (1) It is found that the voluntary movements of the pianist can be observed without putting him to any restraint or embarrassment, for the resistance of the keys is not affected nor is the exterior of the piano altered; (2) for teaching purposes the device has been found of great use; the record made on a roll of paper shows the faults so precisely that, although they are scarcely perceptible to the ear, there is no denying their existence; (3) written music can not show every slight change in time the composer might desire, but by applying the graphical method this difficulty is eliminated and the time will be reproduced with the smallest details.

The Cigar-Case Bearer.—A new fruit-tree pest has recently appeared in New York State, and is described in a bulletin from the Cornell Experiment Station. It is called the cigar-case bearer. Owing to its small size and peculiar habits, the insect in any stage will be rarely noticed by a fruit-grower, and yet the second one of the curious suits or cases which the little caterpillar wears is conspicuous enough to reveal its presence to the casual observer. The first suit is manufactured in the fall, to be worn all winter; but about the 15th of May the half-grown caterpillar finds this too small, and proceeds to make a summer suit which resembles a miniature cigar in shape and color. The first indication of the insect's presence occurs on the swelling buds of apple, pear, or plum trees. The work on the expanded foliage is seen in skeletonized dead areas, which have near their centers a clean-cut round hole through one skin, usually on the under side of the leaf. The caterpillars also often attack the growing fruit. It is only possible to fight the insect successfully in the caterpillar stage, and even then it requires very thorough work to destroy it.

A Contemplated Antarctic Expedition.—A committee has been formed in London to promote a mercantile and scientific antarctic expedition, and has already published its plan of operations. The scientific contingent, which will be accompanied by Mr. C. E. Borgrevink, will consist of twelve Englishmen trained in science, equipped with the necessary huts, dogs, sledges, etc., and will be left at Cape Adare, with the expectation of spending one year in South Victoria Land. The investigations will include the work of a land party toward the south magnetic pole, there to make magnetic observations; a survey of the coast line of the open bay, with exploration and soundings of fiords and bays; the making of zoölogical, botanical, mineralogical, and geological collections; dredging; and barometrical, thermometrical, meteorological, pendulum, air-current, and water-current observations. While the scientific men are thus exploring the land, the vessels will hunt whales, seals, etc., and expect to make three trips with their cargoes between the antarctic country and Melbourne. It is contemplated now that the expedition shall start about the 1st of September. Some money has been subscribed for the cost, but more is needed.

Mountain-climbing in Montana.—An article describing a trip of exploration to the Montana Rockies by L. W. Chaney, Jr., in a recent issue of Science, contains some interesting facts. In July last the party entered the mountains by the Great Northern road, which crosses the range about forty miles south of the international boundary, following on the western side of the divide the Middle Fork of the Flathead River. Twenty miles from the summit, at Two-Medicine Pass, is Belton Station. Here there falls into the fork a large and rapid mountain creek; it comes from Macdonald Lake, three miles away in the mountains to the northward. This lake is already much resorted to for fishing and camping purposes. At the northern end of it a small settlement exists, and from here the party started. After some unproductive explorations in a neighboring valley, they decided to try their fortunes farther north, and set out for a group of mines known as the International Camp, where the range, after sweeping northward from Lake Macdonald for thirty miles, turns quite abruptly to the west. This camp is sixty-five hundred feet above the sea. To the east is a saddle of the main range some two thousand feet above the camp. "To this saddle we then directed our attention, and the morning after our arrival we made the ascent, finding it not difficult. Immediately on stepping down from the rocks on the eastern side of the range we found an immense snowfield filling an amphitheater some four miles in diameter. As we crossed the snowfield to the east there appeared running parallel with the curving wall of the amphitheater lines upon the surface, whose significance we did not at first apprehend. Observations with the field glass soon indicated, what closer examination afterward confirmed, that these were long crevasses in the ice. We then knew that we stood upon the upper snowfields of a glacier not of great size, but in many respects very typical. Passing on to the eastern side of the amphitheater we ascended the rocky ridge which formed its boundary. Then suddenly there burst upon us one of the most tremendous mountain scenes any of the party had ever had the good fortune to witness. Sheer down below was a cliff which repeated experiments with falling rocks showed to be more than sixteen hundred feet of perpendicular precipice. From the base of this cliff the talus sloped down sharply to the bottom of the valley, no less than three thousand feet below. Around the northern end of the ridge on which we stood swept the glacier narrowed into a true ice river. As it broke over the cliff to plunge into the valley it was fractured with numerous crevasses. The largest was about twenty feet across, and into it plunged one of the surface streams which came down the glacier. Below in the valley lay a succession of lakes—the first of so deep and dark a blue that without hesitation we called it Emerald Lake. The moraine at the foot of the glacier was evidently almost entirely ground moraine. There were very few large rocks lying in a mass of finely divided gray detritus. Across this rushed the stream which came from the glacier." Some crude observations were made as to the rate of movement of the glacier; between two days there seemed to be a movement at the center of the mass of about two inches. Mr. Chaney commends these regions to those who wish to study mountain forms or glaciers and glaciation. "There is an abundant and very interesting fauna and flora, and on every side the majesty and glory of one of the noblest mountain ranges."

Commercial Liquid Air.—A method for the commercial preparation of liquid air has been devised by Herr Linde, and steps are being taken to put it into practical operation. The successive coolings to the critical temperature, which the chemists effect by the evaporation of other liquefied gases, are in this process brought about by successive compressions and expansions of gaseous air. With an adaptation of piston machinery a volume of air is greatly compressed, and its temperature, which has of course become very high, is reduced by a cooling process. The piston is then withdrawn and the cooled compressed air allowed suddenly to expand, when another and greater cooling takes place, and is communicated by an ingenious adjustment of the machinery to the air that is to be liquefied. The process is repeated, a lower temperature being reached at each repetition, till liquefaction is accomplished, and after this "a continuous stream of liquid air is merely a question of engine power." Further than this, the air during the process becomes steadily richer in oxygen, until that gas forms about seventy per cent of the product, pure enough for most of the purposes for which oxygen is used; and we have here a new source for the cheap supply of it.

The Scientific Alliance.—The Scientific Alliance of New York—which includes the resident active members of the New York Academy of Sciences, the Torrey Botanical Club, the Linnæan Society of New York, the New York Mineralogical Club, the American Mathematical Society, the New York Section of the American Chemical Society, and the New York Entomological Society—has nine hundred and thirty-nine members. An act of incorporation, formally accepted by all the societies, has been obtained from the Legislature of New York. Bulletins are issued about the 1st of each month from October to May, and announce most of the stated papers read before the societies. The list of the last year's papers includes upward of one hundred and eighty titles. A building committee has been appointed, but is at present awaiting the action of the trustees of the Tilden Trust upon a proposition made to them in 1892. Verbal assurances have been received from individual trustees that their plan of building contemplates giving the societies ample and very satisfactory accommodations in the building of the New York Public Library.

A New Variable Star.—The period of Wells's new variable star of the Algol type, known as B. D. + 17° 4367, has been ascertained at Harvard College Observatory to within a few seconds, and will probably be known within one second as soon as the form of light curve is determined. For nearly two hours before and after the minimum it is fainter than the twelfth magnitude. It increases at first very rapidly and then more slowly, and attains its full brightness, magnitude 9·5, about five hours after the minimum. Its variations may be explained by assuming that the star revolves around a comparatively dark body, and is totally eclipsed by it for two or three hours, the light at minimum, if any, being that of the dark body—a condition resembling those of U. Cephei. The variation in light of the new star is greater than that of any other star hitherto discovered.

A New Library Pest.—A comparatively recent importation, which is described in Insect Life, is the *Nicobium* (*Anobium*) *hirtum* Ill of the coleopterous family *Ptinidæ*. It is a native of southern Europe, but has been occasionally found in American libraries for a number of years. It seems now, however, to have become quite abundant, and is doing considerable damage in some of the older libraries of the Southern States. The larva of *Nicobium hirtum* does not differ in general appearance from other ptinid larvæ—i. e., it closely resembles a white grub in miniature, in shape and characteristic curvature of the body. It is covered with sparse but rather long hairs, while even a feeble magnifying glass will show numerous short, brownish spines, with which the larger portion of the dorsal surface is furnished. Although the legs are well developed, the larvæ are barely able to make use of them, and if shaken from the books they are unable to climb back to the shelves. They attack especially old books with soft paper and paper bindings. The beetle is of elongate, oval, cylindrical form, 0·12 to 0·16 inch in length, its color rather light brown, but rendered grayish by a dense, short, and somewhat velvety pubescence. This pubescence, however, does not uniformly cover the elytra, but is here absent on two or three transverse bands of which the anterior is usually quite distinct, while the two posterior ones are less clearly marked out and often confluent or broken up into spots. This peculiar arrangement of the pubescence, as well as the strongly punctate elytral striæ, render this species at once distinguishable from all other beetles which are liable to occur in the rooms of a library.

MINOR PARAGRAPHS.

While illustrating glacier movements to the British Association, Prof. W. J. Sollers said that pitch and glacier ice strikingly resemble each other in behaving as solids or liquids, according to circumstances. On the sudden application of force they are very brittle, but behave as fluids when subjected to gradual pull and pressure. Hence it is possible to employ pitch in the construction of working models of glaciers, in order to get an insight into those internal movements of real glaciers which are beyond the reach of actual observation. The study of glacial deposits has shown that many erratic bowlders are transported during the Glacial period from lower to higher levels hundreds of feet and left stranded on the rocky flanks of mountains. This standing difficulty in the way of physical theories of glacial movement has been explained by the study of pitch models, by means of which it is found that the lower layers of material, in approaching an obstacle, are carried up in an ascending current. The inference, which is confirmed by natural facts, is that similar movements would certainly take place in actual glaciers. Further, a glacier sometimes overrides its terminal without disturbing it, and in an experiment performed by the author this was exemplified, for pitch flowed for several months over a ridge of loose material without carrying a particle of it away.

Believing that the longest-tongued bees are the most profitable—they being able to extract honey from the greatest depths within the flowers yielding it—MM. Charton and Legros have devised methods for measuring bees' tongues. M. Charton's apparatus consists of a box covered with metallic netting, and having the bottom slightly inclined. On this bottom is spread a sweetened liquid which the bees can reach only by passing their tongues through the meshes of the netting. The hive whose bees can suck farthest down the inclined bottom is preserved as a stock for reproduction. M. Legros uses a receiver closed by a sheet of perforated tin plate, from which the sweetened liquid is fixed at carefully adjusted distances. M. Legros finds that the tongues of common unselected bees are 6·5 millimetres long, while the black French bees can extract sirup at a maximum distance of 9·2 millimetres. The tongues of the best American bees reach to 8·73 millimetres.

The domestic weeds of ancient civilization, the roadside weeds and the cornfield weeds, says W. B. Hemsley, in a recent issue of Knowledge, have accompanied man in his most distant wanderings, and in many instances have developed increased vigor, and a power of colonization unsurpassed by man himself. In some instances the reproduction and spread of these weeds are so rapid as to become a great scourge to agriculture, overrunning and destroying crops almost as effectually as swarms of locusts, and laws have been framed making it compulsory on farmers to keep their land free of these prolific strangers. During the last three or four years the so-called Russian thistle (*Salsola kali*, var. *tragus*) has been occupying the serious attention of the farmers of the Eastern and Central States of North America. Thousands of square miles are infested, and the loss resulting therefrom in 1892 was estimated to exceed two million dollars.

Prof. John Miln's report of eight thousand three hundred and thirty-one earthquake shocks recorded in Japan, in which the position of the origin of each shock and the extent of country disturbed by it are described, deals further with the propagation of earthquake disturbances on the surface of the earth, and possibly through it. Elastic gravitational waves travel in Japan, or thence to Europe, as surface waves at a rate of three thousand metres per second, increasing in period as they proceed; these are the earthquake disturbances proper. Preceding them in Japan are minute vibrations, and these apparently travel to Europe at a rate of from about eight thousand to ten thousand metres per second. It is suggested that they may travel, not along the surface, but through the mass of the earth, by some path, straight or curved; and that with a speed greater than would be expected if the globe were of glass or steel. Dr. Rebeur Paschnitz is of the opinion that if such be the case they may throw light on the internal structure of the globe.

NOTES.

At Bedford College (for women) in England a very commendable addition to the curriculum has recently been made in the establishing of a special course in hygiene. Students are required to devote themselves for one session at least to physiology, bacteriology, chemistry, and physics, practically as well as theoretically. It is ordinarily taught in a disconnected, half-hearted way, and has had to give way to subjects of much less importance. It is to be hoped that institutions in this country will take example from Bedford College.

In an article in the Chemical News on the places of argon and helium among the elements, R. M. Deeley says: The discovery of these two elements having small atomic weights has undoubtedly had the effect of greatly shaking the confidence of chemists in the periodic classification of the elements. Indeed, a disposition is often shown to place the periodic law altogether in the background and put undue faith in physical evidence, which is admitted to be inconclusive. The facts are then reviewed from the standpoint of the periodic law, and the difficulties of placing these new elements clearly shown. He closed his paper with the following paragraph: "Under such circumstances would it not be well to follow the indications of the periodic law and refraction equivalents, rather than a doubtful theory concerning the dynamics of the molecule?"

Three years ago M. Joseph F. Loubat, of Paris, offered prizes of one thousand dollars and four hundred dollars, to be awarded every fifth year to authors of the best works on the history, geography, archæology, ethnology, philology, or numismatics of North America within the period mentioned. A committee composed of Prof. H. T. Peck, of Columbia College; Dr. D. G. Brinton, of the University of Pennsylvania; and Prof. Henry C. Adams, the latter of whom was awarded the prize in 1893, will adjudicate essays and works for the next award in 1898.

The defect in ordinary photographing under which the colors fail to be rendered in their proper proportions of black and white is corrected in Mr. Bothamley's orthochromatic photography, by the use of minute quantities of certain dyes, which make the plate more sensitive to orange, yellow, and green rays. By this means colored objects of all kinds, including landscapes, are rendered in monochrome much more correctly.

Prof. Bailey, of the Harvard Observatory station at Arequipa, Peru, has discovered from an examination of the photographs obtained by him of certain globular star-clusters that they contain an extraordinary number of variable stars. This does not appear, however, to be a general condition of stellar clusters. In the cluster in Canes Venatici, Messier 3, eighty-seven stars have been proved to be variable. Sometimes the variation amounts to two magnitudes or more, and sometimes it does not appear to exceed half a magnitude. Forty-six variables were found in Messier 5. Some of these variables have short periods, not more than a few hours. All the cases included in these counts were confirmed by the independent examinations of the photographs by three persons. Other instances of variation were noticed, but are not included, because they have not been sufficiently tested.

Michael S. Bebb, a specialist in the botany of the willow, died in San Bernardino, Cal., December 5th. He was a son of Governor William Bebb, of Ohio, and was born at Hamilton, in that State, in 1833. He began his botanical studies when a boy, led to them probably by the flowers and shrubs in his father's garden, and using Torrey's Report upon the Flora of New York as his only guide and text-book. His family afterward removed to Illinois. Some years after the close of the war he began the systematic study of the willows, and made his first communication on them to the American Naturalist in 1874. He studied all the collections of these plants made in North America; described the California species in Brewer and Watson's Botany of California; the Southwestern species collected by Rothrock, in Wheeler's Report; the Colorado species in Coulter's Manual of the Botany of the Rocky Mountain Region; the species of the Eastern States in the last edition of Gray's Manual; determined the willows of British America for the Geological Survey of Canada; and has contributed to botanical journals many papers on American species of the genus.

Prof. George Lawson, of the chair of Chemistry in Dalhousie College, Halifax, N. S., who died in that city November 10th, was author of several papers on Canadian plants, published mostly in the Transactions of the Royal Society of Canada, and was an authority on the botany of the Maritime Provinces.

Dr. Francis Payne Poucher, a distinguished physician and botanist, died at Charleston, S. C., where he was Professor of Materia Medica and Therapeutics in the Medical College, November 19, 1895, aged about seventy years. He was editor of the Charleston Medical Journal and Review, and author of books on the Southern Fields and Forests; a Medico-botanical Catalogue of the Plants and Ferns of St. John's, Berkeley, S. C.; A Sketch of the Medical Botany of South Carolina; and the Medicinal, Poisonous, and Dietetic Properties of the Cryptogamic Plants of the United States.

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