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EDITED BY
WILLIAM JAY YOUMANS

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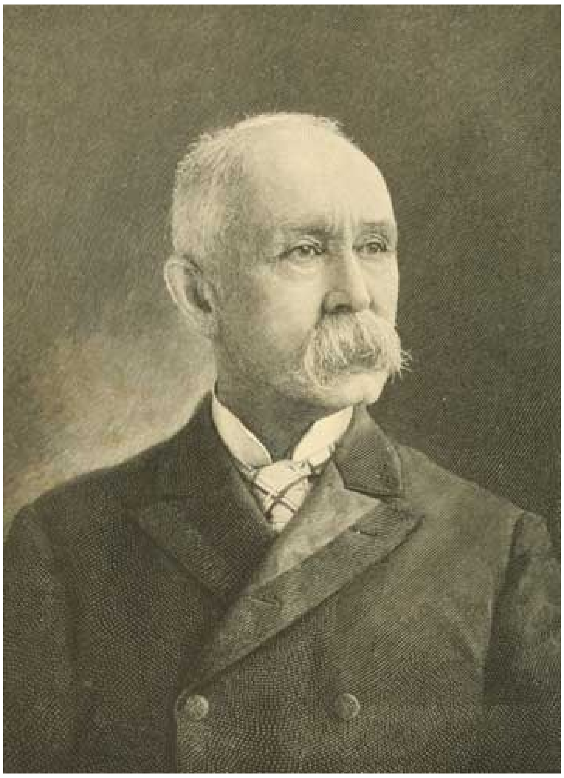

GEORGE M. STERNBERG.

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# APPLETONS' POPULAR SCIENCE MONTHLY.

NOVEMBER, 1899.


# THE REAL PROBLEMS OF DEMOCRACY.

**By FRANKLIN SMITH.**

Much has been written of late about "the real problems of democracy." According to some "thinkers," they consist of the invention of ingenious devices to prevent caucus frauds and the purchase of votes, to check the passage of special laws as well as too many laws, and to infuse into decent people an ardent desire to participate in the wrangles of politics. According to others, they consist of the invention of equally ingenious devices to compel corporations to manage their business in accordance with Christian principles, to transform the so-called natural monopolies into either State or municipal monopolies, and to effect, by means of the power of taxation, a more equitable distribution of wealth. According to still others, they consist of the invention of no less ingenious devices to force people to be temperate, to observe humanity toward children and animals, and to read and study what will make them model citizens. It is innocently and touchingly believed that with the solution of these problems, by the application of the authority that society has over the individual, "the social conscience" will be awakened. But such a belief can not be realized. It has its origin in a conception of democracy that has no foundation either in history or science. What are supposed to be the real problems of democracy are only the problems of despotism—the problems to which every tyrant from time immemorial has addressed himself, to the moral and industrial ruin of his subjects.

If democracy be conceived not as a form of political government under the *régime* of universal suffrage, but as a condition of freedom under moral control, permitting every man to do as he [Pg 2] likes, so long as he does not trench upon the equal right of every other man, deliverance from the sophistries and absurdities of current social and political discussion becomes easy and inevitable. Its real problems cease to be an endless succession of political devices that stimulate cunning and evasion, and countless encroachments upon individual freedom that stir up contention and ill feeling. Instead of being innumerable and complex, defying the solvent power of the greatest intellects and the efforts of the most enthusiastic philanthropists, they become few and simple. While their proper solution is beset with difficulties, these difficulties are not as hopeless as the framing of a statute to produce a growth of virtue in a depraved heart. Indeed, no such task has ever been accomplished, and every effort in that direction has been worse than futile. It has encouraged the growth of all the savage traits that ages of conflict have stamped so profoundly in the nervous system of the race. But let it be understood that the real problems of democracy are the problems of self-support and self-control, the problems that appeared with the appearance of human life, and that their sole solution is to be found in the application of precisely the same methods with which Nature disciplines the meanest of her creatures, then we may expect a measure of success from the efforts of social and political reformers; for freedom of thought and action, coupled with the punishment that comes from a failure to comply with the laws of life and the conditions of existence, creates an internal control far more potent than any law. It impels men to depend upon their own efforts to gain a livelihood; it inspires them with a respect for the right of others to do the same.

Simple and commonplace as the traits of self-support and self-control may seem, they are of transcendent importance. Every other trait sinks into insignificance. The society whose members have learned to care for themselves and to control themselves has no further moral or economic conquests to make. It will be in the happy condition dreamed of by all poets, philosophers, and philanthropists. There will be no destitution, for each person, being able to maintain himself and his family, will have no occasion, except in a case of a sudden and an unforeseen misfortune, to look to his friends and neighbors for aid. But in thus maintaining himself—that is, in pursuing the occupation best adapted to his ability and most congenial to his taste—he will contribute in the largest degree to the happiness of the other members of the community. While they are pursuing the occupations best adapted to their ability and most congenial to their tastes, they will be able to obtain from him, as he will be able to obtain from them, those things that both need to [Pg 3] supplement the products of their own industry. Since each will be left in full possession of all the fruits of his own toil, he will be at liberty to make just such use of them as will contribute most to his happiness, thus permitting the realization, in the only practicable way, of Bentham's principle of "the greatest happiness of the greatest number." Since all of them will be free to make such contracts as they believe will be most advantageous to them, exchanging what they are willing to part with for what some one else is willing to give in return, there will prevail the only equitable distribution of the returns from labor and capital. No one will receive more and no one less than he is entitled to. Thus will benefit be in proportion to merit, and the most scrupulous justice be satisfied.

But this *régime* of equity in the distribution of property implies, as I have already said, the possession of a high degree of self-control. Not only must all persons have such a keen sense of their own rights as will never permit them to submit to infringement, but they must have such a keen sense of the rights of others that they will not be guilty themselves of infringement. Not only will they refrain from the commission of those acts of aggression whose ill effects are immediate and obvious; they will refrain from those acts whose ill effects are remote and obscure. Although they will not, for example, deceive or steal or commit personal assaults, they will not urge the adoption of a policy that will injure the unknown members of other communities, like the Welsh tin-plate makers and the Vienna pearl-button makers that the McKinley Bill deprived of employment. Realizing the vice of the plea of the opponents of international copyright that cheap literature for a people is better than scrupulous honesty, they will not refuse to foreign authors the same protection to property that they demand. They will not, finally, allow themselves to take by compulsion or by persuasion the property of neighbors to be used to alleviate suffering or to disseminate knowledge in a way to weaken the moral and physical strength of their fellows. But the possession of a sense of justice so scrupulous assumes the possession of a fellow-feeling so vivid that it will allow no man to refuse all needful aid to the victims of misfortune. As suffering to others will mean suffering to himself, he will be as powerfully moved to go to their rescue as he would to protect himself against the same misfortune. Indeed, he will be moved, as all others will be moved, to undertake without compulsion all the benevolent work, be it charitable or educational, that may be necessary to aid those persons less fortunate than himself to obtain the greatest possible satisfaction out of life.

[Pg 4] But the methods of social reform now in greatest vogue do not contribute to the realization of any such millennium. They are a flagrant violation of the laws of life and the conditions of existence. They make difficult, if not impossible, the establishment of the moral government of a democracy that insures every man and woman not only freedom but also sustentation and protection. In disregard of the principles of biology, which demand that benefit shall be in proportion to merit, the feeble members of society are fostered at the expense of the strong. Setting at defiance the principles of psychology, which insist upon the cultivation of the clearest perception of the inseparable relation of cause and effect and the equally inseparable relation of aggression and punishment, honest people are turned into thieves and murderers, and thieves and murderers are taught to believe that no retribution awaits the commission of the foulest crime. Scornful of the principles of sociology, which teach in the plainest way that the institutions of feudalism are the products of war and can serve no other purpose than the promotion of aggression, a deliberate effort, born of the astonishing belief that they can be transformed into the agencies of progress, is made in time of peace to restore them to life.

To the American Philistine nothing is more indicative of the marvelous moral superiority of this age and country than the rapid increase in the public expenditures for enterprises "to benefit the people." Particularly enamored is he of the showy statistics of hospitals, asylums, reformatories, and other so-called charitable institutions supported by public taxation. "How unselfish we are!" he exclaims, swelling with pride as he points to them. "In what other age or in what other country has so much been done for the poor and unfortunate?" Naught shall ever be said by me against the desire to help others. The fellow-feeling that thrives upon the aid rendered to the sick and destitute I believe to be the most precious gift of civilization. Upon its growth depends the further moral advancement of the race. As I have already intimated, only as human beings are able to represent to themselves vividly the sufferings of others will they be moved to desist from the conduct that contributes to those sufferings. But the system of public charity that prevails in this country is not charity at all; it is a system of forcible public largesses, as odious and demoralizing as the one that contributed so powerfully to the downfall of Athens and Rome. By it money is extorted from the taxpayer with as little justification as the crime of the highwayman, and expended by politicians with as little love as he of their fellows. What is the result? Precisely
[Pg 5] what might be expected. He is infuriated because of the growing burden of his taxes. Instead of being made more humane and sympathetic with every dollar he gives under compulsion to the poor and suffering, he becomes more hard-hearted and bitter toward his fellows. The notion that society, as organized at present, is reducing him to poverty and degradation takes possession of him. He becomes an agitator for violent reforms that will only render his condition worse. At the same time the people he aids come to regard him simply as a person under obligations to care for them. They feel no more gratitude toward him than the wolf toward the victim of its hunger and ferocity.

Akin to public charity are all those public enterprises undertaken to ameliorate the condition of the poor—parks, model tenement houses, art galleries, free concerts, free baths, and relief works of all kinds. To these I must add all those Federal, State, and municipal enterprises, such as the post office with the proposed savings attachment, a State system of highways and waterways, municipal water, gas and electric works, etc., that are supposed to be of inestimable advantage to the same worthy class. These likewise fill the heart of the American Philistine with immense satisfaction. Although he finds, by his study of pleasing romances on municipal government in Europe, that we have yet to take some further steps before we fall as completely as the inhabitants of Paris and Berlin into the hands of municipal despotism, he is convinced that we have made gratifying headway, and that the outlook for complete subjection to that despotism is encouraging. But it should be remembered that splendid public libraries and public baths, and extensive and expensive systems of highways and municipal improvements, built under a modified form of the old *corvée*, are no measure of the fellow-feeling and enlightenment of a community. On the contrary, they indicate a pitiful incapacity to appreciate the rights of others, and are, therefore, a measure rather of the low degree of civilization. It should be remembered also, especially by the impoverished victims of the delusions of the legislative philanthropist, that there is no expenditure that yields a smaller return in the long run than public expenditure; that however honest the belief that public officials will do their duty as conscientiously and efficiently as private individuals, history has yet to record the fact of any bureaucracy; that however profound the conviction that the cost of these "public blessings" comes out of the pockets of the rich and is on that account particularly justifiable, it comes largely out of the pockets of the poor; and that by the amount abstracted from the income of labor and capital by that amount is the sum divided between labor and capital reduced.

[Pg 6] "But," interposes the optimist, "have the Americans not their great public-school system, unrivaled in the world, to check and finally to end the evils that appear thus far to be inseparably connected with popular government? Is there any truth more firmly established than that it is the

bulwark of American institutions, and that if we maintain it as it should be maintained they will be able to weather any storm that may threaten?" Precisely the same argument has been urged time out of mind in behalf of an ecclesiastical system supported at the expense of the taxpayer. Good men without number have believed, and have fought to maintain their belief, that only by the continuance of this form of aggression could society be saved from corruption and barbarism. Even in England to-day, where freedom and civilization have made their most brilliant conquests, this absurd contention is made to bolster up the rotten and tottering union of Church and state, and to justify the seizure of the property of taxpayers to support a particular form of ecclesiastical instruction. But no fact of history has received demonstrations more numerous and conclusive than that such instruction, whether Protestant or Catholic, Buddhist or Mohammedan, in the presence of the demoralizing forces of militant activities, is as impotent as the revolutions of the prayer wheel of a pious Hindu. To whatever country or people or age we may turn, we find that the spirit of the warrior tramples the spirit of the saint in the dust. Despite the lofty teachings of Socrates and Plato, the Athenians degenerated until the name of the Greek became synonymous with that of the blackest knave. With the noble examples and precepts of the Stoics in constant view, the Romans became beastlier than any beast. All through the middle ages and down to the present century the armies of ecclesiastics, the vast libraries of theology, and the myriads of homilies and prayers were impotent to prevent the social degradation that inundated the world with the outbreak of every great conflict. Take, for example, a page from the history of Spain. At the time of Philip II, who tried to make his people as rigid as monks, that country had no rival in its fanatical devotion to the Church, or its slavish observance of the forms of religion. Yet its moral as well as its intellectual and industrial life was sinking to the lowest level. Official corruption was rampant. The most shameless sexual laxity pervaded all ranks. The name of Spanish women, who had "in previous times been modest, almost austere and Oriental in their deportment," became a byword and a reproach throughout the world. "The ladies are naturally shameless," says Camille Borghese, the Pope's delegate to Madrid in 1593, "and even in the
[Pg 7] streets go up and address men unknown to them, looking upon it as a kind of heresy to be properly introduced. They admit all sorts of men to their conversation, and are not in the least scandalized at the most improper proposals being made to them." To see how ecclesiastics themselves fall a prey to the ethics of militant activities, becoming as heartless and debauched as any other class, take a page from Italian history at the time of Pope Alexander VI. "Crimes grosser than Scythian," says a pious Catholic who visited Rome, "acts of treachery worse than Carthaginian, are committed without disguise in the Vatican itself under the eyes of the Pope. There are rapines, murders, incests, debaucheries, cruelties exceeding those of the Neros and Caligulas." Similar pages from the history of every other country in Europe given up to war, including Protestant England, might be quoted.

But what is true of ecclesiastical effort in the presence of militant activities is true of pedagogic effort in the presence of political activities. For more than half a century the public-school system in its existing form has been in full and energetic operation. The money devoted to it every year now reaches the enormous total of one hundred and eighty million dollars. Simultaneously an unprecedented extension of secondary education has occurred. Since the war, colleges and universities, supported in whole or in part at the public expense, have been established in more than half of the States and Territories of the Union. To these must be added the phenomenal growth of normal schools, high schools, and academies, and of the equipment of the educational institutions already in existence. Yet, as a result, are the American people more moral than they were half a century ago? Have American institutions—that is, the institutions based upon the freedom of the individual—been made more secure? I venture to answer both questions with an emphatic negative. The construction and operation of the greatest machine of pedagogy recorded in history has been absolutely impotent to stem the rising tide of political corruption and social degeneration. If there are skeptics that doubt the truth of this indictment let them study the criminal history of the day that records the annual commission of more than six thousand suicides and more than ten thousand homicides, and the embezzlement of more than eleven million dollars. Let them study the lying pleas of the commercial interests of the country that demand protection against "the pauper labor of Europe," and thus commit a shameless aggression upon the pauper labor of America. Let them study the records of the deeds of intolerance and violence committed upon workingmen that refuse to exchange their personal liberty for membership of a despotic labor organization. Let them study the columns of the
[Pg 8] newspapers, crowded with records of crime, salacious stories, and ignorant comment on current questions and events that appeal to a population as unlettered and base as themselves. Let them study, finally, the appalling indictment of American political life, in a State where the native blood still runs pure in the veins of the majority of the inhabitants, that Mr. John Wanamaker framed in a great speech at the opening of his memorable campaign in Lancaster against the most powerful and most corrupt despotism that can be found outside of Russia or Turkey. "In the fourth century of Rome, in the time of Emperor Theodosius, Hellebichus was master of the forces," he said, endeavoring to describe a condition of affairs that exists in a similar degree in every State in the Union, "and Cæsarius was count of the offices. In the nineteenth century, M. S. Quay is count of the offices, and W. A. Andrews, Prince of Lexow, is master of forces in Pennsylvania, and we have to come through the iron age and the silver age to the worst of all ages—the degraded, evil age of conscienceless, debauched politics.... Profligacy and extravagance and boss rule everywhere oppress the people. By the multiplication of indictments your district attorney has multiplied his fees far beyond the joint salaries of both your judges. The administration of justice before the magistrates has degenerated into organized raids on the county treasury.... Voters are corruptly influenced or forcibly coerced to do the bidding of the bosses, and thus force the fetters of political vassalage on the freemen of the old guard. School

directors, supervisors, and magistrates, and the whole machinery of local government, are involved and dominated by this accursed system."

But Mr. Wanamaker might have added that the whole social and industrial life of the country is involved and dominated by the same system. It is a well-established law of social science that the evil effects of a dominant activity are not confined to the persons engaged in it. Like a contagion, they spread to every part of the social organization, and poison the life farthest removed from their origin. Yet the public-school system, so impotent to save us from social and political degradation and still such an object of unbounded pride and adulation, is, as Mr. Wanamaker, all unconscious of the implication of his scathing criticism, points out in so many words, an integral part of the vast and complex machinery that political despotism has seized upon to plunder and enslave the American people. As in the case of every other extension of the duties of government beyond the limits of the preservation of order and the enforcement of justice, it is an aggression upon the rights of the individual, and, as in the case of every other aggression, contributes
[Pg 9] powerfully to the decay of national character and free institutions. It adds thousands upon thousands to the constantly growing army of tax eaters that are impoverishing the people still striving against heavy odds to gain an honest livelihood. It places in the hands of the political despots now ruling the country, without the responsibility that the most odious monarchs have to bear, a revenue and an army of mercenaries that make more and more difficult emancipation from their shackles. It is doing more than anything else except the post-office department to teach people that there is no connection between merit and benefit; that they have the right to look to the State rather than to themselves for maintenance; that they are under no obligations to see that they do not take from others, in the form of salaries not earned nor intended to be earned, what does not belong to them. In the face of this wholesale destruction of fellow-feeling such as occurred in France under the old *régime* and is occurring to-day in Italy and Spain, and the inculcation of the ethics of militant activities, such as may be observed in these countries as well as elsewhere in Europe, is it any wonder that the mind-stuffing that goes on in the public schools has no more effect upon the morals of the American people than the creeds and prayers of the mediæval ecclesiastics that joined in wars and the spoliation of oppressed populations throughout Europe?

Since the path that all people under popular government as well as under forms more despotic are pursuing so energetically and hopefully leads to the certain destruction of the foundations of civilization, what is the path that social science points out? What must they do to prevent the extinction of the priceless acquisition of fellow-feeling, now vanishing so rapidly before the most unselfish efforts to promote it? The supposition is that the social teachings of the philosophy of evolution have no answer to these questions. Believing that they inculcate the hideous *laissez-faire* doctrine of "each for himself and the devil take the hindmost," so characteristic of human relations among all classes of people in this country, the victims of this supposition have repudiated them. But I propose to show that they are the only teachings that give the slightest promise of social amelioration. Although they are ignorantly stigmatized as individualistic, and therefore necessarily selfish and inconsiderate of the welfare of others, they are in reality socialistic in the best sense of the word—that is, they enjoin voluntary, not coercive, co-operation, and insure the noblest humanity and the most perfect civilization, moral as well as material, that can be attained.

Why a society organized upon the individualistic instead of the socialistic basis will realize every
[Pg 10] achievement admits of easy explanation. A man dependent upon himself is forced by the struggle for existence to exercise every faculty he possesses or can possibly develop to save himself and his progeny from extinction. Under such pitiless and irresistible pressure he acquires the highest physical and intellectual strength. Thus equipped with weapons absolutely indispensable in any state of society, whether civilized or uncivilized, he is prepared for the conquest of the world. He gains also the physical and moral courage needful to cope with the difficulties that terrify and paralyze the people that have not been subjected to the same rigid discipline. Energetic and self-reliant, he assails them with no thought of failure. If, however, he meets with reverses, he renews the attack, and repeats it until success finally comes to reward his efforts. Such prolonged struggles give steadiness and solidity to his character that do not permit him to abandon himself to trifles or to yield easily, if at all, to excitement and panic. He never falls a victim to Reigns of Terror. The more trying the times, the more self-possessed, clear-headed, and capable of grappling with the situation he becomes, and soon rises superior to it. With every triumph over difficulties there never fails to come the joy that more than balances the pain and suffering endured. But the pain and suffering are as precious as the joy of triumph. Indelibly registered in the nervous system, they enable their victim to feel as others feel passing through the same experience, and this fellow-feeling prompts him to render them the assistance they may need. In this way be becomes a philanthropist. Possessed of the abundant means that the success of his enterprises has placed in his hands, he is in a position to help them to a degree not within the reach nor the desires of the member of the society organized upon the socialistic basis.

In the briefest appeal to history may be found the amplest support for these deductions from the principles of social science. Wherever the individual has been given the largest freedom to do whatever he pleases, as long as he does not trench upon the equal freedom of others, there we witness all those achievements and discover all those traits that indicate an advanced state of social progress. The people are the most energetic, the most resourceful, the most prosperous, the most considerate and humane, the most anxious, and the most competent to care for their less fortunate fellows. On the other hand, wherever the individual has been most repressed, deterred by custom or legislation from making the most of himself in every way, there are to be observed social immobility or retrogression and all the hateful traits that belong to barbarians. The people are inert, slavish, cruel, and superstitious. In the ancient world one type of society is [Pg 11] represented by the Egyptians and Assyrians, and the other by the Greeks and Romans. In the modern world all the Oriental peoples, particularly the Hindus and Chinese, represent the former, and the Occidental peoples, particularly the Anglo-Saxons, represent the latter. So superior, in fact, are the Anglo-Saxons because of their observance of the sacred and fruitful principle of individual freedom that they control the most desirable parts of the earth's surface. If not checked by the practice of a philosophy that has destroyed all the great peoples of antiquity and paralyzed their competitors in the establishment of colonies in the New as well as the Old World, there is no reason to doubt that the time will eventually come when, like the Romans, there will be no other rule than theirs in all the choicest parts of the globe.

It is the immense material superiority of the Anglo-Saxon peoples over all other nations that first arrests attention. No people in Europe possess the capital or conduct the enterprises that the English and Americans do. They have more railroads, more steamships, more factories, more foundries, more warehouses, more of everything that requires wealth and energy than their rivals. Though the fact evokes the sneers of the Ruskins and Carlyles, these enterprises are the indispensable agents of civilization. They have done more for civilization, for the union of distant peoples, and the development of fellow-feeling—for all that makes life worth living—than all the art, literature, and theology ever produced. Without industry and commerce, which these devotees of "the higher life" never weary of deprecating, how would the inhabitants of the Italian republics have achieved the intellectual and artistic conquests that make them the admiration of every historian? The Stones of Venice could not have been written. The artists could not have lived that enabled Vassari to hand his name down to posterity. The new learning would have been a flower planted in a barren soil, and even before it had come to bud it would have fallen withered. May we not, therefore, expect that in like manner the wealth and freedom of the Anglo-Saxon race will bring forth fruits that shall not evoke scorn and contempt? Already their achievements in every field except painting, sculpture, and architecture eclipse those of their rivals. Not excepting the literature of the Greeks, is any so rich, varied, powerful, and voluminous as theirs? If they have no Cæsar or Napoleon, they have a long list of men that have been of infinitely greater use to civilization than those two products of militant barbarism. If judged by practical results, they are without rivals in the work of education. By their inventions and their [Pg 12] applications of the discoveries of science they have distanced all competitors in the race for industrial and commercial supremacy. In the work of philanthropy no people has done as much as they. The volume of their personal effort and pecuniary contributions to ameliorate the condition of the poor and unfortunate are without parallel in the annals of charity. Yet Professor Ely, echoing the opinion of Charles Booth and other misguided philanthropists, has the assurance to tell us that "individualism has broken down." It is the social philosophy that they are trying to thrust upon the world again that stands hopelessly condemned before the remorseless tribunal of universal experience.

In the light thus obtained from science and history, the duty of the American people toward the current social and political philosophy and all the quack measures it proposes for the amelioration of the condition of the unfortunate becomes clear and urgent. It is to pursue without equivocation or deviation the policy of larger and larger freedom for the individual that has given the Anglo-Saxon his superiority and present dominance in the world. To this end they should oppose with all possible vigor every proposed extension of the duty of the state that does not look to the preservation of order and the enforcement of justice. Regarding it as an onslaught of the forces of barbarism, they should make no compromise with it; they should fight it until freedom has triumphed. The next duty is to conquer the freedom they still lack. Here the battle must be for the suppression of the system of protective tariffs, for the transfer to private enterprise and beneficence, the duties of the post office, the public schools, and all public charities, for the repeal of all laws in regulation of trade and industry as well as those in regulation of habits and morals. As an inspiration it should be remembered that the struggle is not only for freedom but for honesty. For the truth can not be too loudly or too often proclaimed that every law taking a dollar from a man without his consent, or regulating his conduct not in accordance with his own notions, but in accordance with those of his neighbors, contributes to the education of a people in idleness and crime. The next duty is to encourage on every hand an appeal to voluntary effort to accomplish all tasks too great for the strength of the individual. Whether those tasks be moral, industrial, or educational, voluntary co-operation alone should assume them and carry them to a successful issue. The government should have no more to do with them than it has to do with the cultivation of wheat or the management of Sunday schools or the suppression of backbiting. The last and final duty should be to cheapen and, as fast as possible, to establish gratuitous justice. [Pg 13] With the great diminution of crime that would result from the observance of the duties already mentioned there would be much less occasion than now to appeal to the courts. But, whenever the occasion arises, it should involve no cost to the person that feels that his rights have been invaded.

Thus will be solved indirectly all the problems of democracy that social and political reformers seek in vain to solve directly. With the diminution of the duties of the state to the preservation of order and the enforcement of justice will be effected a reform as important and far reaching as the suppression of chronic warfare. When politicians are deprived of the immense plunder now involved in political warfare, it will not be necessary to devise futile plans for caucus reform, or ballot reform, or convention reform, or charter reform, or legislative reform. Having no more incentive to engage in their nefarious business than the smugglers that the abolition of the infamous tariff laws banished from Europe, they will disappear among the crowd of honest toilers. The suppression of the robberies of the tax collectors and tax eaters, who have become so vast an army in the United States, will effect also a solution of all labor problems. A society that permits every toiler to work for whomsoever he pleases and for whatever he pleases, protecting him in the full enjoyment of all the fruits of his labor, has done for him everything that can be done. It has taught him self-support and self-control. In thus guaranteeing him freedom of contract and putting an end to the plunder of a bureaucracy and privileged classes of private individuals, the beneficiaries of special legislation, it has effected the only equitable distribution of property possible. At the same time it has accomplished a vastly greater work. As I have shown, the indispensable condition of success of all movements for moral reform is the suppression not only of militant strife, but of political strife. While they prevail, all ecclesiastical and pedagogic efforts to better the condition of society must fail. Despite lectures, despite sermons and prayers, despite also literature and art, the ethics controlling the conduct of men and women will be those of war. But with the abolition of both forms of militant strife it becomes an easy task to teach the ethics of peace, and to establish a state of society that requires no other government than that of conscience. All the forces of industrialism contribute to the work and insure its success.

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> "This thirst for shooting every rare or unwonted kind of bird," says the author of an article in the London Saturday Review, "is accountable for the disappearance of many interesting forms of life in the British Islands."

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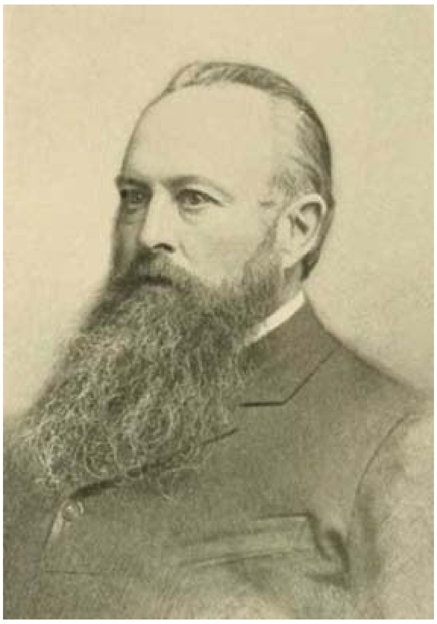
# AN ENGLISH UNIVERSITY.

**By HERBERT STOTESBURY.**

**Michael Foster, K. C. B., M. A., F. R. S., Trinity. Professor of Physiology.**

Most minds in America, as in England, if they think about the subject at all, impute to the two ancient centers of Anglo-Saxon learning—Oxford and Cambridge—an unquestionable supremacy. A halo of greatness surrounds these august institutions, none the less real because to the American mind, at least, it is vague. Half the books students at other institutions require in their various courses have the names of eminent Cambridge or Oxford men upon the fly leaf. Michael Foster's Physiology, Sidgwick's Methods of Ethics, and Bryce's American Commonwealth are recognized text-books wherever the subjects of which they treat are studied; while Sir G. G. Stokes, Jebb, Lord Acton, Caird, Max Müller, and Ray Lankester are as well known to students of Leland Stanford or Princeton as they are to Englishmen. One can scarcely read a work on English literature or open an English novel which does not make some reference to one or other of the great universities or their colleges, inseparably associated as they are with English life and history, past and present. Our oldest college owes its existence to John Harvard, of Emmanuel, Cambridge, and the name of the mother university still clings to her transatlantic offspring. The English institutions have become firmly associated in the vulgar mind with all that is dignified, venerable, and thorough in learning, but, beyond a vague sentiment of admiration, little adequate knowledge on the subject is abroad. American or German universities are organizations not very difficult to comprehend, and a vague knowledge of them is perhaps sufficient. The understanding, however, of those complicated academic communities, Oxford and Cambridge, is [Pg 15] a matter of intimate experience. They differ widely from their sister institutions in other countries, and in attempting to give some conception of their peculiarities the writer proposes to restrict himself chiefly to Cambridge, because there are not very many striking differences between the latter and Oxford, and because the scientific supremacy of Cambridge is sufficiently established to render her an object of greater interest to the readers of the Science Monthly.

First of all, it must be borne in mind that throughout most of their history these institutions have been closely related, not to the body of the people, but to the aristocracy. This was not so much the case at first, before the university became an aggregate of colleges. Then a rather poor and humble class were enabled, through the small expense involved, to acquire the rudiments of an education, and even to become proficient in the scholastic dialectic. But ere long, and with the gradual endowment of different colleges, the expenses of a student became much greater, and, save where scholarships could be obtained, it required some affluence before parents could afford to give their sons an academic training. Hence, the more fortunate or aristocratic classes



**The Right Hon. Lord Acton, M. A., LL. D., Trinity. Professor of Modern History.**

came in time to contribute the large majority of the student body. Those whose intellectual attainments were so unusual as to constitute ways and means have never been debarred, but impecunious mediocrity had and still has little place or opportunity. It is well to remember, in addition, that the Church fostered these universities in their infancy, that it deserves unqualified credit for having nursed them through their early months, and that it continues to have some considerable influence over the modern institutions. Finally, the growth of Cambridge and Oxford has largely been occasioned by lack of rivals in their own class. In this branch or that, other institutions have become deservedly
[Pg 16] famous. Edinburgh has a high reputation in moral science; Manchester is renowned for her physics, chemistry, and engineering; and London for her medical schools. But Oxford and Cambridge are strong in many branches. Financially powerful, they are able to attract the majority of promising and eminent men, whence has resulted that remarkable *coterie* of unrivaled intellects through whom the above-named universities are chiefly known to the outer and foreign world. This characteristic has its opposite illustrated in the United States, where the tendency is centrifugal, no one or two universities or colleges having advantages so decided as inevitably to attract most of the best minds, and where, in consequence, the best minds are found scattered from California to Harvard and Pennsylvania.

**J. J. Thomson, M. A., F. R. S., Trinity. Professor of Experimental Physics.**

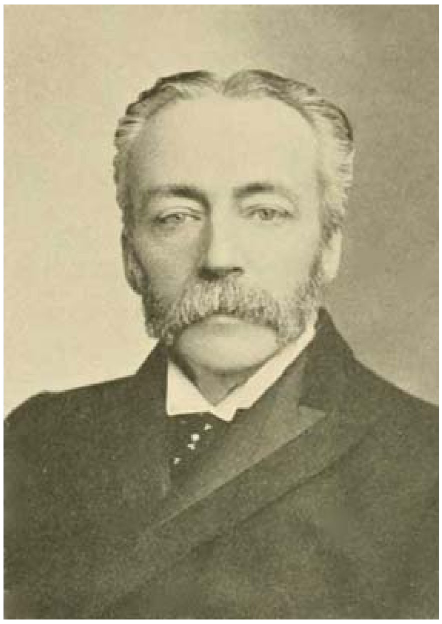
The characteristic peculiar to Cambridge and Oxford, and which distinguishes them not only from American but also from all other universities in England and elsewhere, is the college system. Thus Cambridge is a collection of eighteen colleges which, though nominally united to form one institution, are really distinct, inasmuch as each is a separate community with its own buildings and grounds, its own resident students, its own lecturers, and Fellows—a community which is supported by its own moneys without aid from the university exchequer, and which in most matters legislates for itself. The system is not unlike the American Union on a small scale, with its cluster of governments and their relation to a supreme center. The advantages of this scheme might theoretically be very great. With each college handsomely endowed and, though managing its own affairs, entering freely, in addition, into those relations of reciprocity which make for the good of the whole, one can readily imagine an ideal academic commonwealth. And while the present condition of the university can scarcely be said to approximate very closely
[Pg 17] to such an academic Utopia, it yet derives from its constitution numerous obvious advantages which universities otherwise constituted would and do undoubtedly lack. The chief evils besetting the university are perhaps more adventitious than inherent; they are largely financial, and arise from carrying the system of college individualism too far. A description of the college and university organization may make this apparent. By its endowment a college must support a certain number of Fellows and scholars. The latter form a temporary body, while the former are more or less permanent, and therefore upon them devolves the management of the college. Business is usually done by a council chosen from the Fellows, and the election of new Fellows to fill vacancies is made by this select body. The head of a college is known as the master; he is elected by the Fellows save in one or two cases, where his appointment rests with the crown or with certain wealthy individuals. He lives in the college lodge especially built for him, draws a salary large in proportion to the wealth of his college, and exerts an influence corresponding to his intelligence.

The Fellows are in most cases chosen from those men who have achieved the greatest success in an honor course. At Cambridge College individualism has progressed so far that the Fellows of, say, Magdalen must be Magdalen men, the students of Queens', St Catherine's, or any other being ineligible save for their own fellowships. Oxford obtains perhaps better men on the whole by throwing open the fellowships of each particular college to the graduates of all, thus producing a wider competition. A fellowship until recently was tenable for life, but it has been reduced to about six years, the Fellows as a whole, however, retaining the power to extend the period of possession. And, further, the holding of a college office for fifteen years in general
[Pg 18] qualifies for the holding of a fellowship for life, and for a pension as lecturer or tutor. Thus a man is able to devote himself to research with little fear that at the latter end of his career he will lack the means of support. It is perhaps not too much to say that the offices of college dean, tutor, and

**G. H. Darwin, M. A., F. R. S., Trinity. Plumian Professor of Astronomy.**

lecturer are more perquisites than anything else. They are meant to keep and attract men of ability and parts. However, their existence reacts upon the student body by augmenting the expenses of the latter out of proportion to the benefits to be obtained. For instance, instead of utilizing one set of lecturers for one class of subjects, which all students could attend for a small fee, each of the larger colleges, at any rate, pays special lecturers, drawn from its own Fellows, to speak upon the same subjects each to a mere handful of men from their own college only. The tutor is another luxury inherited from the middle ages and therefore retained, and one for which the students have to pay dearly. The chief business of the tutor is not to teach, but to "look after" a certain number of students who are theoretically relegated to his charge. He looks up their lodgings for them, pays their bills at the end of the term, gets them out of scrapes, and draws a large salary. The tutorships seem to the writer to be a good illustration of how an office necessary to one period persists after that for which it was instituted has ceased to exist. When the students of Oxford and Cambridge were many of them thirteen and fourteen years of age, as in the fourteenth century, nurses were doubtless necessary, but they are still retained when the greater maturity of the students renders them not only unnecessary but at times even an impertinence.

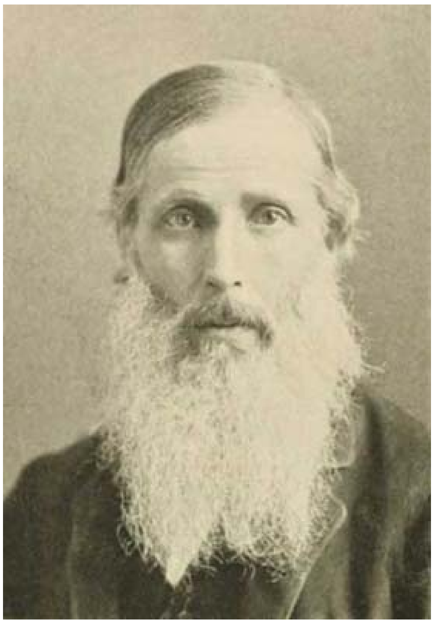
The dean is not, as with us, the head of a department; his functions are not so many, his tasks far less onerous. It is before a college dean that students are "hauled" for such offenses as irregularity at chapel, returning to the college after 12 P. M., smoking in college precincts, bringing dogs into the college grounds, and other villainous offenses against regulations. A dean must also attend chapel. Some colleges require two deans to struggle through these complicated and laborious duties, though some possessing only a few dozen students succeed in getting along with one.



**R. C. Jebb, Litt. D., M. P., Trinity. Regius Professor of Greek.**

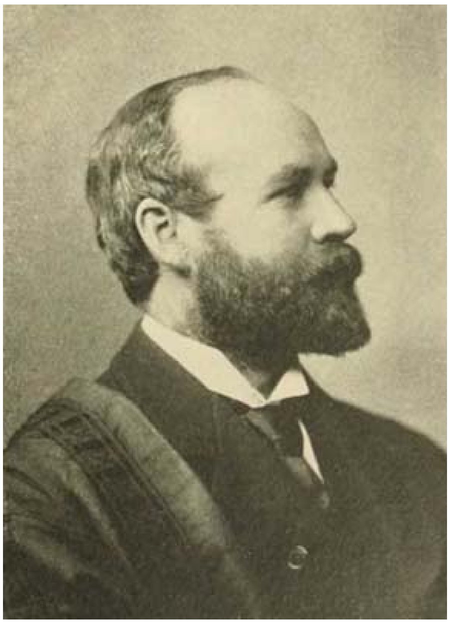
The line of demarcation between the university and the colleges is very distinct. The legislative influence of the former extends over a comparatively restricted field. All professorial chairs and certain lectureships belong to and are paid by the university; the latter has the arranging of the curricula, the care of the laboratories, the disposition of certain noncollegiate scholarships; but, broadly speaking, its two functions are the examination of all students and the [Pg 19] conferring of degrees. The supreme legislative body is the senate, and it is composed of all masters of arts, doctors, and bachelors of divinity whose names still remain on the university books—that is, who continue to pay certain fees into the university treasury. In addition to the legislative body there is an executive head or council of nineteen, including the chancellor—at present the Duke of Devonshire—and the vice-chancellor. Both these bodies must govern according to the statutes, no alteration in which can be effected without recourse being had to Parliament. The senate is a peculiar body, and on occasions becomes somewhat unwieldy. It consists at present of some 6,800 members, of whom only 452 are in residence at Cambridge. Upon ordinary occasions only these 452 vote upon questions proposed by the council; but on occasions of great moment, as when the question of granting university degrees to women came up, some thousands or more of the nonresident members, who in many cases have lost touch with the modern university and modern systems of education, swarm to their alma mater, annihilate the champions of reform, and are hailed by their brethren as the saviors of their university.

The university's exchequer is supplied partly by its endowment, but chiefly by an assessment on the college incomes, a capitation tax on all undergraduates, and the fees attending matriculation, examinations, and the granting of degrees. The examinations are numerous. Every student on entering is required to pass, or to claim exemption from, an entrance examination. In either case he pays £3 to the university, and upon admission to any honor course or "tripos" to qualify for the degree of Bachelor of Arts £3 more is exacted. The income of the university from these examination fees alone amounts to £9,400 per annum, £4,600 of which goes to pay the examiners. In America this is supposed to be a part of the professor's or instructor's duty, no [Pg 20] additional remuneration is allowed, and hence it does not become necessary to make an additional tax upon the students' resources. The conferring of degrees is also made a very profitable affair. Each candidate for the degree of B. A. pays out £7 to the voracious 'varsity chest, and upon proceeding to the M. A. a further contribution of £12 is requested. In this way the university makes about £12,000 a year, and, as though this was not sufficient, she requires a



**Henry Sidgwick, Litt. D., Trinity. Knightbridge Professor of Moral Philosophy.**

matriculation fee of £5 for every student who becomes a member. By this means another annual £5,000 is obtained. It must be remembered that these fees are entirely separate from the college fees. When the £5 matriculation for the latter is taken into consideration and the £8 a term (at Trinity) for lectures, two thirds of which the student does not attend, when it is understood that all this and more does not include living expenses, which are by no means slight, and that there are three terms instead of two, as with us, it will be obvious that Cambridge adheres very closely to the rule that to them only who have wealth shall her refining influence be given. That the greatest universities in existence should render it almost totally impossible for aught but the rich to obtain the advantages of their unusual educational facilities jars with that idea of democracy of learning which an American training is apt to foster. But, as we shall point out later, an aristocracy of learning may also have its uses.



**Donald MacAlister, M. A., M. D., St. Johns. Linacre Lecturer of Physics.**

With all the revenues the university collects from colleges and students, amounting in all to about £65,000, Cambridge still finds herself poor. Some of the colleges, notably King's and Trinity, are extremely wealthy, but the university remains, if not exactly impecunious, at least on the ragged edge of financial difficulties. The various regius and other professorships, inadequately endowed by the munificence [Pg 21] of the crown and of individuals, have each to be augmented from the university chest. The continual repairing of the old laboratories and scientific apparatus, the salaries to lecturers, to proctors, bedells, and other officers, cause a continual drain on the exchequer, which, with the rapidly growing need for larger laboratories and newer apparatus, has finally resulted in an appeal to the country for the sum of half a million pounds.

It has been seen that the drains on a student's pocket are very considerable at Cambridge, owing to the number of perquisites showered by the colleges on their Fellows, and it may appear that this state of things is unjust and wrong. At present Oxford and Cambridge are practically within the reach of only the moneyed population. According, however, to a plausible and frequently repeated theory, it is not the function of these universities to meet the educational needs of the mediocre poor. The writer's critical attitude toward the financial system in vogue at Cambridge is a proper one, only on the assumption that a maximum of education to all classes alike at a minimum of expense is the final cause and desideratum of a university's existence. But if one assumes that Oxford and Cambridge exist for a different purpose, that the chief end they propose to themselves is individual research, and the advancement, not the promulgation, of learning, it must be admitted that their system has little that is reprehensible. According to this standpoint the students only exist by courtesy of the dons (a name for the Fellows), who have a perfect right to impose upon the students, in return for the condescension which is shown them, what terms they see fit. And they argue that this view is the historic one. The colleges were originally endowed solely for the benefit of a certain limited number of Fellows and scholars. The undergraduate body, as it at present exists, is a later growth, whose eventual existence and the importance of which to the university was [Pg 22] probably not anticipated by the college founders. Starting with this, the defenders of the present *régime* would point out, in addition, that there are other English institutions where the poorer classes may be educated, that Cambridge and Oxford are not only not bound to take upon themselves this task, but that they actually subserve a higher purpose and one just as necessary to the development of English science and letters and to the education of the English intellect by specializing in another direction. The good of a philosopher's lifelong reflections, they would say, is not always manifest, but the teachers who instruct the nation's youth are themselves dependent for rational standpoints upon the labor of the greater teacher, and they act as the instruments of communication between the most learned and the unlettered. So Oxford and Cambridge are the sources from whose fountains of wisdom and culture flow streams supplying all the academic mills of Britain, which in their turn are enabled to feed the inhabitants. It would be absurd, they maintain, to insist that the streams and the mills could equally well fulfill the same functions. Cambridge and Oxford instruct just so far as so doing is compatible with what for them is the main end—the furthering of various kinds of research and the offering of all sorts of inducements in order to keep and attract the interested attention of classical butterflies and scientific worms. How well they succeed in this noble ambition is known throughout the civilized world.

Mr. G. H. Darwin, a son of Charles Darwin, has recently had occasion to mention the enormous scientific output of Cambridge University. After saying that the Royal Society is the Academy of Sciences in England, and that in its publications appear accounts of all the most important scientific discoveries in England and most of those in Scotland, Ireland, and other parts of Europe, he goes on to state that he examined the Transactions of this society for three years and discovered that out of the 5,480 pages published in that time 2,418 were contributed by Cambridge men and 1,324 by residents.

In view of these facts, and despite the shortcomings of this university as a teaching institution, it is to be hoped that private generosity will answer her appeal for financial assistance. Her laboratories are a mine of research, and it is in them and in the men who conduct them that Cambridge is perhaps most to be admired.

**Sir G. G. Stokes, Bart., M. A., LL. D., Sc. D., F. R. S., Pembroke. Lucasian Professor of Mathematics.**

The Cavendish Laboratory of Physics, where Clerk-Maxwell and afterward Lord Rayleigh taught, and which is at present in the hand of their able successor, J. J. Thomson, is a building of considerable size and admirably fitted out, but the rapidly increasing number of young physicists who are being allured by the working facilities of the place, and [Pg 23] by the fame of Professor Thomson, is rendering even this splendidly equipped hall of science inadequate. The physiological laboratories are many, they are completely furnished with appliances, and a large number of students are there trained annually under the supervision of one of England's most eminent living scientists, Michael Foster, and his scarcely less able associates—Langley, Hardy, and Gaskell. Chemistry, zoölogy, botany, anatomy, and geology have each their well-appointed halls and masterly exponents. The names MacAlister, Liveing, Dewar, Newton, Sedgwick, Marshall Ward, and Hughes are not easily matched in any other one institution. Indeed, it is when one stops to consider the intellects at Cambridge that it becomes a dangerous matter to institute comparisons, and to say that this discipline or that is most rich in eminent interpreters. In science, at any rate, and in all branches of science, Cambridge stands alone. Not even Oxford can be considered for a moment as in the same class with her. And of all the sciences it is undoubtedly in mathematics and astronomy that the supremacy of Cambridge is most pronounced. The names of Profs. Sir G. G. Stokes and Sir R. S. Ball will be familiar to every reader, while those of Profs. Forsythe and G. H. Darwin and Mr. Baker will be familiar to all mathematicians. In classics Cambridge, while not possessing a similar monopoly of almost all the talent, still holds her own even with Oxford. Professors Jebb, Mayor, and Ridgeway, and Drs. Verrall, Jackson, and Frazer constitute a group of men second to none in the subjects of which they treat. Professor Jebb is also one of the university's two representatives in Parliament. In philosophy Cambridge has two men, Henry Sidgwick and James Ward, the former of whom is perhaps by common consent the first living authority on moral science, while the latter ranks among the first of living psychologists. These men, while representing very different [Pg 24] philosophical standpoints, unite in opposition not only to the Hegelian movement, which, led by Caird and Bradley of Oxford, Seth and Stirling of Edinburgh, threatens the invasion of England, but also to the Spencerian philosophy. The latter system has not many adherents at either university, but the writer has been told by Professor Sully that the ascendency of the neo-Hegelian and other systems is by no means so pronounced elsewhere in England. The Spencerian biology, on the contrary, has been largely defended at Cambridge, while Weismannism, for the most part, is repudiated there and at Oxford.

The teaching at Cambridge, as at all universities, is of many grades. In many subjects the lectures are not meant to give a student sufficient material to get him through an examination, and a "coach" becomes requisite, or at any rate is employed. This system of coaching has attained large dimensions; its results are often good, but it means an additional expense and seems an incentive to laziness, making it unnecessary for a student to exert his own mental aggressiveness or powers of application as he who fights his own battles must do. The Socratic form of instruction, producing a more intimate and unrestricted relation between instructor and student, and which is largely in operation in the States, is little practiced in England. In science the methods of instruction at Cambridge are ideal. That practical acquaintance with the facts of Nature which Huxley and Tyndall taught is the only true means of knowing Nature, is the key according to which all biological and physical instruction at these institutions is conducted.

In the last half dozen years two radical steps have been taken by both Oxford and Cambridge—steps leading, to many respectable minds, in diametrically opposite directions. The step backward (in the writer's view) occurred when the universities, after much excitement, defeated [Pg 25] with slaughter the proposition granting university degrees to women. It was simply proposed that the students of Newnham and Girton, who should successfully compete with male students in an honor course, should have an equal right with the latter to receive the usual degrees from their alma mater. After industrious inquiry among those who were foremost in supporting and opposing this movement the writer has unearthed no objection of weight against the change. "If the women were granted degrees they would have votes in the senate," and "It never has been done"—these are the two reasons most persistently urged in defense of the conservative view; while justice and utility alike appear to be for once, at any rate, unequivocally on the side of the women. Prejudice defeated progress, and students celebrated the auspicious occasion with bonfires. The step forward was taken when the universities and their colleges decided to throw open their gates to the graduates of other universities in England, America, and elsewhere for the purpose of advanced study. But here, as in other things, Cambridge leads the way, and Oxford follows falteringly. The advanced students at Cambridge are treated like Cambridge men, they have the status of Bachelors of Arts, and possess in most respects the advantages, such as they are, of the latter; while at Oxford the advanced students are a restricted class, with restricted advantages, and their relation to the university is not that of the other students. In Cambridge the movement which has resulted in the present admirable condition of affairs was largely brought about by the zeal and enterprise of Dr. Donald MacAlister, of St. John's College, the University Lecturer in Therapeutics, a man of wide sympathies and ability, and whose name is closely associated with this university's metamorphosis into a more modern institution.

**James Ward, Sc. D., Trinity. Professor of Mental Philosophy and Logic.**

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# THE WONDERFUL CENTURY.[1]

### A REVIEW BY W. K. BROOKS,

PROFESSOR OF ZOÖLOGY IN THE JOHNS HOPKINS UNIVERSITY.

Every naturalist has in his heart a warm affection for the author of the Malay Archipelago, and is glad to acknowledge with gratitude his debt to this great explorer and thinker and teacher who gave us the law of natural selection independently of Darwin. When the history of our century is written, the foremost place among those who have guided the thought of their generation and opened new fields for discovery will assuredly be given to Wallace and Darwin.



Few of the great men who have helped to make our century memorable in the history of thought are witnesses of its end, and all who have profited by the labors of Wallace will rejoice that he has been permitted to stand on the threshold of a new century, and, reviewing the past, to give us his impressions of the wonderful century.

We men of the nineteenth century, he says, have not been slow to praise it. The wise and the foolish, the learned and the unlearned, the poet and the pressman, the rich and the poor, alike swell the chorus of admiration for the marvelous inventions and discoveries of our own age, and especially for those innumerable applications of science which now form part of our daily life, and which remind us every hour of our immense superiority over our comparatively ignorant forefathers.

Our century, he tells us, has been characterized by a marvelous and altogether unprecedented progress in the knowledge of the universe and of its complex forces, and also in the application of that knowledge to an infinite variety of purposes calculated, if properly utilized, to supply all the wants of every human being and to add greatly to the comforts, the enjoyments, and the refinements of life. The bounds of human knowledge have been so far extended that new vistas have opened to us in nearly all directions where it had been thought that we could never penetrate, and the more we learn the more we seem capable of learning in the ever-widening expanse of the universe. It may, he says, be truly said of the men of science that they have become as gods knowing good and evil, since they have been able not only to utilize the most recondite powers of Nature in their service, but have in many cases been able to discover the sources of much of the evil that afflicts humanity, to abolish pain, to lengthen life, and to add immensely to the intellectual as well as the physical enjoyments of our race.

In order to get any adequate measure for comparison with the nineteenth century we must take not any preceding century, but the whole preceding epoch of human history. We must take into consideration not only the changes effected in science, in the arts, in the possibilities of human intercourse, and in the extension of our knowledge both of the earth and of the whole visible universe, but the means our century has furnished for future advancement.

Our author, who has borne such a distinguished part in the intellectual progress of our century, shows clearly that in means for the discovery of truth, for the extension of our control over

Nature, and for the alleviation of the ills that beset mankind, the inheritance of the twentieth [Pg 27] century from the nineteenth will be greater than our own inheritance from all the centuries that have gone before.

Some may regret that, while only one third of Wallace's book is devoted to the successes of the wonderful century, the author finds the remaining two thirds none too much for the enumeration of some of its most notable failures; but it is natural for one who has borne his own distinguished part in all this marvelous progress to ask where the century has fallen short of the enthusiastic hopes of its leaders, what that it might have done it has failed to do, and what lies ready at the hand of the workers who will begin the new century with this rich inheritance of new thoughts, new methods, and new resources.

The more we realize the vast possibilities of human welfare which science has given us the more, he says, must we recognize our total failure to make any adequate use of them.

Along with this continuous progress in science, in the arts, and in wealth-production, which has dazzled our imaginations to such an extent that we can hardly admit the possibility of any serious evils having accompanied or been caused by it, there has, he says, been many serious failures—intellectual, social, and moral. Some of our great thinkers, he says, have been so impressed by the terrible nature of these failures that they have doubted whether the final result of the work of the century has any balance of good over evil, of happiness over misery, for mankind at large.

Wallace is no pessimist, but one who believes that the first step in retrieving our failures is to perceive clearly where we have failed, for he says there can be no doubt of the magnitude of the evils that have grown up or persisted in the midst of all our triumphs over natural forces and our unprecedented growth in wealth and luxury, and he holds it not the least important part of his work to call attention to some of these failures.

With ample knowledge of the sources of health, we allow and even compel the bulk of our population to live and work under conditions which greatly shorten life. In our mad race for wealth we have made gold more sacred than human life; we have made life so hard for many that suicide and insanity and crime are alike increasing. The struggle for wealth has been accompanied by a reckless destruction of the stored-up products of Nature, which is even more deplorable because irretrievable. Not only have forest growths of many hundred years been cleared away, often with disastrous consequences, but the whole of the mineral treasures of the earth's surface, the slow productions of long-past eras of time and geological change, have been and are still being exhausted with reckless disregard of our duties to posterity and solely in the [Pg 28] interest of landlords and capitalists. With all our labor-saving machinery and all our command over the forces of Nature, the struggle for existence has become more fierce than ever before, and year by year an ever-increasing proportion of our people sink into paupers' graves.

When the brightness of future ages shall have dimmed the glamour of our material progress he says that the judgment of history will surely be that our ethical standard was low and that we were unworthy to possess the great and beneficent powers that science had placed in our hands, for, instead of devoting the highest powers of our greatest men to remedy these evils, we see the governments of the most advanced nations arming their people to the teeth and expending most of the wealth and all the resources of their science in preparation for the destruction of life, of property, and of happiness.

He reminds us that the first International Exhibition, in 1851, fostered the hope that men would soon perceive that peace and commercial intercourse are essential to national well-being. Poets and statesmen joined in hailing the dawn of an era of peaceful industry, and exposition following exposition taught the nations how much they have to learn from each other and how much to give to each other for the benefit and happiness of all.

Dueling, which had long prevailed, in spite of its absurdity and harmfulness, as a means of settling disputes, was practically abolished by the general diffusion of a spirit of intolerance of private war; and as the same public opinion which condemns it should, if consistent, also condemn war between nations, many thought they perceived the dawn of a wiser policy between nations.

Yet so far are we from progress toward its abolition that the latter half of the century has witnessed not the decay, but a revival of the war spirit, and at its end we find all nations loaded with the burden of increasing armies and navies.

The armies are continually being equipped with new and more deadly weapons at a cost which strains the resources of even the most wealthy nations and impoverishes the mass of the people by increasing burdens of debt and taxation, and all this as a means of settling disputes which have no sufficient cause and no relation whatever to the well-being of the communities which engage in them.

The evils of war do not cease with the awful loss of life and destruction of property which are their immediate results, since they form the excuse for inordinate increase of armaments—an increase which has been intensified by the application to war purposes of those mechanical [Pg 29] inventions and scientific discoveries which, properly used, should bring peace and plenty to all, but which when seized upon by the spirit of militarism directly lead to enmity among nations and to the misery of the people.

The first steps in this military development were the adoption of a new rifle by the Prussian army in 1846, the application of steam to ships of war in 1840, and the use of armor for battle ships in 1859. The remainder of the century has witnessed a mad race between the nations to increase the death-dealing power of their weapons and to add to the number and efficiency of their armies, while all the resources of modern science have been utilized in order to add to the destructive power of cannon and both the defensive and the offensive power of ships. The inability of industrious laboring men to gain any due share of the benefits of our progress in scientific knowledge is due, beyond everything else, to the expense of withdrawing great armies of men in the prime of life from productive labor, joined to the burden of feeding and clothing them and of keeping weapons and ammunition, ships, and fortifications in a state of readiness, of continually renewing stores of all kinds, of pensions, and of all the laboring men who must, besides making good the destruction caused by war, be withdrawn from productive labor and be supported by others that they may support the army.

And what a horrible mockery is this when viewed in the light of either Christianity or advancing civilization! All the nations armed to the teeth and watching stealthily for some occasion to use their vast armaments for their own aggrandizement and for the injury of their neighbors are Christian nations, but their Christian governments do not exist for the good of the governed, still less for the good of humanity or civilization, but for the aggrandizement and greed and lust of the ruling classes.

The devastation caused by the tyrants and conquerors of the middle ages and of antiquity has been reproduced in our times by the rush to obtain wealth. Even the lust of conquest, in order to obtain slaves and tribute and great estates, by means of which the ruling classes could live in boundless luxury, so characteristic of the earlier civilization, is reproduced in our time.

Witness the recent conduct of the nations of Europe toward Crete and Greece, upholding the most terrible despotism in the world because each hopes for a favorable opportunity to obtain some advantage, leading ultimately to the largest share of the spoil.

Witness the struggles in Africa and Asia, where millions of foreign people may be enslaved and bled for the benefit of their new rulers.

[Pg 30] The whole world, says Wallace, is but a gambling table. Just as gambling deteriorates and demoralizes the individual, so the greed for dominion demoralizes governments. The welfare of the people is little cared for, except so far as to make them submissive taxpayers, enabling the ruling and moneyed classes to extend their sway over new territories and to create well-paid places and exciting work for their sons and relatives.

Hence, says Wallace, comes the force that ever urges on the increase of armaments and the extension of empire. Great vested interests are at stake, and ever-growing pressure is brought to bear upon the too-willing governments in the name of the greatness of the country, the extension of commerce, or the advance of civilization. This state of things is not progress, but retrogression. It will be held by the historian of the future to show that we of the nineteenth century were morally and socially unfit to possess the enormous powers for good and evil which the rapid advance of scientific discovery has given us, that our boasted civilization was in many respects a mere superficial veneer, and that our methods of government were not in accord with either Christianity or civilization.

Comparing the conduct of these modern nations, who call themselves Christian and civilized, with that of the Spanish conquerors of the West Indies, Mexico, and Peru, and making some allowances for differences of race and public opinion, Wallace says there is not much to choose between them.

Wealth and territory and native labor were the real objects in both cases, and if the Spaniards were more cruel by nature and more reckless in their methods the results were much the same. In both cases the country was conquered and thereafter occupied and governed by the conquerors frankly for their own ends, and with little regard for the feelings or the well-being of the conquered. If the Spaniards exterminated the natives of the West Indies, we, he says, have done the same thing in Tasmania and about the same in temperate Australia. Their belief that they were really serving God in converting the heathen, even at the point of the sword, was a genuine belief, shared by priests and conquerors alike—not a mere sham as ours is when we defend our conduct by the plea of "introducing the blessings of civilization."

It is quite possible, says Wallace, that both the conquest of Mexico and Peru by the Spaniards and our conquest of South Africa may have been real steps in advance, essential to human progress, and helping on the future reign of true civilization and the well-being of the human race. But if so, we have been and are unconscious agents in hastening the "far-off divine event."
[Pg 31] We deserve no credit for it. Our aims have been for the most part sordid and selfish, and our rule has often been largely influenced and often entirely directed by the necessity of finding well-paid places for young men with influence, and also by the constant demands for fresh markets by the influential class of merchants and manufacturers.

More general diffusion of the conviction that while all share the burdens of war, such good as comes from it is appropriated by the few, will no doubt do much to discourage wars; but we must ask whether there may not be another incentive to war which Wallace does not give due weight—whether love of fighting may not have something to do with wars.

As we look backward over history we are forced to ask whether the greed and selfishness of the wealthy and influential and those who hope to gain are the only causes of war. We went to war with Spain because our people in general demanded war. If we have been carried further than we intended and are now fighting for objects which we did not foresee and may not approve, this is no more than history might have led us to expect. War with Spain was popular with nearly all our people a year ago, and, while wise counsels might have stemmed this popular tide, there can be no doubt that it existed, for the evil passions of the human race are the real cause of wars.

The great problem of the twentieth century, as of all that have gone before, is the development of the wise and prudent self-restraint which represses natural passions and appetites for the sake of higher and better ends.

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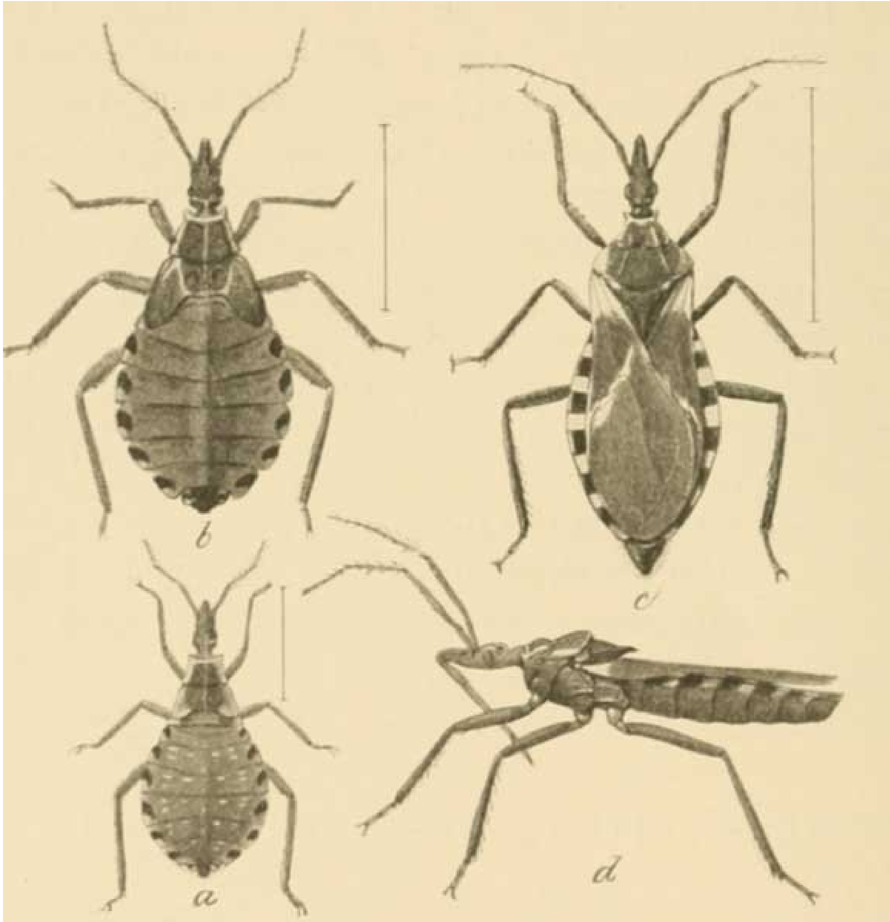
## SPIDER BITES AND "KISSING BUGS."[2]

**By L. O. HOWARD,**

CHIEF OF THE DIVISION OF ENTOMOLOGY, UNITED STATES DEPARTMENT OF AGRICULTURE.

On several occasions during the past ten years, and especially at the Brooklyn meeting of the American Association for the Advancement of Science in 1894, the writer has endeavored to show that most of the newspaper stories of deaths from spider bite are either grossly exaggerated or based upon misinformation. He has failed to thoroughly substantiate a single case of death from a so-called spider bite, and has concluded that there is only one spider in the United States which is capable of inflicting a serious bite—viz., *Latrodectus mactans*, a species [Pg 32] belonging to a genus of world-wide distribution, the other species of which have universally a bad reputation among the peoples whose country they inhabit. In spite of these conclusions, the accuracy of which has been tested with great care, there occur in the newspapers every year stories of spider bites of great seriousness, often resulting in death or the amputation of a limb. The details of negative evidence and of lack of positive evidence need not be entered upon here, except in so far as to state that in the great majority of these cases the spider supposed to have inflicted the bite is not even seen, while in almost no case is the spider seen to inflict the bite; and it is a well-known fact that there are practically no spiders in our more northern States which are able to pierce the human skin, except upon a portion of the body where the skin is especially delicate and which is seldom exposed. There arises, then, the probability that there are other insects capable of piercing tough skin, the results of whose bites may be more or less painful, the wounds being attributed to spiders on account of the universally bad reputation which these arthropods seem to have.



**Different Stages of Conorhinus sanguisugus. Twice natural size. (After Marlatt.)**

These sentences formed the introduction to a paper read by the writer at a meeting of the Entomological Society of Washington, held June 1st last. I went on to state that some of these insects are rather well known, as, for example, the blood-sucking cone-nose (*Conorhinus* [Pg 33] *sanguisugus*) and the two-spotted corsairs (*Rasatus thoracicus* and *R. biguttatus*), both of which occur, however, most numerously in the South and West, and then spoke of *Melanotestis picipes*, a species which had been especially called to my attention by Mr. Frank M. Jones, of Wilmington, Del., who submitted the report of the attending physician in a case of two punctures by this insect inflicted upon the thumb and forefinger of a middle-aged man in Delaware. I further reported upon occasional somewhat severe results from the bites[3] of the old *Reduvius personatus*, now placed in the genus *Opsicostes*, and stated that a smaller species, *Coriscus subcoleoptratus*, had bitten me rather severely under circumstances similar to some of those which have given rise in the past to spider-bite stories. In the course of the discussion which followed the reading of this paper, Mr. Schwarz stated that twice during the present spring he had been bitten rather severely by *Melanotestis picipes* which had entered his room, probably attracted by light. He described it as the worst biter among heteropterous insects with which he had had any experience, and said he thought it was commoner than usual in Washington during the present year.

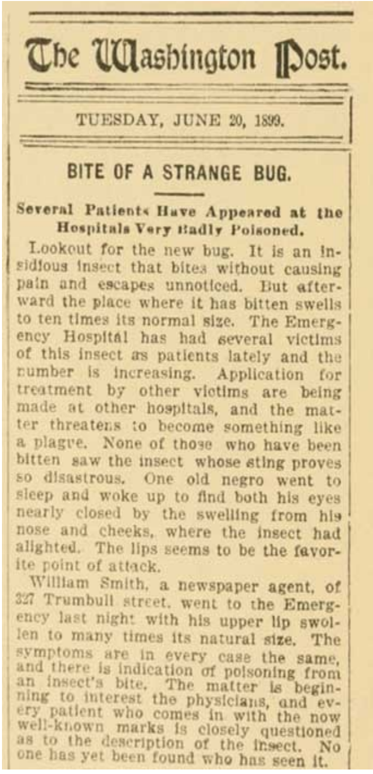
No account of this meeting was published, but within a few weeks thereafter several persons suffering from swollen faces visited the Emergency Hospital in Washington and complained that they had been bitten by some insect while asleep; that they did not see the insect, and could not describe it. This happened during one of the temporary periods when newspaper men are most actively engaged in hunting for items. There was a dearth of news. These swollen faces offered an opportunity for a good story, and thus began the "kissing-bug" scare which has grown to such extraordinary proportions. I have received the following letter and clipping from Mr. J. F. McElhone, of the Washington Post, in reply to a request for information regarding the origin of this curious epidemic:

"Washington, D. C., *August 14, 1899*.

"*Dr. L. O. Howard, Cosmos Club, Washington, D. C.*

"Dear Sir: Attached please find clipping from the Washington Post of June 20, 1899, being the first story that ever appeared in print, so far as I can learn, of the depredations of the *Melanotestis picipes*, better known now as the kissing bug. In my rounds as police reporter of the Post, I noticed, for two or three days before writing this story, that the register of the Emergency Hospital of this city contained unusually [Pg 34] frequent notes of 'bug-bite' cases. Investigating, on the evening of June 19th I learned from the hospital physicians that a noticeable number of patients were applying daily for treatment for very red and extensive swellings, usually on the lips, and apparently the result of an insect bite. This led to the writing of the story attached.

"Very truly yours,
"James F. McElhone."



**The Washington Post.**
TUESDAY, JUNE 20, 1899.
**BITE OF A STRANGE BUG.**
Several Patients Have Appeared at the Hospitals Very Badly Poisoned.

[Pg 35] Lookout for the new bug. It is an insidious insect that bites without causing pain and escapes unnoticed. But afterward the place where it has bitten swells to ten times its normal size. The Emergency Hospital has had several victims of this insect as patients lately and the number is increasing. Application for treatment by other victims are being made at other hospitals, and the matter threatens to become something like a plague. None of those who have been bitten saw the insect whose sting proves so disastrous. One old negro went to sleep and woke up to find both his eyes nearly closed by the swelling from his nose and cheeks, where the insect had alighted. The lips seems to be the favorite point of attack.

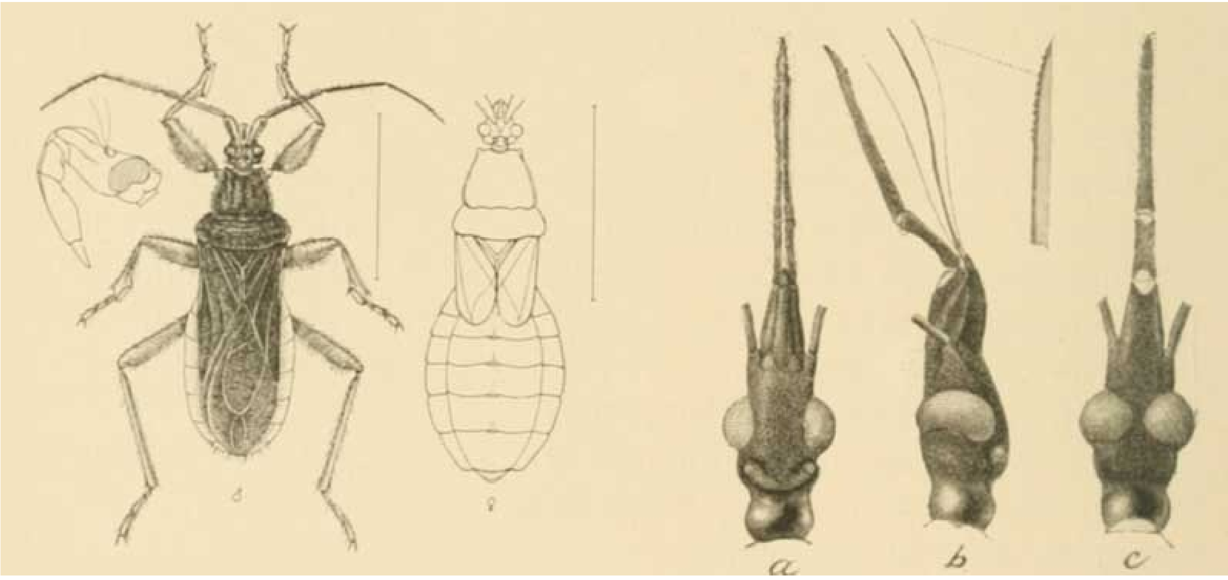
William Smith, a newspaper agent, of 327 Trumbull street, went to the Emergency last night with his upper lip swollen to many times its natural size. The symptoms are in every case the same, and there is indication of poisoning from an insect's bite. The matter is beginning to interest the physicians, and every patient who comes in with the now well-known marks is closely questioned as to the description of the insect. No one has yet been found who has seen it.

It would be an interesting computation for one to figure out the amount of newspaper space which was filled in the succeeding two months by items and articles about the "kissing bug." Other Washington newspapers took the matter up. The New York, Philadelphia, and Baltimore papers soon followed suit. The epidemic spread east to Boston and west to California. By "epidemic" is meant the *newspaper* epidemic, for every insect bite where the biter was not at once recognized was attributed to the popular and somewhat mysterious creature which had been given such an attractive name, and there can be no doubt that some mosquito, flea, and bedbug bites which had by accident resulted in a greater than the usual severity were attributed to the prevailing osculatory insect. In Washington professional beggars seized the opportunity, and went around from door to door with bandaged faces and hands, complaining that they were poor men and had been thrown out of work by the results of "kissing-bug" stings! One beggar came to the writer's door and offered, in support of his plea, a card supposed to be signed by the head surgeon of the Emergency Hospital. In a small town in central New York a man arrested on the charge of swindling entered the plea that he was temporarily insane owing to the bite of the "kissing bug." Entomologists all through the East were also much overworked answering questions asked them about the mysterious creature. Men of local entomological reputations were applied to by newspaper reporters, by their friends, by people who knew them, in church, on the street, and under all conceivable circumstances. Editorials were written about it. Even the Scientific American published a two-column article on the subject; and, while no international complications have resulted as yet, the kissing bug, in its own way and in the short space of two months, produced almost as much of a scare as did the San José scale in its five years of Eastern excitement. Now, however, the newspapers have had their fun, the necessary amount of space has been filled, and the subject has assumed a castaneous hue, to Latinize the slang of a few years back.

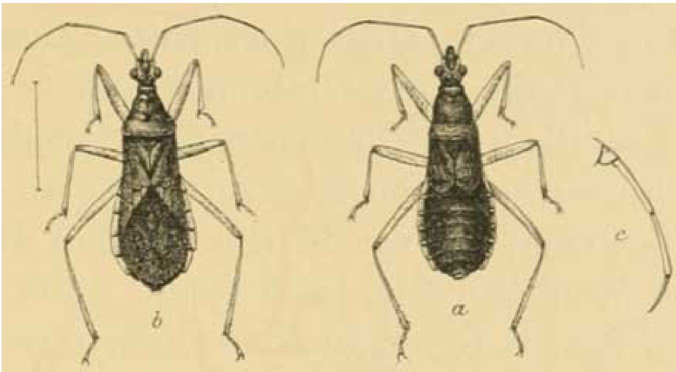
The experience has been a most interesting one. To the reader familiar with the old accounts of the hysterical craze of south Europe, based upon supposed tarantula bites, there can not fail to come the suggestion that we have had in miniature and in modernized form, aided largely by the newspapers, a hysterical craze of much the same character. From the medical and psychological point of view this aspect is interesting, and deserves investigation by competent persons.

As an entomologist, however, the writer confines himself to the actual authors of the bites so far as he has been able to determine them. It seems undoubtedly true that while there has been a great cry there has been very little wool. It is undoubtedly true, also, that there have been a certain number of bites by heteropterous insects, some of which have resulted in considerable swelling. It seems true that *Melanotestis picipes* and *Opsicostes personatus* have been more numerous than usual this year, at least around Washington. They have been captured in a number of instances while biting people, and have been brought to the writer's office for determination in such a way that there can be no doubt about the accuracy of this statement. As the story went West, bites by *Conorhinus sanguisuga* and *Rasatus thoracicus* were without doubt termed "kissing-bug" bites. With regard to other cases, the writer has known of an instance where the mosquito bite upon the lip of a sleeping child produced a very considerable swelling. Therefore he argues that many of these reported cases may have been nothing more than mosquito bites. With nervous and excitable individuals the symptoms of any skin puncture become exaggerated not only in the mind of the individual but in their actual characteristics, and [Pg 36] not only does this refer to cases of skin puncture but to certain skin eruptions, and to some of those early summer skin troubles which are known as strawberry rash, etc. It is in this aspect of the subject that the resemblance to tarantulism comes in, and this is the result of the hysterical wave, if it may be so termed.

Six different heteropterous insects were mentioned in the early part of this article, and it will be appropriate to give each of them some little detailed consideration, taking the species of Eastern distribution first, since the scare had its origin in the East, and has there perhaps been more fully exploited.



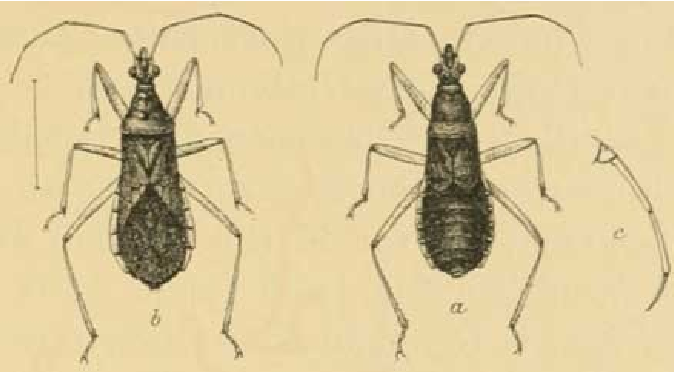
**Melanotestis abdominalis. Female at right; male at left, with enlarged beak at side. Twice natural size. (Original.)**



**Head and Proboscis of Conorhinus sanguisugus. (After Marlatt.)**

*Opsicostes personatus*, also known as *Reduvius personatus*, and which has been termed the "cannibal bug," is a European species introduced into this country at some unknown date, but possibly following close in the wake of the bedbug. In Europe this species haunts houses for the purpose of preying upon bedbugs. Riley, in his well-known article on Poisonous Insects, published in Wood's Reference Handbook of Medical Science, states that if a fly or another insect is offered to the cannibal bug it is first touched with the antennæ, a sudden spring follows, and at the same time the beak is thrust into the prey. The young specimens are covered with a glutinous substance, to which bits of dirt and dust adhere. They move deliberately, with a long pause between each step, the step being taken in a jerky manner. The distribution of the species, as given by Reuter in his Monograph of the Genus *Reduvius*, is Europe to the middle of Sweden, Caucasia, Asia Minor, Algeria, Madeira; North America, Canada, New York, Philadelphia, Indiana; Tasmania, Australia—from which it appears that the insect is already practically cosmopolitan, and in fact may [Pg 37] almost be termed a household insect. The collections of the United States National Museum and of Messrs. Heidemann and Chittenden, of Washington, D. C., indicate the following localities for this species: Locust Hill, Va.; Washington, D. C.; Baltimore, Md.; Ithaca, N. Y.; Cleveland, Ohio; Keokuk, Iowa.

The bite of this species is said to be very painful, more so than that of a bee, and to be followed by numbness (Lintner). One of the cases brought to the writer's attention this summer was that of a Swedish servant girl, in which the insect was caught, where the sting was upon the neck, and was followed by considerable swelling. Le Conte, in describing it under the synonymical name *Reduvius pungens*, gives Georgia as the locality, and makes the following statement: "This species is remarkable for the intense pain caused by its bite. I do not know whether it ever willingly plunges its rostrum into any person, but when caught or unskillfully handled it always stings. In this case the pain is almost equal to that of the bite of a snake, and the swelling and irritation which result from it will sometimes last for a week. In very weak and irritable constitutions it may even prove fatal."[4]

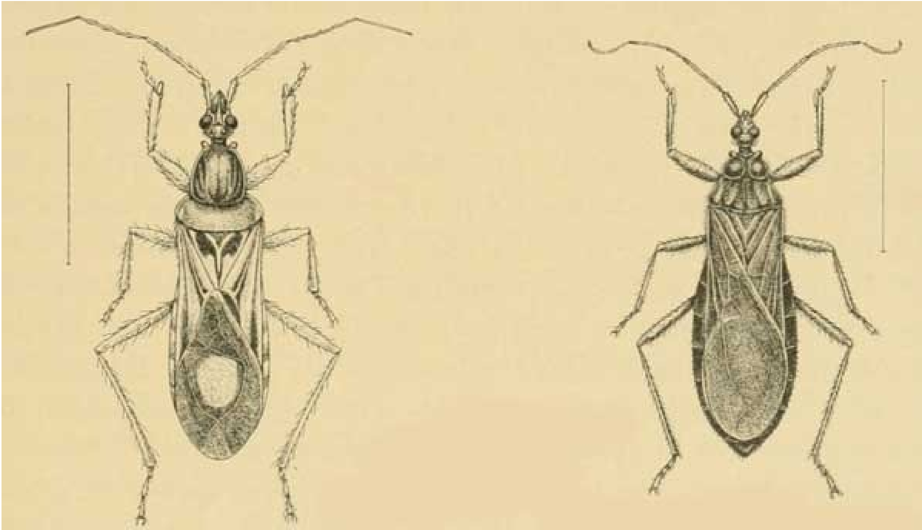


**Coriscus subcoleoptratus: *a*, wingless form; *b*, winged form; *c*, proboscis. All twice natural size. (Original.)**

The second Eastern species is *Melanotestis picipes*. This and the closely allied and possibly identical *M. abdominalis* are not rare in the United States, and have been found all along the Atlantic States, in the West and South, and also in Mexico. They live underneath stones and logs, and run swiftly. Both sexes of *M. picipes* in the adult are fully winged, but the female of *M. abdominalis* is usually found in the short-winged condition. Prof. P. R. Uhler writes (in litt.): "*Melanotestis abdominalis* is not rare in this section (Baltimore), but the winged female is a great rarity. At the present time I have not a specimen of the winged female in my collection. I have seen specimens from the South, in North Carolina and Florida, but I do not remember one from Maryland. I am satisfied that *M. picipes* is distinct from *M. abdominalis*. I have not known the two species to unite sexually, but I have seen them both united to their proper consorts. Both species are sometimes found under the same flat stone or log, and they both hibernate in our valleys beneath stones and rubbish in loamy soils." [Pg 38] Specimens in Washington collections show the following localities for *M. abdominalis*: Baltimore, Md.; Washington, D. C.; Wilmington, Del.; New Jersey; Long Island; Fort Bliss, Texas; Louisiana; and Keokuk, Iowa;, and for *M. picipes*, Washington, D. C.; Roslyn, Va.; Baltimore, Md.; Derby, Conn.; Long Island; a series labeled New Jersey; Wilmington, Del.; Keokuk, Iowa; Cleveland and Cincinnati, Ohio; Louisiana; Jackson, Miss.; Barton County, Mo.; Fort Bliss, Texas; San Antonio, Texas; Crescent City, Fla.; Holland, S. C.

This insect has been mentioned several times in entomological literature. The first reference to its bite probably was made by Townend Glover in the Annual Report of the Commissioner of Agriculture for 1875 (page 130). In Maryland, he states, *M. picipes* is found under stones, moss, logs of wood, etc., and is capable of inflicting a severe wound with its rostrum or piercer. In 1888 Dr. Lintner, in his Fourth Report as State Entomologist of New York (page 110), quotes from a correspondent in Natchez, Miss., concerning this insect: "I send a specimen of a fly not known to us here. A few days ago it punctured the finger of my wife, inflicting a painful sting. The swelling was rapid, and for several days the wound was quite annoying." Until recent years this insect has not been known to the writer as occurring in houses with any degree of frequency. In May, 1895, however, I received a specimen from an esteemed correspondent—Dr. J. M. Shaffer, of Keokuk, Iowa—together with a letter written on May 7th, in which the statement was made that four specimens flew into his window the night before. The insect, therefore, is attracted to light or is becoming attracted to light, is a night-flier, and enters houses through open windows. Among the several cases coming under the writer's observation of bites by this insect, one has been reported by the well-known entomologist Mr. Charles Dury, of Cincinnati, Ohio, in which this species (*M. picipes*) bit a man on the back of the hand, making a bad sore. In another case, where the insect was brought for our determination and proved to be this species, the bite was upon the cheek, and the swelling was said to be great, but with little pain. In a third case, occurring at Holland, S. C., the symptoms were more serious. The patient was bitten upon the end of the middle finger, and stated that the first paroxysm of pain was about like that resulting from a hornet or a bee sting, but almost immediately it grew ten times more painful, with a feeling of weakness followed by vomiting. The pain was felt to shoot up the arm to the under jaw, and the sickness lasted for a [Pg 39] number of days. A fourth case, at Fort Bliss, Texas, is interesting as having occurred in bed. The patient was bitten on the hand, with very painful results and bad swelling.

The third of the Eastern species, *Coriscus subcoleoptratus*, is said by Uhler to have a general distribution in the Northern States, and is like the species immediately preceding a native insect. There is no record of any bite by this species, and it is introduced here for the reason that it attracted the writer's attention crawling upon the walls of an earth closet in Greene County, New York, where on one occasion it bit him between the fingers. The pain was sharp, like the prick of a pin, but only a faint swelling followed, and no further inconvenience. The insect is mentioned, however, for the reason that, occurring in such situations, it is one of the forms which are liable to carry pathogenic bacteria.



Rasatus biguttatus. Twice natural size. (Original.)    Reduvius (Opsicostes) personatus. Twice natural size. (Original.)

There remain for consideration the Southern and Western forms—*Rasatus thoracicus* and *R. biguttatus*, and *Conorhinus sanguisugus*.

The two-spotted corsair, as *Rasatus biguttatus* is popularly termed, is said by Riley to be found frequently in houses in the Southern States, and to prey upon bedbugs. Lintner, referring to the fact that it preys upon bedbugs, says: "It evidently delights in human blood, but prefers taking it at second hand." Dr. A. Davidson, formerly of Los Angeles, Cal., in an important paper entitled So-called Spider Bites and their Treatment, published in the Therapeutic Gazette of February 15, 1897, arrives at the conclusion that almost all of the so-called spider bites met with in southern California are produced by no spider at all, but by *Rasatus biguttatus*. The symptoms which he [Pg 40] describes are as follows: "Next day the injured part shows a local cellulitis, with a central dark spot; around this spot there frequently appears a bullous vesicle about the size of a ten-cent piece, and filled with a dark grumous fluid; a small ulcer forms underneath the vesicle, the necrotic area being generally limited to the central part, while the surrounding tissues are more or less swollen and somewhat painful. In a few days, with rest and proper care, the swelling subsides, and in a week all traces of the cellulitis are usually gone. In some of the cases no vesicle forms at the point of injury, the formation probably depending on the constitutional vitality of the individual or the amount of poison introduced." The explanation of the severity of the wound suggested by Dr. Davidson, and in which the writer fully concurs with him, is not that the insect introduces any specific poison of its own, but that the poison introduced is probably accidental and contains the ordinary putrefactive germs which may adhere to its proboscis. Dr. Davidson's treatment was corrosive sublimate—1 to 500 or 1 to 1,000—locally applied to the wound, keeping the necrotic part bathed in the solution. The results have in all cases been favorable. Uhler gives the distribution of *R. biguttatus* as Arizona, Texas, Panama, Pará, Cuba, Louisiana, West Virginia, and California. After a careful study of the material in the United States National Museum, Mr. Heidemann has decided that the specimens of *Rasatus* from the southeastern part of the country are in reality Say's *R. biguttatus*, while those from the Southwestern States belong to a distinct species answering more fully, with slight exceptions, to the description of Stal's *Rasatus thoracicus*. The writer has recently received a large series of *R. thoracicus* from Mr. H. Brown, of Tucson, Arizona, and had a disagreeable experience with the same species in April, 1898, at San José de Guaymas, in the State of Sonora, Mexico. He had not seen the insect alive before, and was sitting at the supper table with his host—a ranchero of cosmopolitan language. One of the bugs, attracted by the light, flew in with a buzz and flopped down on the table. The writer's entomological instinct led him to reach out for it, and was warned by his host in the remarkable sentence comprising words derived from three distinct languages: "Guardez, guardez! Zat animalito sting like ze dev!" But it was too late; the writer had been stung on the forefinger, with painful results. Fortunately, however, the insect's beak must have been clean, and no great swelling or long inconvenience ensued.

Perhaps the best known of any of the species mentioned in our list is the blood-sucking cone-nose (*Conorhinus sanguisugus*). This ferocious insect belongs to a genus which has several representatives in the United States, all, however, confined to the South or West. *C. rubrofasciatus* [Pg 41] and *C. variegatus*, as well as *C. sanguisugus*, are given the general geographical distribution of "Southern States." *C. dimidiatus* and *C. maculipennis* are Mexican forms, while *C. gerstaeckeri* occurs in the Western States. The more recently described species, *C. protractus* Uhl., has been taken at Los Angeles, Cal.; Dragoon, Ariz.; and Salt Lake City, Utah. All of these insects are blood-suckers, and do not hesitate to attack animals. Le Conte, in his original description of *C. sanguisugus*,[5] adds a most significant paragraph or two which, as it has not been quoted of late, will be especially appropriate here: "This insect, equally with the former" (see above), "inflicts a most painful wound. It is remarkable also for sucking the blood of mammals, particularly of children. I have known its bite followed by very serious consequences, the patient not recovering from its effects for nearly a year. The many relations which we have of spider bites frequently proving fatal have no doubt arisen from the stings of these insects or others of the same genera. When the disease called spider bite is not an anthrax or carbuncle it is undoubtedly occasioned by the bite of an insect—by no means however, of a spider. Among the many species of *Araneidæ* which we have in the United States I have never seen one capable of inflicting the slightest wound. Ignorant persons may easily mistake a *Cimex* for a spider. I have known a physician who sent to me the fragments of a large ant, which he supposed was a spider, that came out of his grandchild's head." The fact that Le Conte was himself a physician, having graduated from the College of Physicians and Surgeons in 1846, thus having been nine years in practice at the time, renders this statement all the more significant. The life history and habits of *C. sanguisugus* have been so well written up by my assistant, Mr. Marlatt, in Bulletin No. 4, New Series, of the Division of Entomology, United States Department of Agriculture, that it is not necessary to enter upon them here. The point made by Marlatt—that the constant and uniform character of the symptoms in nearly all cases of bites by this insect indicate that there is a specific poison connected with the bite—deserves consideration, but there can be no doubt that the very serious results which sometimes follow the bite are due to the introduction of extraneous poison germs. The late Mr. J. B. Lembert, of Yosemite, Cal., noticed particularly that the species of *Conorhinus* occurring upon the Pacific coast is attracted by carrion. Professor Toumey, of Tucson, Arizona, shows how a woman broke out all over the body and limbs with red blotches and [Pg 42] welts from a single sting on the shoulders. Specimens of *C. sanguisugus* received in July, 1899, from Mayersville, Miss., were accompanied by the statement—which is appropriate, in view of the fact that the newspapers have insisted that the "kissing bug" prefers the lip—that a friend of the writer was bitten on the lip, and that the effect was a burning pain, intense itching, and much swelling, lasting three or four days. The writer of the letter had been bitten upon the leg and arm, and his brother was bitten upon both feet and legs and on the arm, the symptoms being the same in all cases.

More need hardly be said specifically concerning these biting bugs. The writer's conclusions are that a puncture by any one of them may be and frequently has been mistaken for a spider bite, and that nearly all reported spider-bite cases have had in reality this cause, that the so-called "kissing-bug" scare has been based upon certain undoubted cases of the bite of one or the other of them, but that other bites, including mosquitoes, with hysterical and nervous symptoms produced by the newspaper accounts, have aided in the general alarm. The case of Miss Larson, who died in August, 1898, as the result of a mosquito bite, at Mystic, Conn., is an instance which goes to show that no mysterious new insect need be looked for to explain occasional remarkable cases. One good result of the "kissing-bug" excitement will prove in the end to be that it will have relieved spiders from much unnecessary discredit.

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## THE MOSQUITO THEORY OF MALARIA.[6]

**By Major RONALD ROSS.**

I have the honor to address you, on completion of my term of special duty for the investigation of malaria, on the subject of the practical results as regard the prevention of the disease which may be expected to arise from my researches; and I trust that this letter may be submitted to the Government if the director general thinks fit.

It has been shown in my reports to you that the parasites of malaria pass a stage of their existence in certain species of mosquitoes, by the bites of which they are inoculated into the blood of healthy men and birds. These observations have solved the problem—previously thought insolvable—of the mode of life of these parasites in external Nature.

My results have been accepted by Dr. Laveran, the discoverer of the parasites of malaria; by Dr. [Pg 43] Manson, who elaborated the mosquito theory of malaria; by Dr. Nuttall, of the Hygienic Institute of Berlin, who has made a special study of the relations between insects and disease; and, I understand, by M. Metchnikoff, Director of the Laboratory of the Pasteur Institute in Paris. Lately, moreover, Dr. C. W. Daniels, of the Malaria Commission, who has been sent to study with me in Calcutta, has confirmed my observations in a special report to the Royal Society; while, lastly, Professor Grassi and Drs. Bignami and Bastianelli, of Rome, have been able, after receiving specimens and copies of my reports from me, to repeat my experiments in detail, and to follow two of the parasites of human malaria through all their stages in a species of mosquito called the *Anopheles claviger*.

It may therefore be finally accepted as a fact that malaria is communicated by the bites of some species of mosquito; and, to judge from the general laws governing the development of parasitic animals, such as the parasites of malaria, this is very probably the only way in which infection is acquired, in which opinion several distinguished men of science concur with me.

In considering this statement it is necessary to remember that it does not refer to the mere recurrences of fever to which people previously infected are often subject as the result of chill, fatigue, and so on. When I say that malaria is communicated by the bites of mosquitoes, I allude only to the original infection.

It is also necessary to guard against assertions to the effect that malaria is prevalent where mosquitoes and gnats do not exist. In my experience, when the facts come to be inquired into, such assertions are found to be untrue. Scientific research has now yielded so absolute a proof of the mosquito theory of malaria that hearsay evidence opposed to it can no longer carry any weight.

Hence it follows that, in order to eliminate malaria wholly or partly from a given locality, it is necessary only to exterminate the various species of insect which carry the infection. This will certainly remove the malaria to a large extent, and will almost certainly remove it altogether. It remains only to consider whether such a measure is practicable.

Theoretically the extermination of mosquitoes is a very simple matter. These insects are always hatched from aquatic larvæ or grubs which can live only in small stagnant collections of water, such as pots and tubs of water, garden cisterns, wells, ditches and drains, small ponds, half-dried water courses, and temporary pools of rain-water. So far as I have yet observed, the larvæ are seldom to be found in larger bodies of water, such as tanks, rice fields, streams, and rivers and lakes, because in such places they are devoured by minnows and other small fish. Nor have I ever
[Pg 44] seen any evidence in favor of the popular view that they breed in damp grass, dead leaves, and so on.

Hence, in order to get rid of these insects from a locality, it will suffice to empty out or drain away, or treat with certain chemicals, the small collections of water in which their larvæ must pass their existence.

But the practicability of this will depend on circumstances—especially, I think, on the species of mosquito with which we wish to deal. In my experience, different species select different habitations for their larvæ. Thus the common "brindled mosquitoes" breed almost entirely in pots and tubs of water; the common "gray mosquitoes" only in cisterns, ditches, and drains; while the rarer "spotted-winged mosquitoes" seem to choose only shallow rain-water puddles and ponds too large to dry up under a week or more, and too small or too foul and stagnant for minnows.

Hence the larvæ of the first two varieties are found in large numbers round almost all human dwellings in India; and, because their breeding grounds—namely, vessels of water, drains, and wells—are so numerous and are so frequently contained in private tenements, it will be almost impossible to exterminate them on a large scale.

On the other hand, spotted-winged mosquitoes are generally much more rare than the other two varieties. They do not appear to breed in wells, cisterns, and vessels of water, and therefore have no special connection with human habitations. In fact, it is usually a matter of some difficulty to obtain their larvæ. Small pools of any permanence—such as they require—are not common in most parts of India, except during the rains, and then pools of this kind are generally full of minnows which make short work of any mosquito larvæ they may find. In other words, the breeding grounds of the spotted-winged varieties seem to be so isolated and small that I think it may be possible to exterminate this species under certain circumstances.

The importance of these observations will be apparent when I add that hitherto the parasites of human malaria have been found only in spotted-winged mosquitoes—namely, in two species of them in India and in one species in Italy. As a result of very numerous experiments I think that the common brindled and gray mosquitoes are quite innocuous as regards human malaria—a fortunate circumstance for the human race in the tropics; and Professor Grassi seems to have come to the same conclusion as the result of his inquiries in Italy.

But I wish to be understood as writing with all due caution on these points. Up to the present our
[Pg 45] knowledge, both as regards the habits of the various species of mosquito and as regards the capacity of each for carrying malaria, is not complete. All I can now say is that if my anticipations be realized—if it be found that the malaria-bearing species of mosquito multiply only in small isolated collections of water which can easily be dissipated—we shall possess a simple mode of eliminating malaria from certain localities.

I limit this statement to certain localities only, because it is obvious that where the breeding pools are very numerous, as in water-logged country, or where the inhabitants are not sufficiently advanced to take the necessary precautions, we can scarcely expect the recent observations to be of much use—at least for some years to come. And this limitation must, I fear, exclude most of the rural areas in India.

Where, however, the breeding pools are not very numerous, and where there is anything approaching a competent sanitary establishment, we may, I think, hope to reap the benefit of these discoveries. And this should apply to the most crowded areas, such as those of cities, towns and cantonments, and also to tea, coffee, and indigo estates, and perhaps to military camps.

For instance, malaria causes an enormous amount of sickness among the poor in most Indian cities. Here the common species of mosquitoes breed in the precincts of almost all the houses, and can therefore scarcely be exterminated; but pools suitable for the spotted-winged varieties are comparatively scarce, being found only on vacant areas, ill-kept gardens, or beside roads in very exceptional positions where they can neither dry up quickly nor contain fish. Thus a single small puddle may supply the dangerous mosquitoes to several square miles containing a crowded population: if this be detected and drained off—which will generally cost only a very few rupees—

we may expect malaria to vanish from that particular area.

The same considerations will apply to military cantonments and estates under cultivation. In many such malaria causes the bulk of the sickness, and may often, I think, originate from two or three small puddles of a few square yards in size. Thus in a malarious part of the cantonment of Secunderabad I found the larvæ of spotted-winged mosquitoes only after a long search in a single little pool which could be filled up with a few cart-loads of town rubbish.

In making these suggestions I do not wish to excite hopes which may ultimately prove to have been unfounded. We do not yet know all the dangerous species of mosquito, nor do we even [Pg 46] possess an exhaustive knowledge of the haunts and habits of any one variety. I wish merely to indicate what, so far as I can see at present, may become a very simple means of eradicating malaria.

One thing may be said for certain. Where previously we have been unable to point out the exact origin of the malaria in a locality, and have thought that it rises from the soil generally, we now hope for much more precise knowledge regarding its source; and it will be contrary to experience if human ingenuity does not finally succeed in turning such information to practical account.

More than this, if the distinguishing characteristics of the malaria-bearing mosquitoes are sufficiently marked (if, for instance, they all have spotted wings), people forced to live or travel in malarious districts will ultimately come to recognize them and to take precautions against being bitten by them.

Before practical results can be reasonably looked for, however, we must find precisely—

(*a*) What species of Indian mosquitoes do and do not carry human malaria.

(*b*) What are the habits of the dangerous varieties.

I hope, therefore, that I may be permitted to urge the desirability of carrying out this research. It will no longer present any scientific difficulties, as only the methods already successfully adopted will be required. The results obtained will be quite unequivocal and definite.

But the inquiry should be exhaustive. It will not suffice to distinguish merely one or two malaria-bearing species of mosquito in one or two localities; we should learn to know all of them in all parts of the country.

The investigation will be abbreviated if the dangerous species be found to belong only to one class of mosquito, as I think is likely; and the researches which are now being energetically entered upon in Germany, Italy, America, and Africa will assist any which may be undertaken in India, though there is reason for thinking that the malaria-bearing species differ in various countries.

As each species is detected it will be possible to attempt measures at once for its extermination in given localities as an experiment.

I regret that, owing to my work connected with *kala-azar*, I have not been able to advance this branch of knowledge as much during my term of special duty as I had hoped to do; but I think that the solution of the malaria problem which has been obtained during this period will ultimately yield results of practical importance.

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# FOOD POISONING.

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Within the past fifteen or twenty years cases of poisoning with foods of various kinds have apparently become quite numerous. This increase in the number of instances of this kind has been both apparent and real. In the first place, it is only within recent years that it has been recognized that foods ordinarily harmless may become most powerful poisons. In the second place, the more extensive use of preserved foods of various kinds has led to an actual increase in the number of outbreaks of food poisoning.

The harmful effects of foods may be due to any of the following causes:

1. Certain poisonous fungi may infect grains. This is the cause of epidemics of poisoning with ergotized bread, which formerly prevailed during certain seasons throughout the greater part of continental Europe, but which are now practically limited to southern Russia and Spain. In this country ergotism is practically unknown, except as a result of the criminal use of the drug ergot. However, a few herds of cattle in Kansas and Nebraska have been quite extensively affected with this disease.

2. Plants and animals may feed upon substances that are not harmful to them, but which may seriously affect man on account of his greater susceptibility. It is a well-known fact that hogs may eat large quantities of arsenic or antimony without harm to themselves, and thus render their flesh unfit for food for man. It is believed that birds that feed upon the mountain laurel furnish a food poisonous to man.

3. During periods of the physiological activity of certain glands in some of the lower animals the flesh becomes harmful to man. Some species of fish are poisonous during the spawning season.

4. Both animal and vegetable foods may become infected with the specific germs of disease and serve as the carriers of the infection to man. Instances of the distribution of typhoid fever by the milkman are illustrations of this.

5. Animals may be infected with specific diseases, which may be transmitted to man in the meat or milk. This is one of the means by which tuberculosis is spread.

6. Certain nonspecific, poison-producing germs may find their way into foods of various kinds, [Pg 48] and may by their growth produce chemical poisons either before or after the food has been eaten. This is the most common form of food poisoning known in this country.

We will briefly discuss some foods most likely to prove harmful to man.

Mussel Poisoning.—It has long been known that this bivalve is occasionally poisonous. Three forms of mussel poisoning are recognized. The first, known as *Mytilotoxismus gastricus*, is accompanied by symptoms practically identical with those of cholera morbus. At first there is nausea, followed by vomiting, which may continue for hours. In severe cases the walls of the stomach are so seriously altered that the vomited matter contains considerable quantities of blood. Vomiting is usually accompanied by severe and painful purging. The heart may be markedly affected, and death may result from failure of this organ. Examination after death from this cause shows the stomach and small intestines to be highly inflamed.

The second form of mussel poisoning is known as *Mytilotoxismus exanthematicus* on account of visible changes in the skin. At first there is a sensation of heat, usually beginning in the eyelids, then spreading to the face, and finally extending over the whole body. This sensation is followed by an eruption, which is accompanied by intolerable itching. In severe cases the breathing becomes labored, the face grows livid, consciousness is lost, and death may result within two or three days.

The most frequently observed form of mussel poisoning is that designated as *Mytilotoxismus paralyticus*. As early as 1827 Combe reported his observations upon thirty persons who had suffered from this kind of mussel poisoning. The first symptoms, as a rule, appeared within two hours after eating the poisonous food. Some suffered from nausea and vomiting, but these were not constant or lasting symptoms. All complained of a prickly feeling in the hands, heat and constriction of the throat, difficulty of swallowing and speaking, numbness about the mouth, gradually extending over the face and to the arms, with great debility of the limbs. Most of the sufferers were unable to stand; the action of the heart was feeble, and the face grew pale and expressed much anxiety. Two of the thirty cases terminated fatally. Post-mortem examination showed no abnormality.

Many opinions have been expressed concerning the nature of harmful mussels. Until quite recently it was a common belief that certain species are constantly toxic. Virchow has attempted to describe the dangerous variety of mussels, stating that it has a brighter shell, sweeter, more [Pg 49] penetrating, bouillonlike odor than the edible kind, and that the flesh of the poisonous mussel is yellow; the water in which they are boiled becomes bluish.

However, this belief in a poisonous species is now admitted to be erroneous. At one time it was suggested that mussels became hurtful by absorbing the copper from the bottoms of vessels, but Christison made an analysis of the mussels that poisoned the men mentioned by Combe, with negative results, and also pointed out the fact that the symptoms were not those of poisoning with copper. Some have held that the ill effects were due wholly to idiosyncrasies in the consumers, but cats and dogs are affected in the same way as men are. It has also been believed that all mussels are poisonous during the period of reproduction. This theory is the basis of the popular superstition that shellfish should not be eaten during the months in the name of which the letter "r" does not occur. At one time this popular idea took the form of a legal enactment in France forbidding the sale of shellfish from May 1st to September 1st. This widespread idea has a grain of truth in it, inasmuch as decomposition is more likely to alter food injuriously during the summer months. However, poisoning with mussels may occur at any time of the year.

It has been pretty well demonstrated that the first two forms of mussel poisoning mentioned above are due to putrefactive processes, while the paralytic manifestations seen in other cases are due to a poison isolated a few years ago by Brieger, and named by him mytilotoxin. Any mussel may acquire this poison when it lives in filthy water. Indeed, it has been shown experimentally that edible mussels may become harmful when left for fourteen days or longer in filthy water; while, on the other hand, poisonous mussels may become harmless if kept four weeks or longer in clear water. This is true not only of mussels, but of oysters as well. Some years ago, many cases of poisoning from oysters were reported at Havre. The oysters had been taken from a bed near the outlet of a drain from a public water closet. Both oysters and mussels may harbor the typhoid bacillus, and may act as carriers of this germ to man.

There should be most stringent police regulations against the sale of all kinds of mollusks, and all fish as well, taken from filthy waters. Certainly one should avoid shellfish from impure waters, and it is not too much to insist that those offered for food should be washed in clean water. All forms of clam and oyster broth should be avoided when it has stood even for a few hours at summer heat. These preparations very quickly become infected with bacteria, which develop most potent poisons.

[Pg 50] Fish Poisoning.—Some fish are supplied with poisonous glands, by means of which they secure their prey and protect themselves from their enemies. The "dragon weaver," or "sea weaver" (*Trachinus draco*), is one of the best known of these fish. There are numerous varieties widely distributed in salt waters. The poisonous spine is attached partly to the maxilla and partly to the gill cover at its base. This spine is connected with a poisonous gland; the spine itself is grooved and covered with a thin membrane, which converts the grooves into canals. When the point enters another animal its membrane is stripped back and the poison enters the wound. Men sometimes wound their feet with the barbs of this fish while bathing. It also occasionally happens that a fisherman pricks his fingers with one of these barbs. The most poisonous variety of this fish known is found in the Mediterranean Sea. Wounds produced by these animals sometimes cause death. In *Synanceia brachio* there are in the dorsal fin thirteen barbs, each connected with two poison reservoirs. The secretion from these glands is clear, bluish in color, and acid in reaction, and when introduced beneath the skin causes local gangrene and, if in sufficient quantity, general paralysis. In *Plotosus lineatus* there is a powerful barb in front of the ventral fin, and the poison is not discharged unless the end of the barb is broken. The most poisonous variety of this fish is found only in tropical waters. In *Scorpæna scrofa* and other species of this family there are poison glands connected with the barbs in the dorsal and in some varieties in the caudal fin.

A disease known as *kakke* was a few years ago quite prevalent in Japan and other countries along the eastern coast of Asia. With the opening up of Japan to the civilized world the study of this disease by scientific methods was undertaken by the observant and intelligent natives who acquired their medical training in Europe and America. In Tokio the disease generally appears in May, reaches its greatest prevalence in August, and gradually disappears in September and October. The researches of Miura and others have fairly well demonstrated that this disease is due to the eating of fish belonging to the family of *Scombridæ*. There are other kinds of fish in Japanese waters that undoubtedly are poisonous. This is true of the *tetrodon*, of which, according to Remey, there are twelve species whose ovaries are poisonous. Dogs fed upon these organs soon suffered from salivation, vomiting, and convulsive muscular contractions. When some of the fluid obtained by rubbing the ovaries in a mortar was injected subcutaneously in dogs the symptoms were much more severe, and death resulted. Tahara states that he has isolated from [Pg 51] the roe of the tetrodon two poisons, one of which is a crystalline base, while the other is a white, waxy body. From 1885 to 1892 inclusive, 933 cases of poisoning with this fish were reported in Tokio, with a mortality of seventy-two per cent.

Fish poisoning is quite frequently observed in the West Indies, where the complex of symptoms is designated by the Spanish term *siguatera*. It is believed by the natives that the poisonous properties of the fish are due to the fact that they feed upon decomposing medusæ and corals. In certain localities it is stated that all fish caught off certain coral reefs are unfit for food. However, all statements concerning the origin and nature of the poison in these fish are mere assumptions, since no scientific work has been done. Whatever the source of the poison may be, it is quite powerful, and death not infrequently results. The symptoms are those of gastro-intestinal irritation followed by collapse.

In Russia fish poisoning sometimes causes severe and widespread epidemics. The Government has offered a large reward for any one who will positively determine the cause of the fish being poisonous and suggest successful means of preventing these outbreaks. Schmidt, after studying several of these epidemics, states the following conclusions:

(*a*) The harmful effects are not due to putrefactive processes. (*b*) Fish poisoning in Russia is always due to the eating of some member of the sturgeon tribe. (*c*) The ill effects are not due to the method of catching the fish, the use of salt, or to imperfections in the methods of preservation. (*d*) The deleterious substance is not uniformly distributed through the fish, but is confined to certain parts. (*e*) The poisonous portions are not distinguishable from the nonpoisonous, either macroscopically or microscopically. (*f*) When the fish is cooked it may be eaten without harm. (*g*) The poison is an animal alkaloid produced most probably by bacteria that cause an infectious disease in the fish during life.

The conclusion reached by Schmidt is confirmed by the researches of Madame Sieber, who found a poisonous bacillus in fish which had caused an epidemic.

In the United States fish poisoning is most frequently due to decomposition in canned fish. The most prominent symptoms are nausea, vomiting, and purging. Sometimes there is a scarlatinous rash, which may cover the whole body. The writer has studied two outbreaks of this kind of fish poisoning. In both instances canned salmon was the cause of the trouble. Although a discussion of the treatment of food poisoning is foreign to this paper, the writer must call attention to the

danger in the administration of opiates in cases of poisoning with canned fish. Vomiting and
[Pg 52] purging are efforts on the part of Nature to remove the poison, and should be assisted by the stomach tube and by irrigation of the colon. In one of the cases seen by the writer large doses of morphine had been administered in order to check the vomiting and purging and to relieve the pain; in this case death resulted. The danger of arresting the elimination of the poison in all cases of food poisoning can not be too emphatically condemned.

Meat Poisoning.—The diseases most frequently transmitted from the lower animals to man by the consumption of the flesh or milk of the former by the latter are tuberculosis, anthrax, symptomatic anthrax, pleuro-pneumonia, trichinosis, mucous diarrhœa, and actinomycosis. It hardly comes within the scope of this article to discuss in detail the transmission of these diseases from the lower animals to man. However, the writer must be allowed to offer a few opinions concerning some mooted questions pertaining to the consumption of the flesh of tuberculous animals. Some hold that it is sufficient to condemn the diseased part of the tuberculous cow, and that the remainder may be eaten with perfect safety. Others teach that "total seizure" and destruction of the entire carcass by the health authorities are desirable. Experiments consisting of the inoculation of guinea pigs with the meat and meat juices of tuberculous animals have given different results to several investigators. To one who has seen tuberculous animals slaughtered, these differences in opinion and in experimental results are easily explainable. The tuberculous invasion may be confined to a single gland, and this may occur in a portion of the carcass not ordinarily eaten; while, on the other hand, the invasion may be much more extensive and the muscles may be involved. The tuberculous portion may consist of hard nodules that do not break down and contaminate other tissues in the process of removal, but the writer has seen a tuberculous abscess in the liver holding nearly a pint of broken-down infected matter ruptured or cut in removing this organ, and its contents spread over the greater part of the carcass. This explains why one investigator succeeds in inducing tuberculosis in guinea pigs by introducing small bits of meat from a tuberculous cow into the abdominal cavity, while another equally skillful bacteriologist follows the same details and fails to get positive results. No one desires to eat any portion of a tuberculous animal, and the only safety lies in "total seizure" and destruction. That the milk from tuberculous cows, even when the udder is not involved, may contain the specific bacillus has been demonstrated experimentally. The writer has suggested that every one selling milk should be licensed, and the granting of a license should be
[Pg 53] dependent upon the application of the tuberculin test to every cow from which milk is sold. The frequency with which tuberculosis is transmitted to children through milk should justify this action.

That a profuse diarrhœa may render the flesh of an animal unfit food for man was demonstrated by the cases studied by Gärtner. In this instance the cow was observed to have a profuse diarrhœa for two days before she was slaughtered. Both the raw and cooked meat from this animal poisoned the persons who ate it. Medical literature contains the records of many cases of meat poisoning due to the eating of the flesh of cows slaughtered while suffering from puerperal fever. It has been found that the flesh of animals dead of symptomatic anthrax may retain its infection after having been preserved in a dry state for ten years.

One of the most frequently observed forms of meat poisoning is that due to the eating of decomposed sausage. Sausage poisoning, known as *botulismus*, is most common in parts of Germany. Germans who have brought to the United States their methods of preparing sausage occasionally suffer from this form of poisoning. The writer had occasion two years ago to investigate six cases of this kind, two of which proved fatal. The sausage meat had been placed in uncooked sections of the intestines and alternately frozen and thawed and then eaten raw. In this instance the meat was infected with a highly virulent bacillus, which resembled very closely the *Bacterium coli*.

In England, Ballard has reported numerous epidemics of meat poisoning, in most of which the meat had become infected with some nonspecific, poison-producing germ. In 1894 the writer was called upon to investigate cases of poisoning due to the eating of pressed chicken. The chickens were killed Tuesday afternoon and left hanging in a market room at ordinary temperature until Wednesday forenoon, when they were drawn and carried to a restaurant and here left in a warm room until Thursday, when they were cooked (not thoroughly), pressed, and served at a banquet in which nearly two hundred men participated. All ate of the chicken, and were more or less seriously poisoned. The meat contained a slender bacillus, which was fatal to white rats, guinea pigs, dogs, and rabbits.

Ermengem states that since 1867 there have been reported 112 epidemics of meat poisoning, in which 6,000 persons have been affected. In 103 of these outbreaks the meat came from diseased animals, while in only five was there any evidence that putrefactive changes in the meat had taken place. My experience convinces me that in this country meat poisoning frequently results from putrefactive changes.

[Pg 54] Instances of poisoning from the eating of canned meats have become quite common. Although it may be possible that in some instances the ill effects result from metallic poisoning, in a great majority of cases the poisonous substances are formed by putrefactive changes. In many cases it is probable that decomposition begins after the can has been opened by the consumer; in others the canning is imperfectly done, and putrefaction is far advanced before the food reaches the consumer. In still other instances the meat may have been taken from diseased animals, or it may have undergone putrefactive changes before the canning. It should always be remembered that canned meat is especially liable to putrefactive changes after the can has been opened, and when the contents of the open can are not consumed at once the remainder should be kept in a cold place or should be thrown away. People are especially careless on this point. While every one knows that fresh meat should be kept in a cold place during the summer, an open can of meat is often allowed to stand at summer temperature and its contents eaten hours after the can has been opened. This is not safe, and has caused several outbreaks of meat poisoning that have come under the observation of the writer.

Milk Poisoning.—In discussing this form of food poisoning we will exclude any consideration of the distribution of the specific infectious diseases through milk as the carrier of the infection, and will confine ourselves to that form of milk poisoning which is due to infection with nonspecific, poison-producing germs. Infants are highly susceptible to the action of the galactotoxicons (milk poisons). There can no longer be any doubt that these poisons are largely responsible for much of the infantile mortality which is alarmingly high in all parts of the world. It has been positively shown that the summer diarrhœa of infancy is due to milk poisoning. The diarrhœas prevalent among infants during the summer months are not due to a specific germ, but there are many bacteria that grow rapidly in milk and form poisons which induce vomiting and purging, and may cause death. These diseases occur almost exclusively among children artificially fed. It is true that there are differences in chemical composition between the milk of woman and that of the cow, but these variations in percentage of proteids, fats, and carbohydrates are of less importance than the infection of milk with harmful bacteria. The child that takes its food exclusively from the breast of a healthy mother obtains a food that is free from poisonous bacteria, while the bottle-fed child may take into its body with its food a great number and variety of germs, some of which may be quite deadly in their effects. The diarrhœas of infancy [Pg 55] are practically confined to the hot months, because a high temperature is essential to the growth and wide distribution of the poison-producing bacteria. Furthermore, during the summer time these bacteria grow abundantly in all kinds of filth. Within recent years the medical profession has so urgently called attention to the danger of infected milk that there has been a great improvement in the care of this article of diet, but that there is yet room for more scientific and thorough work in this direction must be granted. The sterilization and Pasteurization of milk have doubtlessly saved the lives of many children, but every intelligent physician knows that even the most careful mother or nurse often fails to secure a milk that is altogether safe.

It is true that milk often contains germs the spores of which are not destroyed by the ordinary methods of sterilization and Pasteurization. However, these germs are not the most dangerous ones found in milk. Moreover, every mother and nurse should remember that in the preparation of sterilized milk for the child it is not only necessary to heat the milk, but, after it has been heated to a temperature sufficiently high and sufficiently prolonged, the milk must subsequently be kept at a low temperature until the child is ready to take it, when it may be warmed. It should be borne in mind that the subsequent cooling of the milk and keeping it at a low temperature is a necessary feature in the preparation of it as a food for the infant.

Cheese Poisoning.—Under this heading we shall include the ill effects that may follow the eating of not only cheese but other milk products, such as ice cream, cream custard, cream puffs, etc. Any poison formed in milk may exist in the various milk products, and it is impossible to draw any sharp line of distinction between milk poisoning and cheese poisoning. However, the distinction is greater than is at first apparent. Under the head of milk poisoning we have called especial attention to those substances formed in milk to which children are particularly susceptible, while in cheese and other milk products there are formed poisonous substances against which age does not give immunity. Since milk is practically the sole food during the first year or eighteen months of life, the effect of its poisons upon infants is of the greatest importance; on the other hand, milk products are seldom taken by the infant, but are frequent articles of diet in after life.

In 1884 the writer succeeded in isolating from poisonous cheese a highly active basic substance, to which he gave the name *tyrotoxicon*. The symptoms produced by this poison are quite marked, but differ in degree according to the amount of the poison taken. At first there is dryness of the mouth, followed by constriction of the fauces, then nausea, vomiting, and purging. The first [Pg 56] vomited matter consists of food, then it becomes watery and is frequently stained with blood. The stools are at first semisolid, and then are watery and serous. The heart is depressed, the pulse becomes weak and irregular, and in severe cases the face appears cyanotic. There may be dilatation of the pupil, but this is not seen in all. The most dangerous cases are those in which the vomiting is slight and soon ceases altogether, and the bowels are constipated from the beginning. Such cases as these require prompt and energetic treatment. The stomach and bowels should be thoroughly irrigated in order to remove the poison, and the action of the heart must be sustained.

At one time the writer believed that tyrotoxicon was the active agent in all samples of poisonous cheese, but more extended experimentation has convinced him that this is not the case. Indeed, this poison is rarely found, while the number of poisons in harmful cheese is no doubt considerable. There are numerous poisonous albumins found in cheese and other milk products. While all of these are gastro-intestinal irritants, they differ considerably in other respects.

In 1895 the writer and Perkins made a prolonged study of a bacillus found in cheese which had poisoned fifty people. Chemically the poison produced by this germ is distinguished from tyrotoxicon by the fact that it is not removed from alkaline solution with ether. Physiologically the new poison has a more pronounced effect on the heart, in which it resembles muscarin or neurin more closely than it does tyrotoxicon. Pathologically, the two poisons are unlike, inasmuch as the new poison induces marked congestion of the tissues about the point of injection when used upon animals hypodermically. Furthermore, the intestinal constrictions which are so uniformly observed in animals poisoned by tyrotoxicon was not once seen in our work with this new poison, although it was carefully looked for in all our experiments.

In 1898 the writer, with McClymonds, examined samples of cheese from more than sixty manufacturers in this country and in Europe. In all samples of ordinary American green cheese poisonous germs were found in greater or less abundance. These germs resemble very closely the colon bacillus, and most likely their presence in the milk is to be accounted for by contamination with bits of fecal matter from the cow. It is more than probable that the manufacture of cheese is yet in its infancy, and we need some one to do for this industry what Pasteur did for the manufacture of beer. At present the flavor of a given cheese depends upon the bacteria and molds which accidentally get into it. The time will probably come when all milk used [Pg 57] for the manufacture of cheese will be sterilized, and then selected molds and bacteria will be sown in it. In this way the flavor and value of a cheese will be determined with scientific accuracy, and will not be left to accident.

Canned Foods.—As has been stated, the increased consumption of preserved foods is accountable for a great proportion of the cases of food poisoning. The preparation of canned foods involves the application of scientific principles, and since this work is done by men wholly ignorant of science it is quite remarkable that harmful effects do not manifest themselves more frequently than they do. Every can of food which is not thoroughly sterilized may become a source of danger to health and even to life. It may be of interest for us to study briefly the methods ordinarily resorted to in the preparation of canned foods. With most substances the food is cooked before being put into the can. This is especially true of meats of various kinds. Thorough cooking necessarily leads to the complete sterilization of the food; but after this, it must be transferred to the can, and the can must be properly closed. With the handling necessary in canning the food, germs are likely to be introduced. Moreover, it is possible that the preliminary cooking is not thoroughly done and complete sterilization is not reached. The empty can should be sterilized. If one wishes to understand the *modus operandi* of canning foods, let him take up a round can of any fruit, vegetable, or meat and examine the bottom of the can, which is in reality the top during the process of canning and until the label is put on. The food is introduced through the circular opening in this end, now closed by a piece which can be seen to be soldered on. After the food has been introduced through this opening the can and contents are heated either in a water bath or by means of steam. The opening through which the food was introduced is now closed by a circular cap of suitable size, which is soldered in position.

This cap has near its center a "prick-hole" through which the steam continues to escape. This "prick-hole" is then closed with solder, and the closed can again heated in the water bath or with steam. If the can "blows" (if the ends of the can become convex) during this last heating the "prick-hole" is again punctured and the heated air allowed to escape, after which the "prick-hole" is again closed. Cans thus prepared should be allowed to stand in a warm chamber for four or five days. If the contents have not been thoroughly sterilized gases will be evolved during this time, or the can will "blow" and the contents should be discarded. Unscrupulous manufacturers take cans which have "blown," prick them to allow the escape of the contained gases, and then [Pg 58] resterilize the cans with their contents, close them again, and put them on the market. These "blowholes" may be made in either end of the can, or they may be made in the sides of the can, where they are subsequently covered with the label. Of course, it does not necessarily follow that if a can has "blown" and been subsequently resterilized its contents will prove poisonous, but it is not safe to eat the contents of such cans. Reputable manufacturers discard all "blown" cans.

Nearly all canned jellies sold in this country are made from apples. The apples are boiled with a preparation sold under the trade name "tartarine." This consists of either dilute hydrochloric or sulphuric acid. Samples examined by the writer have invariably been found to consist of dilute hydrochloric acid. The jelly thus formed by the action of the dilute acid upon the apple is converted into quince, pear, pineapple, or any other fruit that the pleasure of the manufacturer may choose by the addition of artificial flavoring agents. There is no reason for believing that the jellies thus prepared are harmful to health.

Canned fruits occasionally contain salicylic acid in some form. There has been considerable discussion among sanitarians as to whether or not the use of this preservative is admissible. Serious poisoning with canned fruits is very rare. However, there can be but little doubt that many minor digestive disturbances are caused by acids formed in these foods. There has been much apprehension concerning the possibility of poisoning resulting from the soluble salts of tin formed by the action of fruit acids upon the can. The writer believes that anxiety on this point is unnecessary, and he has failed to find any positive evidence of poisoning resulting from this cause.

There are two kinds of condensed milk sold in cans. These are known as condensed milk "with" and "without" sugar. In the preparation of the first-mentioned kind a large amount of cane sugar is added to condensed milk, and this acting as a preservative renders the preparation and successful handling of this article of food comparatively easy. On the other hand, condensed milk to which sugar has not been added is very liable to decomposition, and great care must be used in its preparation. The writer has seen several cases of severe poisoning that have resulted from decomposed canned milk. Any of the galactotoxicons (milk poisons) may be formed in this milk. In these instances the cans were "blown," both ends being convex.

[Pg 59]

One of the most important sanitary questions in which we are concerned to-day is that pertaining to the subject of canned meats. It is undoubtedly true that unscrupulous manufacturers are putting upon the market articles of this kind of food which no decent man knowingly would eat, and which are undoubtedly harmful to all.

The knowledge gained by investigations in chemical and bacteriological science have enabled the unscrupulous to take putrid liver and other disgusting substances and present them in such a form that the most fastidious palate would not recognize their origin. In this way the flesh from diseased animals and that which has undergone putrefactive changes may be doctored up and sold as reputable articles of diet. The writer does not believe that this practice is largely resorted to in this country, but that questionable preservatives have been used to some extent has been amply demonstrated by the testimony of the manufacturers of these articles themselves, given before the Senate committee now investigating the question of food and food adulterations. It is certainly true that most of the adulterations used in our foods are not injurious to health, but are fraudulent in a pecuniary sense; but when the flesh of diseased animals and substances which have undergone putrefactive decomposition can be doctored up and preserved by the addition of such agents as formaldehyde, it is time that the public should demand some restrictive measures.

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# WIRELESS TELEGRAPHY.


**By Prof. JOHN TROWBRIDGE,**

DIRECTOR OF JEFFERSON PHYSICAL LABORATORY, HARVARD UNIVERSITY.


I never visit the historical collection of physical apparatus in the physical laboratory of Harvard University without a sense of wonderment at the marvelous use that has been made of old and antiquated pieces of apparatus which were once considered electrical toys. There can be seen the first batteries, the model of dynamo machines, and the electric motor. Such a collection is in a way a Westminster Abbey—dead mechanisms born to new uses and a great future.

There is one simple piece of apparatus in the collection, without which telephony and wireless telegraphy would be impossible. To my mind it is the most interesting skeleton there, and if physicists marked the resting places of their apparatus laid to apparent rest and desuetude, this merits the highest sounding and most suggestive inscription. It is called a transformer, and consists merely of two coils of wire placed near each other. One coil is adapted to receive an electric current; the other coil, entirely independent of the first, responds by sympathy, or what

[Pg 60]

is called induction, across the space which separates the coils. Doubtless if man knew all the capabilities of this simple apparatus he might talk to China, or receive messages from the antipodes. He now, by means of it, analyzes the light of distant suns, and produces the singular X rays which enable him to see through the human body. By means of it he already communicates his thoughts between stations thousands of miles apart, and by means of its manifestations I hope to make this article on wireless telegraphy intelligible. My essay can be considered a panegyric of this buried form—a history of its new life and of its unbounded possibilities.

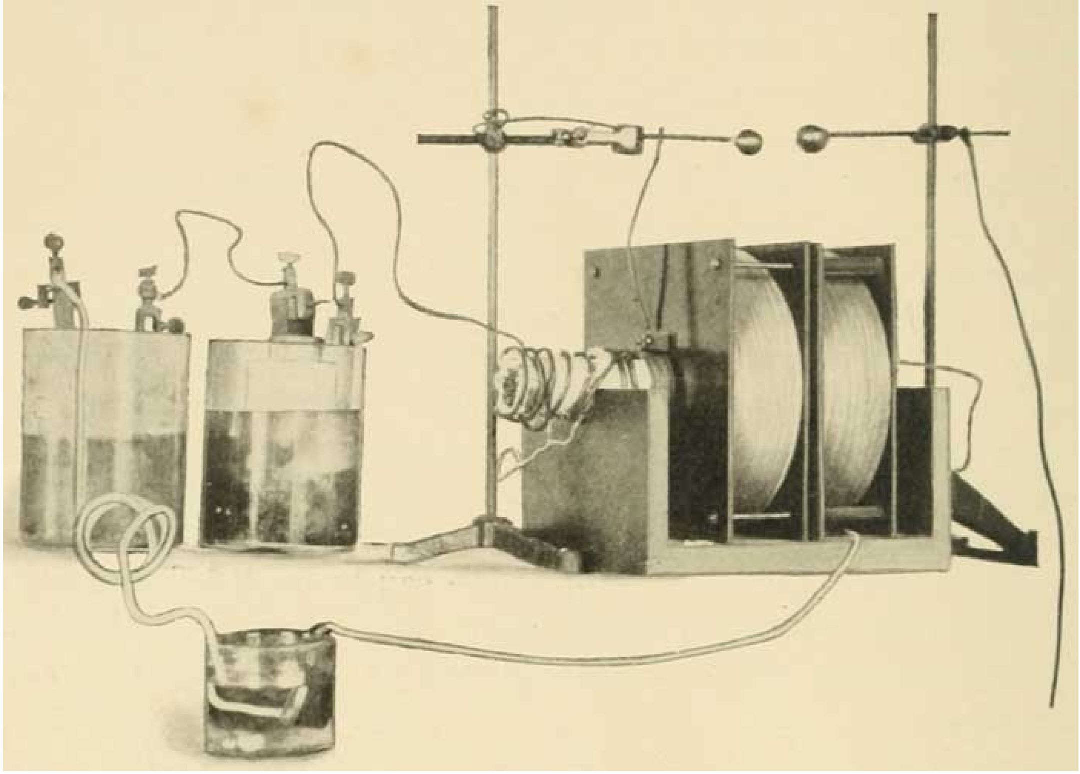

**Fig. 1.—Disposition of batteries and coils at the sending station, showing the arrangement of the vertical wire and the spark gap.**

For convenience, one of the coils of the transformer is placed inside the other, and the combination is called a Ruhmkorf coil. It is represented in the accompanying photograph (Fig. 1), with batteries attached to the inner coil, while the outer coil is connected to two balls, between which an electric spark jumps whenever the battery circuit is broken. In fact, any disturbance in the battery circuit—a weakening, a strengthening, or a break—provided that the changes are sudden, produces a corresponding change in the neighboring circuit. One coil thus responds to the other, in some mysterious way, across the interval of air which separates them. Usually the coils are placed very near to each other—in fact, one embraces the other, as shown in the photograph.

[Pg 61] The coils, however, if placed several miles apart, will still respond to each other if they are made sufficiently large, if they are properly placed, and if a powerful current is used to excite one coil. Thus, by simply varying the distance between the coils of wire we can send messages through the air between stations which are not connected with a wire. This method, however, does not constitute the system of wireless telegraphy of Marconi, which it is the object of this paper to describe. Marconi has succeeded in transmitting messages over forty miles between points not connected by wires, and he has accomplished this feat by merely slightly modifying the disposition of the coils, thus revealing a new possibility of the wondrous transformer. If the reader will compare the following diagram (Fig. 2) with the photograph (Fig. 1), he will see how simple the sending apparatus of Marconi is.

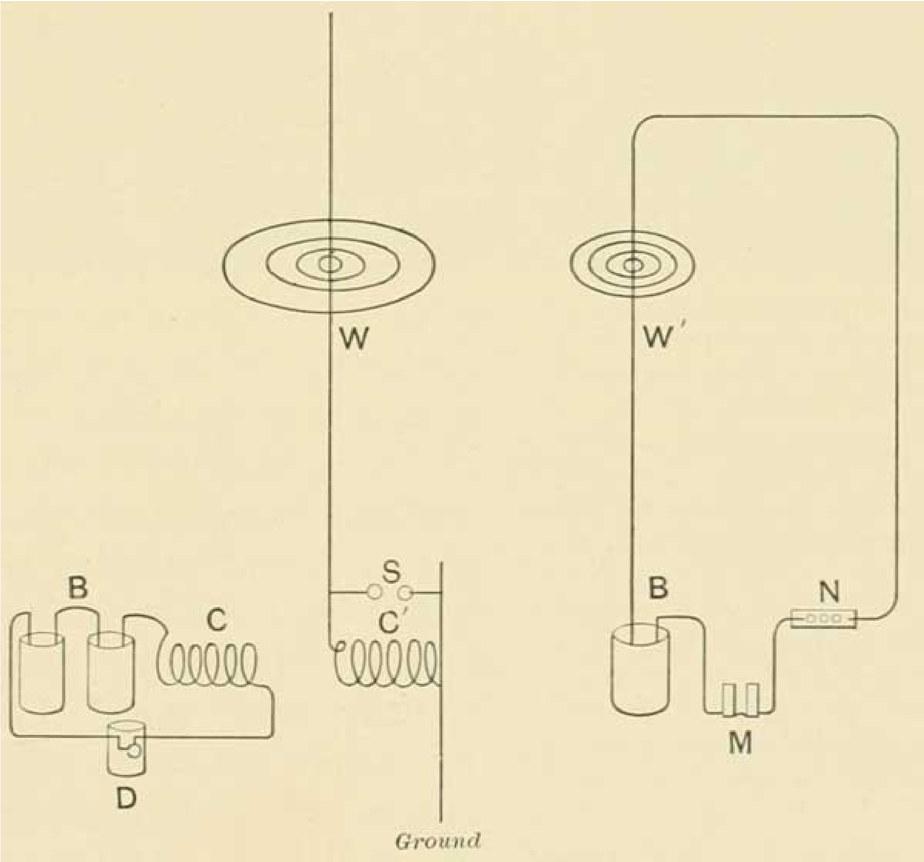


**Fig. 2.—Diagram of the arrangement of wires and batteries at the receiving station.**

S is a gap between the ends of one coil, across which an electric spark is produced whenever the current from the batteries B flowing through the coil C is broken by an arrangement at D. This break produces an electrical pulsation in the coil C', which travels up and down the wire W, which is elevated to a considerable height above the ground. This pulsation can not be seen by the eye. The wire does not move; it appears perfectly quiescent and dead, and seems only a wire and nothing more. At night, under favorable circumstances, one could see a luminosity on the wire, especially at the end, when messages are being transmitted, by a powerful battery B.

[Pg 62] It is very easy to detect the electric lines which radiate from every part of such a wire when a spark jumps between the terminals S of the coil. All that is necessary to do is to pass the wire through a sensitive film and to develop the film. The accompanying photograph (Fig. 3) was taken at the top of such a wire, by means of a very powerful apparatus at my command. When the photograph is examined with a microscope the arborescent electric lines radiating from the wire, like the rays of light from a star, exhibit a beautiful fernlike structure. These lines, however, are not chiefly instrumental in transmitting the electric pulse across space.

There are other lines, called magnetic lines of force, which emanate from every portion of the vertical wire W just as ripples spread out on the surface of placid water when it is disturbed by the fall of a stone. These magnetic ripples travel in the ether of space, and when they embrace a neighboring wire or coil they produce similar ripples, which whirl about the distant wire and produce in some strange way an electrical current in the wire. These magnetic pulsations can travel great distances.

In the photographs of these magnetic whirls, Fig. 4 is the whirl produced in the circuit C' by the battery B (Fig. 2), while Fig. 5 is that produced by electrical sympathy, or as it is called induction, in a neighboring wire. These photographs were obtained by passing the circuits through the sensitive films, perpendicularly to the latter, and then sprinkling very fine iron filings on these surfaces and exposing them to the light. In order to obtain these photographs a very powerful electrical current excited the coil C (Fig. 2), and the neighboring circuit W' (Fig. 5) was placed very near the circuit W.

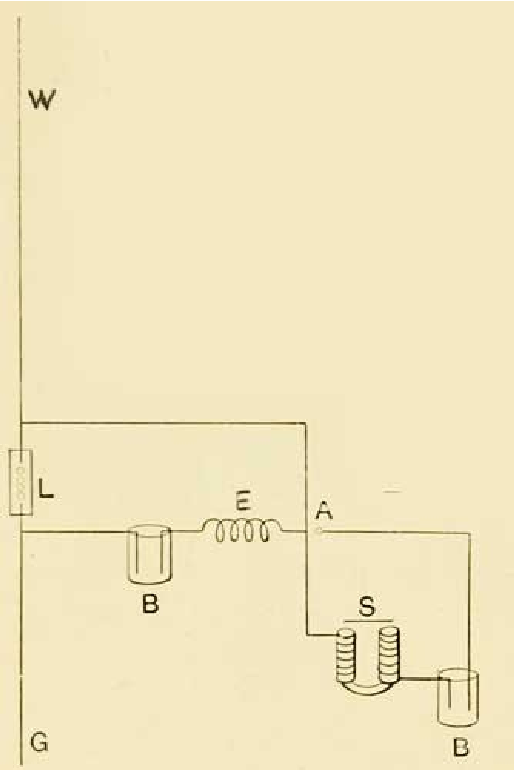


**Fig. 2*a* represents a more complete electrical arrangement of the receiver circuit. The vertical wire, W', is connected to one wire of the coherer, L. The other wire of the coherer is led to the ground, G. The wires in the coherer, L, are separated by fine metallic particles. B represents a battery. E, an electro-magnet which attracts a piece of iron, A (armature), and closes a local battery, B, causing a click of the sounder (electro-magnet), S. The magnetic waves (Fig. 5) embracing the wire, W', cause a pulsation in this wire which produces an electrical disturbance in the coherer analogous to that shown in Fig. 3, by means of which an electrical current is enabled to pass through the electro-magnet, E.**

When the receiving wire is at the distance of several miles from the sending wire it is impossible to detect by the above method the magnetic ripples or whirls. We can, however, detect the electrical currents which these magnetic lines of force cause in the receiving wire; and this leads me to speak of the
[Pg 63] discovery of a remarkable phenomenon which has made Marconi's system of wireless telegraphy possible. In order that an electrical current may flow through a mass of particles of a metal, a mass, for instance, of iron filings, it is necessary either to compress them or to cause a minute spark or electrical discharge between the particles. Now, it is supposed that the magnetic whirls, in embracing the distant receiving circuit, cause these minute sparks, and thus enable the electric current from the battery B to work a telegraphic sounder or bell M. The metallic filings are inclosed in a glass tube between wires which lead to the battery, and the arrangement is called a coherer. It can be made small and light. Fig. 6 is a representation in full size of one that has been found to be very sensitive. It consists of two silver wires with a few iron filings contained in a glass tube between the ends of the wires. It is necessary that this little tube should be constantly shaken up in order that after the electrical circuit is made the iron filings should return to their non-conducting condition, or should cease to cohere together, and should thus be ready to respond to the following signal. My colleague, Professor Sabine, has employed a very small electric motor to cause the glass tube to revolve, and thus to keep the filings in motion while signals are being received. Fig. 7 shows the arrangement of the receiving apparatus.

The coherer and the motor are shown between two batteries, one of which drives the motor while the
[Pg 64]
other serves to work the bell or sounder when the electric wire excites the iron filings. In Fig. 2 this receiving apparatus is shown diagrammatically. B is the battery which sends a current through the sounder M and the coherer N when the magnetic whirls coming from the sending wire W embrace the receiving wire W'.

The term wireless telegraphy is a misnomer, for without wires the method would not be possible. The phenomenon is merely an enlargement of one that we are fully conscious of in the case of telegraph and telephone circuits,

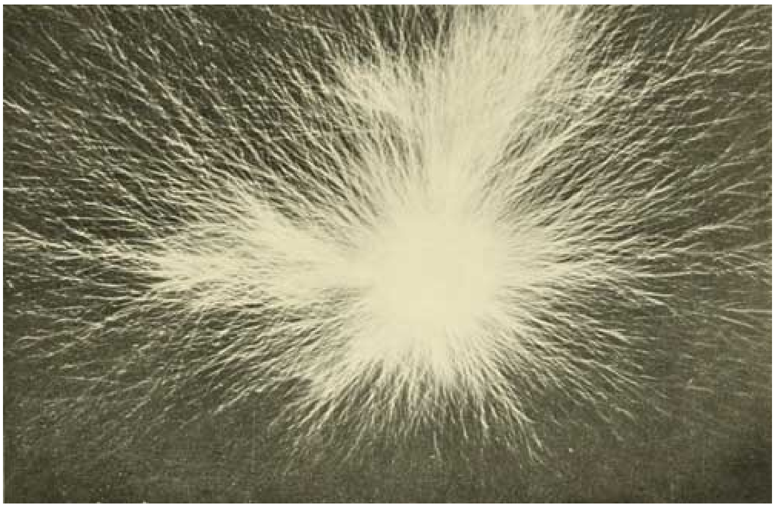

**Fig. 3.—Photograph of the electric lines which emanate from the**

**end of the wire at the sending station, and which are probably reproduced among the metallic filings of the coherer at the receiving station.**

which is termed electro-magnetic induction. Whenever an electric current suddenly flows or suddenly ceases to flow along a wire, electrical currents are caused by induction in neighboring wires. The receiver employed by Marconi is a delicate spark caused by this induction, which forms a bridge so that an electric current from the relay battery can pass and influence magnetic instruments.

Many investigators had succeeded before Marconi in sending telegraphic messages several miles through the air or ether between two points not directly connected by wires. Marconi has extended the distance by employing a much higher electro-motive force at the sending station and using the feeble inductive effect at a distance to set in action a local battery.

**Fig. 4.—Magnetic whirls about the sending wire.**

[Pg 65] It is evident that wires are needed at the sending station from every point of which magnetic and electric waves are sent out, and wires at the receiving station which embrace, so to speak, these waves in the manner shown by our photographs. These waves produce minute sparks in the receiving instrument, which act like a suddenly drawn flood gate in allowing the current from a local battery to flow through the circuit in which the spark occurs, and thus produce a click on a telegraphic instrument.

We have said that messages had been sent by what is called wireless telegraphy before Marconi made his experiments. These messages had also been sent by induction, signals on one wire being received by a parallel and distant wire. To Marconi is due the credit of greatly extending the method by using a vertical wire. The method of using the coherer to detect electric pulses is not due, however, to Marconi. It is usually attributed to Branly; it had been employed, however, by previous observers, among whom is Hughes, the inventor of the microphone, an instrument analogous in its action to that of the coherer. In the case of the microphone, the waves from the human voice shake up the particles of carbon in the microphone transmitter, and thus cause an electrical current to flow more easily through the minute contacts of the carbon particles.

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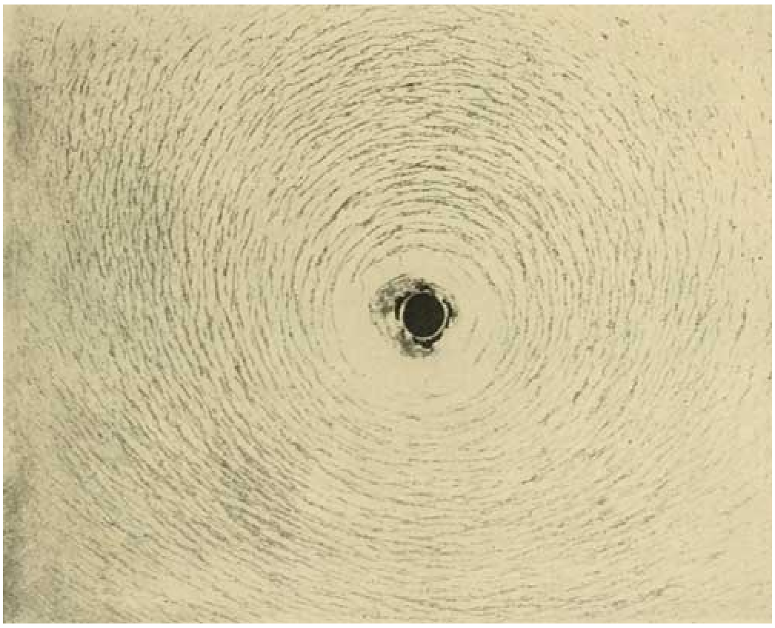

**Fig. 5.—Magnetic whirls about the receiving wire.**

The action of the telephone transmitter, which also consists of minute conducting particles in which a battery terminals are immersed, and the analogous coherer is microscopic, and there are many theories to account for their changes of resistance to electrical currents. We can not, I believe, be far wrong in thinking that the electric force breaks down the insulating effect of the infinitely thin layers of air between the particles, and thus allows an electric current to flow. This action is doubtless of the nature of an electric spark. An electric spark, in the case of wireless telegraphy, produces magnetic and electric lines of force in space, these reach out and embrace the circuit containing the coherer, and produce in turn minute sparks. *Similia similibus*—one action perfectly corresponds to the other.

The Marconi system, therefore, of what is called wireless telegraphy is not new in principle, but only new in practical application. It had been used to show the phenomena of electric waves in lecture rooms. Marconi extended it from distances of sixty to one hundred feet to fifty or sixty miles. He did this by lifting the sending-wire spark on a lofty pole and improving the sensitiveness of the metallic filings in the glass tube at the receiving station. He adopted a mechanical arrangement for continually tapping the coherer in order to break up the minute bridges formed by the cohering action, and thus to prepare the filings for the next magnetic pulse. The system of wireless telegraphy is emphatically a spark system strangely analogous to flash-light signaling, a system in which the human eye with its rods and cones in the retina acts as the coherer, and the nerve system, the local battery, making a signal or sensation in the brain.

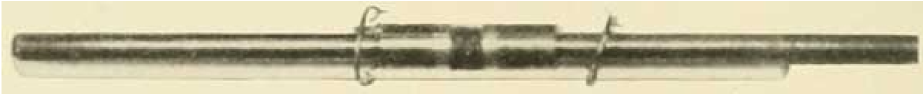

**Fig. 6.—The coherer employed to receive the electric waves. (One and a third actual size.)**

Let us examine the sending spark a little further. An electric spark is perhaps the most interesting phenomenon in electricity. What causes it—how does the air behave toward it—what is it that apparently flows through the air, sending out light and heat waves as well as magnetic and electric waves? If we could answer all these questions, we should know what electricity is. A critical study of the electric spark has not only its scientific but its practical side. We see the latter side evidenced by its employment in wireless telegraphy and in the X rays; for in the latter case we have an electric discharge in a tube from which the air is removed—a special case of an
[Pg 67] electric spark. In order to understand the capabilities of wireless telegraphy we must turn to the scientific study of the electric spark; for its practical employment resides largely in its strength, in its frequency in its position, and in its power to make the air a conductor for electricity. All these points are involved in wireless telegraphy. How, then, shall we study the electric spark? The eye sees only an instantaneous flash following a devious path. It can not tell in what direction a spark flies (a flash of lightning, for instance), or indeed whether it has a direction. There is probably no commoner fallacy mankind entertains than the belief that the direction of lightning, or any electric spark, can be ascertained by the eye—that is, the direction from the sky to the earth or from the earth to the sky. I have repeatedly tested numbers of students in regard to this question, employing sparks four to six feet in length, taking precautions in regard to the concealment of the directions in which I charged the poles of the charging batteries, and I have never found a consensus of opinion in regard to directions. The ordinary photograph, too, reveals no more than the eye can see—a brilliant, devious line or a flaming discharge.

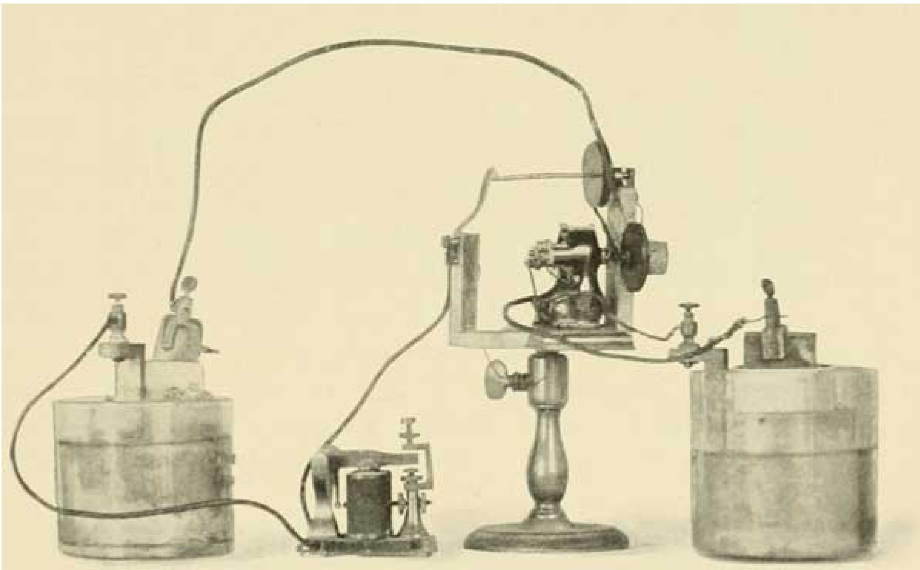

**Fig. 7.—Arrangement of batteries of motor (to disturb the coherer) and the sounder by which the messages are received.**

A large storage battery forms the best means of studying electric sparks, for with it one can run the entire gamut of this phenomenon—from the flaming discharge which we see in the arc light on the street to the crackling spark we employ in wireless telegraphy, and the more powerful discharges of six or more feet in length which closely resemble lightning discharges. A critical
[Pg 68] study of this gamut throws considerable light on the problem of the possibility of secret wireless telegraphy—a problem which it is most important to solve if the system is to be made practical; for at present the message spreads out from the sending spark in great circular ripples in all directions, and may be received by any one.

Several methods enable us to transform electrical energy so as to obtain suitable quick and intense blows on the surrounding medium. Is it possible that there is some mysterious vibration in the spark which is instrumental in the effective transmission of electrical energy across space? If the spark should vibrate or oscillate to and fro faster than sixteen times a second the human eye could not detect such oscillations; for an impression remains on the eye one sixteenth of a

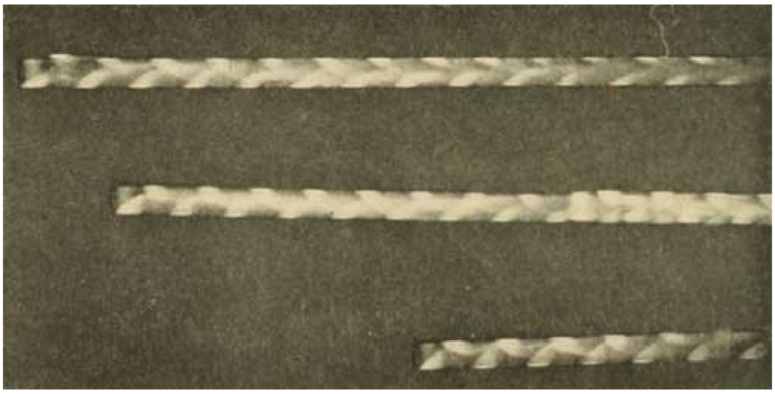

**Fig. 8.—Photograph of electrical pulses. The interval between the pulses is one millionth of a second.**

second, and subsequent ones separated by intervals shorter than a sixteenth would mingle together and could not be separated. The only way to ascertain whether the spark is oscillatory, or whether it is not one spark, as it appears to the eye, but a number of to-and-fro impulses, is to photograph it by a rapidly revolving mirror. The principle is similar to that of the biograph or the vitoscope, in which the quick to-and-fro motions of the spark are received on a sensitive film, which is in rapid motion. One terminal of the spark gap, the positive terminal so called, is always brighter than the other. Hence, if the sensitive film is moved at right angles to the path of the discharge, we shall get a row of dots which are the images of the brighter terminal, and these dots occur alternately first on one terminal and then on the other, showing that the discharge oscillates—that is, leaps in one discharge (which seems but one to the eye) many times in a hundred thousandth of a second. In practice it is found better to make an image of the spark move across the sensitive film instead of moving the film. This is accomplished by the same method that a boy uses in flashing sunlight by  means of a mirror. The faster the mirror moves the faster moves the image of the light. In this way a speed of a millionth of a second can be attained. In this case the distance between the dots on the film may be one tenth of an inch, sufficient to separate them to the eye. The photograph of electric sparks (Fig. 8) was taken in this manner. The distance between any two bright spots in the trail of the photographic images represents the time of the electric oscillation or the time of the magnetic pulse or wave which is sent out from the spark, and which will cause a distant circuit to respond by a similar oscillation.

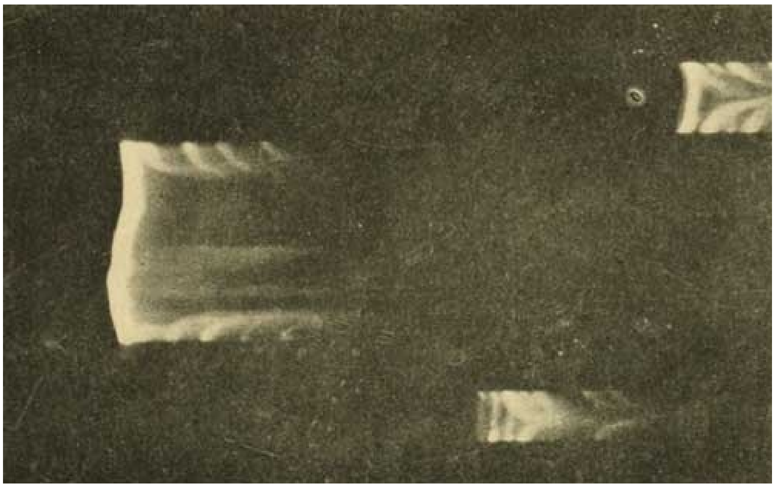

**Fig. 9.—Photograph of a pilot spark, which is the principal factor in the method of wireless telegraphy.**

At present the shortest time that can, so to speak, be photographed in this manner is about one two-millionth of a second. This is the time of propagation of a magnetic wave over four hundred feet long. The waves used in wireless telegraphy are not more than four feet in length—about one hundredth the length of those we can photograph. The photographic method thus reveals a mechanism of the spark which is entirely hidden from the eye and will always be concealed from human sight. It reveals, however, a greater mystery which it seems incompetent to solve—the mystery of what is called the pilot spark, the first discharge which we see on our photograph (Fig. 9) stretching intact from terminal to terminal, having the prodigious velocity of one hundred and eighty thousand miles a second. None of our experimental devices suffice to penetrate the mystery of this discharge. It is this pilot spark which is chiefly instrumental in sending out the magnetic pulses or waves which are powerful enough to reach forty or fifty miles. The preponderating influence of this pilot spark—so called since it finds a way for the subsequent  surgings or oscillations—is a bar to the efforts to make wireless telegraphy secret. We can see from the photograph how much greater its strength is than that of the subsequent discharges shown by the mere brightening of the terminals. A delicate coherer will immediately respond to the influence of this pilot spark, and the subsequent oscillations of this discharge will have little effect. How, then, can we effectively time a receiving circuit so that it will respond to only one sending station? We can not depend upon the oscillatory nature of the spark, or adopt, in other words, its rate of vibration and form a coherer with the same rate.

It seems as if it would be necessary to invent some method of sending pilot sparks at a high and definite rate of vibration, and of employing coherers which will only respond to definite powerful rates of magnetic pulsation. Various attempts have been made to produce by mechanical means powerful electric surgings, but they have been unsuccessful. Both high electro-motive force and strength of current are needed. These can be obtained by the employment of a great number of storage cells. The discharge from a large number of these cells, however, is not suitable for the purpose of wireless telegraphy, although it may possess the qualifications of both high electrical pressure and strength of current.

The only apparatus we have at command to produce quick blows on the ether is the Ruhmkorf coil. This coil, I have said, has been in all our physical cabinets for fifty years. It contained within itself the germ of the telephone transmitter and the method of wireless telegraphy, unrecognized until the present. In its elements it consists, as we have seen, of two electrical circuits, placed near each other, entirely unconnected. A battery is connected with one of these circuits, and any change in the strength of the electrical current gives a blow to the ether or medium between the two circuits. A quick stopping of the electrical current gives the strongest impulse to the ether, which is taken up by the neighboring circuit. For the past fifty years very little advance has been made in the method of giving strong electrical impulses to the medium of space. It is accomplished simply by a mechanical breaking of the connection to the battery, either by a revolving wheel with suitable projections, or by a vibrating point. All the various forms of mechanical breaks are inefficient. They do not give quick and uniform breaks. Latterly, hopes have been excited by the discovery of a chemical break, called the Weynelt interrupter, shown in Fig. 1. The electrical current in passing through a vessel of diluted sulphuric acid from a point of [Pg 71] platinum to a disk of lead causes bubbles of gas which form a barrier to its passage which is suddenly broken down, and this action goes on at a high rate of speed, causing a torrent of sparks in the neighboring circuit. The medium between the two circuits is thereby submitted to rapid and comparatively powerful impulses. The discovery of this and similar chemical or molecular interruptions marks an era in the history of the electrical transformer, and the hopes of further progress by means of them is far greater than in the direction of mechanical interruptions.

We are still, however, unable to generate sufficiently powerful and sufficiently well-timed electrical impulses to make wireless telegraphy of great and extended use. Can we not hope to strengthen the present feeble impulses in wireless telegraphy by some method of relaying or repeating? In the analogous subject of telephony many efforts have also been made to render the service secret, and to extend it to great distances by means of relays. These efforts have not been successful up to the present. We still have our neighbors' call bells, and we could listen to their messages if we were gossips. The telephone service has been extended to great distances—for instance, from Boston to Omaha—not by relays, but by strengthening the blows upon the medium between the transmitting circuit and the receiving one, just as we desire to do in what is called wireless telegraphy, the apparatus of which is almost identical in principle to that employed in telephony. The individual call in telephony is not a success for nearly the same reasons that exist in the case of wireless telegraphy. Perfectly definite and powerful rates of vibration can not be sent from point to point over wires to which only certain definite apparatus will respond. There are so many ways in which the energy of the electric current can be dissipated in passing over wires and through calling bells that the form of the waves and their strength becomes attenuated. The form of the electrical waves is better preserved in free space, where there are no wires or where there is no magnetic matter. The difficulty in obtaining individual calls in wireless telegraphy resides in the present impossibility of obtaining sufficiently rapid and powerful electrical impulses, and a receiver which will properly respond to a definite number of such impulses.

The question of a relay seems as impossible of solution as it does in telephony. The character of speech depends upon numberless delicate inflections and harmonies. The form, for instance, of the wave transmitting the vowel *a* must be preserved in order that the sound may be recognized. A relay in telephony acts very much like one's neighbor in the game called gossip, in which a sentence repeated more or less indistinctly, after passing from one person to another, becomes [Pg 72] distorted and meaningless. No telephone relay has been invented which preserves the form of the first utterance, the vowel *a* loses its delicate characteristics, and becomes simply a meaningless noise. It is maintained by some authorities that such a relay can not be invented, that it is impossible to preserve the delicate inflections of the human voice in passing from one circuit to another, even through an infinitesimal air gap or ether space. It is well, however, to reflect upon Hosea Bigelow's sapient advice "not to prophesy unless you know." It was maintained in the early days of the telephone that speech would lose so many characteristics in the process of transmission over wires and through magnetic apparatus that it would not be intelligible. It is certain that at present long-distance transmission of speech can only be accomplished by using more powerful transmitters, and by making the line of copper better fitted for the transmission—just as quick transportation from place to place has not been accomplished by quitting the earth and by flying through space, but by obtaining more powerful engines and by improving the roadbeds.

The hopes of obtaining a relay for wireless telegraphy seem as small as they do in telephony. The present method is practically limited to distances of fifty or sixty miles—distances not much exceeding those which can be reached by a search-light in fair weather. Indeed, there is a close parallelism between the search-light and the spark used in Marconi's experiments: both send out waves which differ only in length. The waves of the search-light are about one forty-thousandth of an inch long, while the magnetic waves of the spark, invisible to the eye, are three to four feet—more than a million times longer than the light waves. These very long waves have this advantage over the short light waves: they are able to penetrate fog, and even sand hills and masonry. One can send messages into a building from a point outside. A prisoner could communicate with the outer world, a beleaguered garrison could send for help, a disabled light-ship could summon assistance, and possibly one steamer could inform another in a fog of its course.

Wireless telegraphy is the nearest approach to telepathy that has been vouchsafed to our intelligence, and it serves to stimulate our imagination and to make us think that things greatly hoped for can be always reached, although not exactly in the way expected. The nerves of the whole world are, so to speak, being bound together, so that a touch in one country is transmitted instantly to a far-distant one. Why should we not in time speak through the earth to the antipodes? If the magnetic waves can pass through brick and stone walls and sand hills, why [Pg 73] should we not direct, so to speak, our trumpet to the earth, instead of letting its utterances skim over the horizon? In regard to this suggestion, we know certainly one fact from our laboratory experiences: that these magnetic waves, meeting layers of electrically conducting matter, like layers of iron ore, would be reflected back, and would not penetrate. Thus a means may be discovered through the instrumentality of such waves of exploring the mysteries of the earth before success is attained in completely penetrating its mass.

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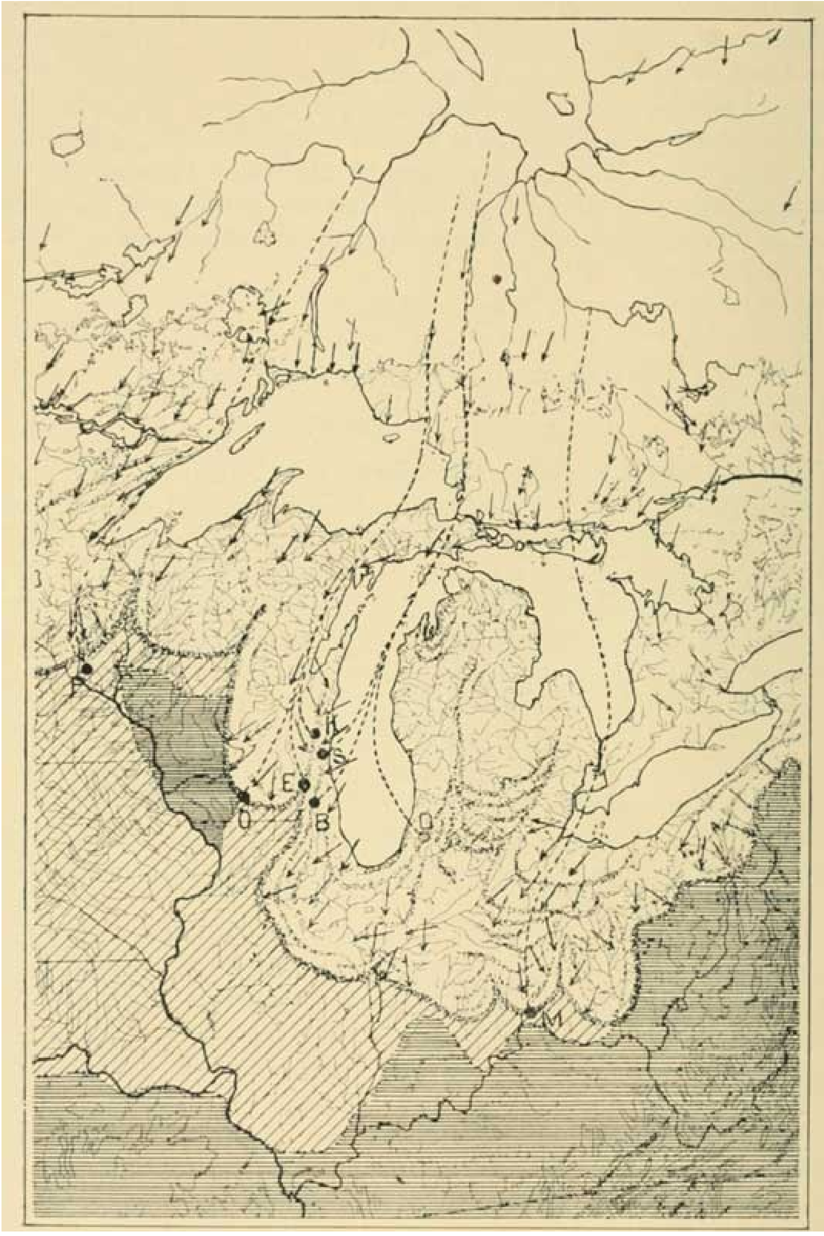
# EMIGRANT DIAMONDS IN AMERICA.

**By Prof. WILLIAM HERBERT HOBBS.**

To discover the origin of the diamond in Nature we must seek it in its ancestral home, where the rocky matrix gave it birth in the form characteristic of its species. In prosecuting our search we should very soon discover that, in common with other gem minerals, the diamond has been a great wanderer, for it is usually found far from its original home. The disintegrating forces of the atmosphere, by acting upon the rocky material in which the stones were imbedded, have loosed them from their natural setting, to be caught up by the streams, sorted from their disintegrated matrix, and transported far from the parent rock, to be at last set down upon some gravelly bed over which the force of the current is weakened. The mines of Brazil and the Urals, of India, Borneo, and the "river diggings" of South Africa either have been or are now in deposits of this character.

The "dry diggings" of the Kimberley district, in South Africa, afford the unique locality in which the diamond has thus far been found in its original home, and all our knowledge of the genesis of the mineral has been derived from study of this locality. The mines are located in "pans," in which is found the "blue ground" now recognized as the disintegrated matrix of the diamond. These "pans" are known to be the "pipes," or "necks," of former volcanoes, now deeply dissected by the forces of the atmosphere—in fact, worn down if not to their roots, at least to their stumps. These remnants of the "pipes," through which the lava reached the surface, are surrounded in part by a black shale containing a large percentage of carbon, and this is believed to be the material out of which the diamonds have been formed. What appear to be modified fragments of the black shale inclosed within the "pipes" afford evidence that portions of the shale have been broken from the [Pg 74] parent beds by the force of the ascending current of lava—a common enough accompaniment to volcanic action—and have been profoundly altered by the high temperature and the extreme hydrostatic pressure under which the mass must have been held. The most important feature of this alteration has been the recrystallization of the carbon of the shale into diamond.



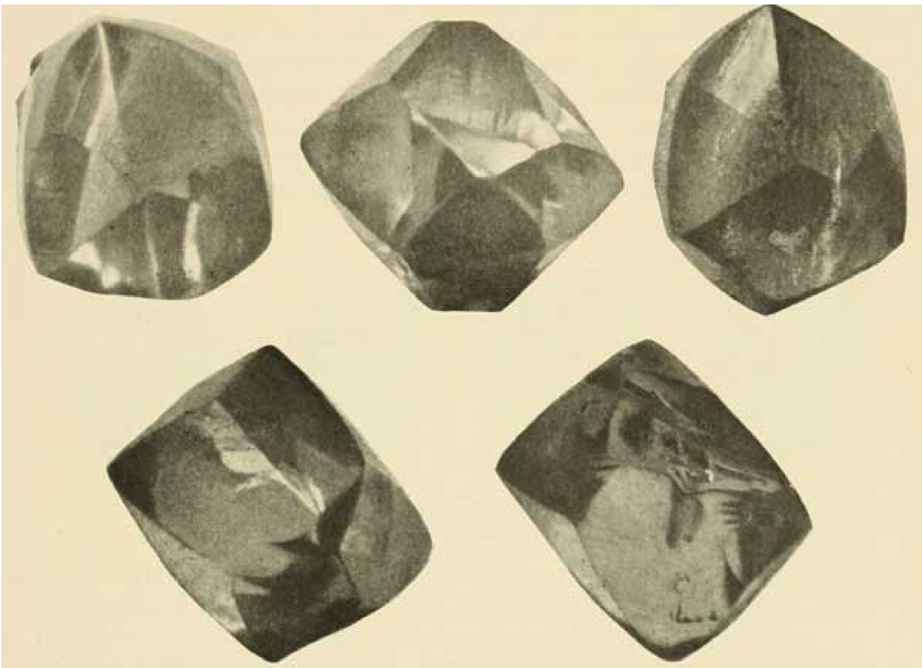

**GLACIAL MAP OF THE GREAT LAKES REGION**

| | | |
|---|---|---|
| shaded | //////// | clear |
| Driftless Areas. | Older Drift. | Newer Drift. |
| Moraines. | Glacial Striae. | Track of Diamonds. |
| Diamond Localities. | E. Eagle. | O. Oregon. |

K. Kohlsville D. Dowagiac M. Milford. P. Plum Crk. B. Burlington.

We are indebted to the University of Chicago Press for the above illustration.

[Pg 75]



Copyright, 1899, by George F. Kunz.

**Five Views of the Eagle Diamond (sixteen carats); enlarged about three diameters.**
**(Owned by Tiffany and Company.)**

We are indebted to the courtesy of Mr. G. F. Kunz, of Tiffany and Company, for the illustrations of the Oregon and Eagle diamonds.

This apparent explanation of the genesis of the diamond finds strong support in the experiments of Moissan, who obtained artificial diamond by dissolving carbon in molten iron and immersing the mass in cold water until a firm surface crust had formed. The "chilled" mass was then removed, to allow its still molten core to solidify slowly. This it does with the development of enormous pressures, because the natural expansion of the iron on passing into the solid condition is resisted by the strong shell of "chilled" metal. The isolation of the diamond was then accomplished by dissolving the iron in acid.



The prevailing form of the South African diamonds is that of a rounded crystal, with eight large and a number of minute faces—a form called by crystallographers a *modified octahedron*. Their shapes would be roughly simulated by the Pyramids of Egypt if they could be seen, combined with their reflected images, in a placid lake, or, better to meet the conditions of the country, in a desert mirage. It is a peculiar property of diamond crystals to have convexly rounded faces, so that the edges which separate the faces are not straight, but gently curving. Less frequently in the African mines, but commonly in some other regions, diamonds are bounded by four, twelve, twenty-four, or even forty-eight faces. These must not, of course, be confused with the faces of cut stones, which are the product of the lapidary's art.

Geological conditions remarkably like those observed at the Kimberley mines have recently been discovered in Kentucky, with the difference that here the shales contain a much smaller percentage of carbon, which may be the reason that diamonds have not rewarded the diligent search that has been made for them.

Though now found in the greatest abundance in South Africa and in Brazil, diamonds were formerly obtained from India, Borneo, and from the Ural Mountains of Russia. The great stones of history have, with hardly an exception, come from India, though in recent years a number of diamond monsters have been found in South Africa. One of these, the "Excelsior," weighed nine hundred and seventy carats, which is in excess even of the supposed weight of the "Great Mogul."

Copyright, 1899, by George F. Kunz.

**Four Views of the Oregon Diamond; enlarged about three diameters.**
**(Owned by Tiffany and Company.)**

Occasionally diamonds have come to light in other regions than those specified. The Piedmont plateau, at the southeastern base of the Appalachians, has produced, in the region between southern Virginia and Georgia, some ten or twelve diamonds, which have varied in weight from those of two or three carats to the "Dewey" diamond, which when found weighed over twenty-three carats.

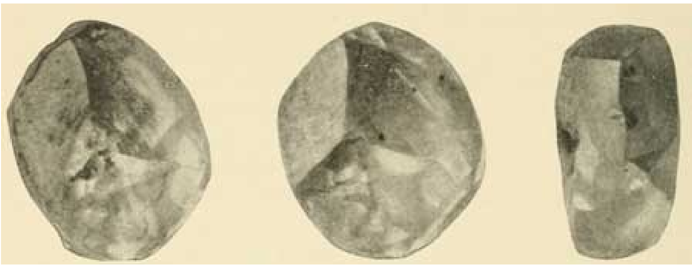
It is, however, in the territory about the Great Lakes that the greatest interest now centers, for in this region a very interesting problem of origin is being worked out. No less than seven diamonds, ranging in size from less than four to more than twenty-one carats, not to mention a [Pg 77] number of smaller stones, have been recently found in the clays and gravels of this region, where their distribution was such as to indicate with a degree of approximation the location of their distant ancestral home.

In order clearly to set forth the nature of this problem and the method of its solution it will be necessary, first, to plot upon a map of the lake region the locality at which each of the stones has been found, and, further, to enter upon the same map the data which geologists have gleaned regarding the work of the great ice cap of the Glacial period. During this period, not remote as geological time is reckoned, an ice mantle covered the entire northeastern portion of our continent, and on more than one occasion it invaded for considerable distances the territory of the United States. Such a map as has been described discloses an important fact which holds the clew for the detection of the ancestral home of these diamonds. Each year is bringing with it new evidence, and we may look forward hopefully to a full solution of the problem.

In 1883 the "Eagle Stone" was brought to Milwaukee and sold for the nominal sum of one dollar. When it was submitted to competent examination the public learned that it was a diamond of sixteen carats' weight, and that it had been discovered seven years earlier in earth removed from a well-opening. Two events which were calculated to arouse local interest followed directly upon the discovery of the real nature of this gem, after which it passed out of the public notice. The woman who had parted with the gem for so inadequate a compensation brought suit against the jeweler to whom she had sold it, in order to recover its value. This curious litigation, which naturally aroused a great deal of interest, was finally carried to the Supreme Court of the State of Wisconsin, from which a decision was handed down in favor of the defendant, on the ground that he, no less than the plaintiff, had been ignorant of the value of the gem at the time of purchasing it. The other event was the "boom" of the town of Eagle as a diamond center, which, after the finding of two other diamonds with unmistakable marks of African origin upon them, ended as suddenly as it had begun, with the effect of temporarily discrediting, in the minds of geologists, the genuineness of the original "find."

Ten years later a white diamond of a little less than four carats' weight came to light in a collection of pebbles found in Oregon, Wisconsin, and brought to the writer for examination. The stones had been found by a farmer's lad while playing in a clay bank near his home. The investigation of the subject which was thereupon made brought out the fact that a third diamond, [Pg 78] and this the larges of all, had been discovered at Kohlsville, in the same State, in 1883, and was still in the possession of the family on whose property it had been found.

As these stones were found in the deposits of "drift" which were left by the ice of the Glacial period, it was clear that they had been brought to their resting places by the ice itself. The map reveals the additional fact, and one of the greatest significance, that all these diamonds were found in the so-called "kettle moraine." This moraine or ridge was the dumping ground of the ice for its burden of bowlders, gravel, and clay at the time of its later invasion, and hence indicates the boundaries of the territory over which the ice mass was then extended. In view of the fact that two of the three stones found had remained in the hands of the farming population, without coming to the knowledge of the world, for periods of eleven and seven years respectively, it seems most probable that others have been found, though not identified as diamonds, and for this reason are doubtless still to be found in many cases in association with other local "curios" on the clock shelves of country farmhouses in the vicinity of the "kettle moraine." The writer felt warranted in predicting, in 1894, that other diamonds would occasionally be brought to light in the "kettle moraine," though the great extent of this moraine left little room for hope that more than one or two would be found at any one point of it.



**Three Views of the Saukville Diamond (six carats); enlarged about three diameters.**
**(Owned by Bunde and Upmeyer, Milwaukee.)**

We are indebted to the courtesy of Bunde and Upmeyer, of Milwaukee, for the illustrations showing the Burlington and Saukville diamonds.

In the time that has since elapsed diamonds have been found at the rate of about one a year, though not, so far as I am aware, in any case as the result of search. In Wisconsin have been found the Saukville diamond, a beautiful white stone of six carats' weight, and also the Burlington stone, having a weight of a little over two carats. The former had been for more than sixteen [Pg 79] years in the possession of the finder before he learned of its value. In Michigan has been found the Dowagiac stone, of about eleven carats' weight, and only very recently a diamond weighing six carats and of exceptionally fine "water" has come to light at Milford, near Cincinnati. This augmentation of the number of localities, and the nearness of all to the "kettle moraines," leaves little room for doubt that the diamonds were conveyed by the ice at the time of its later invasion of the country.

Having, then, arrived at a satisfactory conclusion regarding not only the agent which conveyed the stones, but also respecting the period during which they were transported, it is pertinent to inquire by what paths they were brought to their adopted homes, and whether, if these may be definitely charted, it may not be possible to follow them in a direction the reverse of that taken by the diamonds themselves until we arrive at the point from which each diamond started upon its journey. If we succeed in this we shall learn whether they have a common home, or whether they were formed in regions more or less widely separated. From the great rarity of diamonds in Nature it would seem that the hypothesis of a common home is the more probable, and this view finds confirmation in the fact that certain marks of "consanguinity" have been observed upon the stones already found.

**Four Views of the Burlington Diamond (a little over two carats); enlarged about three diameters. (Owned by Bunde and Upmeyer, Milwaukee.)**

Not only did the ice mantle register its advance in the great ridge of morainic material which we know as the "kettle moraine," but it has engraved upon the ledges of rock over which it has ridden, in a simple language of lines and grooves, the direction of its movement, after first having planed away the disintegrated portions of the rock to secure a smooth and lasting surface. As the same ledges have been overridden more than once, and at intervals widely separated, they are often found, palimpsestlike, with recent characters superimposed upon earlier, partly effaced, and nearly illegible ones. Many of the scattered leaves of this record have, however, been copied by geologists, and the autobiography of the ice is now read from maps which give the direction of [Pg 80] its flow, and allow the motion of the ice as a whole, as well as that of each of its parts, to be satisfactorily studied. Recent studies by Canadian geologists have shown that one of the highest summits of the ice cap must have been located some distance west of Hudson Bay, and that another, the one which glaciated the lake region, was in Labrador, to the east of the same body of water. From these points the ice moved in spreading fans both northward toward the Arctic Ocean and southward toward the States, and always approached the margins at the moraines in a direction at right angles to their extent. Thus the rock material transported by the ice was spread out in a great fan, which constantly extended its boundaries as it advanced.

The evidence from the Oregon, Eagle, and Kohlsville stones, which were located on the moraine of the Green Bay glacier, is that their home, in case they had a common one, is between the northeastern corner of the State of Wisconsin and the eastern summit of the ice mantle—a narrow strip of country of great extent, but yet a first approximation of the greatest value. If we assume, further, that the Saukville, Burlington, and Dowagiac stones, which were found on the moraine of the Lake Michigan glacier, have the same derivation, their common home may confidently be placed as far to the northeast as the wilderness beyond the Great Lakes, since the Green Bay and Lake Michigan glaciers coalesced in that region. The small stones found at Plum Creek, Wisconsin, and the Cincinnati stone, if the locations of their discovery be taken into consideration, still further circumscribe the diamond's home territory, since the lobes of the ice mass which transported them made a complete junction with the Green Bay and Lake Michigan lobes or glaciers considerably farther to the northward than the point of union of the latter glaciers themselves.

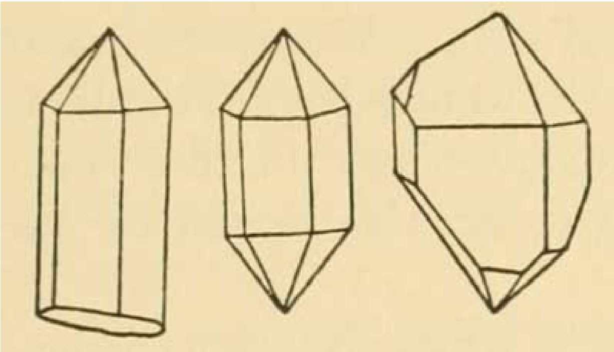
**Three Views of a Lead Cast of the Milford Stone (six carats);**

**enlarged about three diameters.**

We are indebted to the courtesy of Prof. T. H. Norton, of the University of Cincinnati, for the above illustrations.

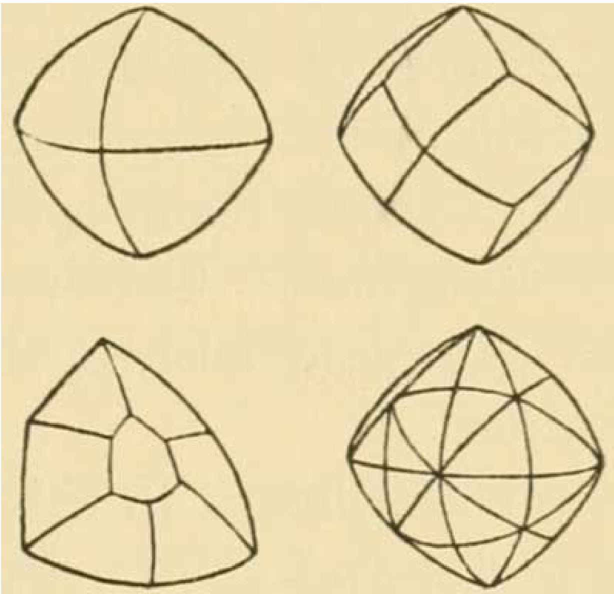
If, therefore, it is assumed that all the stones which have been found have a common origin, the
[Pg 81] conclusion is inevitable that the ancestral home must be in the wilderness of Canada between the points where the several tracks marking their migrations converge upon one another, and the former summit of the ice sheet. The broader the "fan" of their distribution, the nearer to the latter must the point be located.

It is by no means improbable that when the barren territory about Hudson Bay is thoroughly explored a region for profitable diamond mining may be revealed, but in the meantime we may be sure that individual stones will occasionally be found in the new American homes into which they were imported long before the days of tariffs and ports of entry. Mother Nature, not content with lavishing upon our favored nation the boundless treasures locked up in her mountains, has robbed the territory of our Canadian cousins of the rich soils which she has unloaded upon our lake States, and of the diamonds with which she has sowed them.



**Common Forms of Quartz Crystals.**

The range of the present distribution of the diamonds, while perhaps not limited exclusively to the "kettle moraine," will, as the events have indicated, be in the main confined to it. This moraine, with its numerous subordinate ranges marking halting places in the final retreat of the ice, has now been located with sufficient accuracy by the geologists of the United States Geological Survey and others, approximately as entered upon the accompanying map. Within the territory of the United States the large number of observations of the rock scorings makes it clear that the ice of each lobe or glacier moved from the central portion toward the marginal moraines, which are here indicated by dotted bands. In the wilderness of Canada the observations have been rare, but the few data which have been gleaned are there represented by arrows pointed in the direction of ice movement.



**Common Forms of Diamonds. The African stones most resemble the figure above at the left (octahedron). The Wisconsin stones most resemble the figure above at the right (dodecahedron).**

There is every encouragement for persons who reside in or near the marginal moraines to search in them for the scattered jewels, which may be easily identified and which have a large commercial as well as scientific value.

[Pg 82] The Wisconsin Geological and Natural History Survey is now interesting itself in the problem of the diamonds, and has undertaken the task of disseminating information bearing on the subject to the people who reside near the "kettle moraine." With the co-operation of a number of mineralogists who reside near this "diamond belt," it offers to make examination of the supposed gem stones which may be collected.

The success of this undertaking will depend upon securing the co-operation of the people of the morainal belt. Wherever gravel ridges have there been opened in cuts it would be advisable to look for diamonds. Children in particular, because of their keen eyes and abundant leisure, should be encouraged to search for the clear stones.

The serious defect in this plan is that it trusts to inexperienced persons to discover the buried diamonds which in the "rough" are probably unlike anything that they have ever seen. The first result of the search has been the collection of large numbers of quartz pebbles, which are everywhere present but which are entirely valueless. There are, however, some simple ways of distinguishing diamonds from quartz.

Diamonds never appear in thoroughly rounded forms like ordinary pebbles, for they are too hard to be in the least degree worn by contact with their neighbors in the gravel bed. Diamonds always show, moreover, distinct forms of crystals, and these generally bear some resemblance to one of the forms figured. They are never in the least degree like crystals of quartz, which are, however, the ones most frequently confounded with them. Most of the Wisconsin diamonds have either twelve or forty-eight faces. Crystals of most minerals are bounded by plane surfaces—that is to say, their faces are flat—the diamond, however, is inclosed by distinctly curving surfaces.

The one property of the diamond, however, which makes it easy of determination is its extraordinary hardness—greater than that of any other mineral. Put in simple language, the hardness of a substance may be described as its power to scratch other substances when drawn across them under pressure. To compare the hardness of two substances we should draw a sharp point of one across a surface of the other under a pressure of the fingers, and note whether a permanent scratch is left. The harder substances will always scratch the softer, and if both have the same hardness they may be made to mutually scratch each other. Since diamond, sapphire, and ruby are the only minerals which are harder than emery they are the only ones which, when [Pg 83] drawn across a rough emery surface, will not receive a scratch. Any stone which will not take a scratch from emery is a gem stone and of sufficient interest to be referred to a competent mineralogist.

The dissemination of information regarding the lake diamonds through the region of the moraine should serve the twofold purpose of encouraging search for the buried stones and of discovering diamonds in the little collections of "lucky stones" and local curios which accumulate on the clock shelves of country farmhouses. When it is considered that three of the largest diamonds thus far found in the region remained for periods of seven, eight, and sixteen years respectively in the hands of the farming population, it can hardly be doubted that many other diamonds have been found and preserved as local curiosities without their real nature being discovered.

If diamonds should be discovered in the moraines of eastern Ohio, of western Pennsylvania, or of western New York, considerable light would thereby be thrown upon the problem of locating the ancestral home. More important than this, however, is the mapping of the Canadian wilderness to the southeastward and eastward of James Bay, in order to determine the direction of ice movement within the region, so that the *tracking* of the stones already found may be carried nearer their home. The Director of the Geological Survey of Canada is giving attention to this matter, and has also suggested that a study be made of the material found in association with the diamonds in the moraine, so that if possible its source may be discovered.

With the discovery of new localities of these emigrant stones and the collection of data regarding the movement of the ice over Canadian territory, it will perhaps be possible the more accurately and definitely to circumscribe their home country, and as its boundaries are drawn closer and closer to pay this popular jewel a visit in its ancestral home, there to learn what we so much desire to know regarding its genesis and its life history.

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William Pengelly related, in one of his letters to his wife from the British Association, Oxford meeting, 1860, of Sedgwick's presidency of the Geological Section, that his opening address was "most characteristic, full of clever fun, most imperative that papers should be as brief as possible—about ten minutes, he thought—he himself amplifying marvelously." The next day Pengelly himself was about to read his paper, when "dear old Sedgwick wished it compressed. I replied that I would do what I could to please him, but did not know which to follow, his precept or example. The roar of laughter was deafening. Old Sedgwick took it capitally, and behaved much better in consequence." On the third day Pengelly went to committee, where, he says, "I found Sedgwick very cordial, took my address, and talks of paying me a visit."

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[Pg 84]

# NEEDED IMPROVEMENTS IN THEATER SANITATION.

**By WILLIAM PAUL GERHARD, C. E.,**

CONSULTING ENGINEER FOR SANITARY WORKS.

Buildings for the representation of theatrical plays must fulfill three conditions: they must be (1) comfortable, (2) safe, and (3) healthful. The last requirement, of *healthfulness*, embraces the following conditions: plenty of pure air, freedom from draughts, moderate warming in winter, suitable cooling in summer, freedom at all times from dust, bad odors, and disease germs. In addition to the requirements for the theater audience, due regard should be paid to the comfort, healthfulness, and safety of the performers, stage hands, and mechanics, who are required to spend more hours in the stage part of the building than the playgoers.

It is no exaggeration to state that in the majority of theater buildings disgracefully unsanitary conditions prevail. In the older existing buildings especially sanitation and ventilation are sadly neglected. The air of many theaters during a performance becomes overheated and stuffy, pre-eminently so in the case of theaters where illumination is effected by means of gaslights. At the end of a long performance the air is often almost unbearably foul, causing headache, nausea, and dizziness.

In ill-ventilated theaters a chilly air often blows into the auditorium from the stage when the curtain is raised. This air movement is the cause of colds to many persons in the audience, and it is otherwise objectionable, for it carries with it noxious odors from the stage or under stage, and in gas-lighted theaters this air is laden with products of combustion from the footlights and other means of stage illumination.

Attempts at ventilation are made by utilizing the heat due to the numerous flames of the central chandelier over the auditorium, to create an ascending draught, and thereby cause a removal of the contaminated air, but seldom is provision made for the introduction of fresh air from outdoors, hence the scheme of ventilation results in failure. In other buildings, openings for the introduction of pure air are provided under the seats or in the floor, but are often found stuffed up with paper because the audience suffered from draughts. The fear of draughts in a theater also leads to the closing of the few possibly available outside windows and doors. The plan of a theater building renders it almost impossible to provide outside windows, therefore "air flushing" [Pg 85] during the day can not be practiced. In the case of the older theaters, which are located in the midst or rear of other buildings, the nature of the site precludes a good arrangement of the main fresh-air ducts for the auditorium.

Absence of fresh air is not the only sanitary defect of theater buildings; there are many other defects and sources of air pollution. In the parts devoted to the audience, the carpeted floors become saturated with dirt and dust carried in by the playgoers, and with expectorations from careless or untidy persons which in a mixed theater audience are ever present. The dust likewise adheres to furniture, plush seats, hangings, and decorations, and intermingled with it are numerous minute floating organisms, and doubtless some germs of disease.

Behind the curtain a general lack of cleanliness exists—untidy actors' toilet rooms, ill-drained cellars, defective sewerage, leaky drains, foul water closets, and overcrowded and poorly located dressing rooms into which no fresh air ever enters. The stage floor is covered with dust; this is stirred up by the frequent scene shifting or by the dancing of performers, and much of it is absorbed and retained by the canvas scenery.

Under such conditions the state of health of both theater goers and performers is bound to suffer. Many persons can testify from personal experience to the ill effects incurred by spending a few hours in a crowded and unventilated theater; yet the very fact that the stay in such buildings is a brief one seems to render most people indifferent, and complaints are seldom uttered. It really rests with the theater-going public to enforce the much-needed improvements. As long as they will flock to a theater on account of some attractive play or "star actor," disregarding entirely the unsanitary condition of the building, so long will the present notoriously bad conditions remain. When the public does not call for reforms, theater managers and owners of playhouses will not, as a rule, trouble themselves about the matter. We have a right to demand theater buildings with less outward and inside gorgeousness, but in which the paramount subjects of comfort, safety, and health are diligently studied and generously provided for. Let the general public but once show a determined preference for sanitary conditions and surroundings in theaters and abandon visits to ill-kept theaters, and I venture to predict that the necessary reforms in sanitation will soon be introduced, at least in the better class of playhouses. In the cheaper theaters, concert and amusement halls, houses with "continuous" shows, variety theaters, etc., sanitation is even more urgently required, and may be readily enforced by a few visits and peremptory orders from the Health Board.

[Pg 86] When, a year ago, the writer, in a paper on Theater Sanitation presented at the annual meeting of the American Public Health Association, stated that "chemical analyses show the air in the dress circle and gallery of many a theater to be in the evening more foul than the air of street sewers," the statement was received by some of his critics with incredulity. Yet the fact is true of many theaters. Taking the amount of carbonic acid in the air as an indication of its contamination, and assuming that the organic vapors are in proportion to the amount of carbonic acid (not including the $CO_2$ due to the products of illumination), we know that normal outdoor air contains from 0.03 to 0.04 parts of $CO_2$ per 100 parts of air, while a few chemical analyses of the air in English theaters, quoted below, suffice to prove how large the contamination sometimes is:

| | | | | | | |
|---|---|---|---|---|---|---|
| Strand Theater, | 10 P.M., | gallery | 0.101 | parts | $CO_2$ | per 100. |
| Surrey Theater, | 10 P.M., | boxes | 0.126 | " | " | " |
| Surrey Theater, | 12 P.M., | boxes | 0.218 | " | " | " |
| Olympia Theater, | 11.30 P.M., | boxes | 0.082 | " | " | " |
| Olympia Theater, | 11.55 P.M., | boxes | 0.101 | " | " | " |
| Victoria Theater, | 10 P.M., | boxes | 0.126 | " | " | " |
| Haymarket Theater, | 10 P.M., | boxes | 0.076 | " | " | " |
| City of London Theater, | 11.15 P.M., | pit | 0.252 | " | " | " |
| Standard Theater, | 11 P.M., | pit | 0.320 | " | " | " |
| Theater Royal, Manchester, | | pit | 0.2734 | " | " | " |
| Theater Royal, Manchester, | | pit | 0.2734 | " | " | " |
| Grand Theater, Leeds, | | pit | 0.150 | " | " | " |
| Grand Theater, Leeds, | | upper circle | 0.143 | " | " | " |
| Grand Theater, Leeds, | | balcony | 0.142 | " | " | " |

| | | | | | |
|---|---|---|---|---|---|
| Prince's Theater, Manchester, | balcony | 0.11-0.17 | " | " | " |

(Analyses made by Drs. Smith, Bernays, and De Chaumont.)

Compare with these figures some analyses of the air of sewers. Dr. Russell, of Glasgow, found the air of a well-ventilated and flushed sewer to contain 0.051 vols. of $CO_2$. The late Prof. W. Ripley Nichols conducted many careful experiments on the amount of carbonic acid in the Boston sewers, and found the following averages, viz., 0.087, 0.082, 0.115, 0.107, 0.08, or much less than the above analyses of theater air showed. He states: "It appears from these examinations that the air even in a tide-locked sewer does not differ from the standard as much as many no doubt suppose."

A comparison of the number of bacteria found in a cubic foot of air inside of a theater and in the street air would form a more convincing statement, but I have been unable to find published records of any such bacteriological tests. Nevertheless, we know that while the atmosphere contains some bacteria, the indoor air of crowded assembly halls, laden with floating dust, is [Pg 87] particularly rich in living micro-organisms. This has been proved by Tyndall, Miquel, Frankland, and other scientists; and in this connection should be mentioned one point of much importance, ascertained quite recently, namely, that the air of sewers, contrary to expectation, is remarkably free from germs. An analysis of the air in the sewers under the Houses of Parliament, London, showed that the number of micro-organisms was much less than that in the atmosphere outside of the building.

In recent years marked improvements in theater planning and equipment have been effected, and corresponding steps in advance have been made in matters relating to theater hygiene. It should therefore be understood that my remarks are intended to apply to the average theater, and in particular to the older buildings of this class. There are in large cities a few well-ventilated and hygienically improved theaters and opera houses, in which the requirements of sanitation are observed. Later on, when speaking more in detail of theater ventilation, instances of well-ventilated theaters will be mentioned. Nevertheless, the need of urgent and radical measures for comfort and health in the majority of theaters is obvious. Much is being done in our enlightened age to improve the sanitary condition of school buildings, jails and prisons, hospitals and dwelling houses. Why, I ask, should not our theaters receive some consideration?

The efficient ventilation of a theater building is conceded to be an unusually difficult problem. In order to ventilate a theater properly, the causes of noxious odors arising from bad plumbing or defective drainage should be removed; outside fumes or vapors must not be permitted to enter the building either through doors or windows, or through the fresh-air duct of the heating apparatus. The substitution of electric lights in place of gas is a great help toward securing pure air. This being accomplished, a standard of purity of the air should be maintained by proper ventilation. This includes both the removal of the vitiated air and the introduction of pure air from outdoors and the consequent entire change of the air of a hall three or four times per hour. The fresh air brought into the building must be ample in volume; it should be free from contamination, dust and germs (particularly pathogenic microbes), and with this in view must in cities be first purified by filtering, spraying, or washing. It should be warmed in cold weather by passing over hot-water or steam-pipe stacks, and cooled in warm weather by means of ice or the brine of mechanical refrigerating machines. The air should be of a proper degree of humidity, and, what is most important of all, it should be admitted into the various parts of the theater [Pg 88] imperceptibly, so as not to cause the sensation of draught; in other words, its velocity at the inlets must be very slight. The fresh air should enter the audience hall at numerous points so well and evenly distributed that the air will be equally diffused throughout the entire horizontal cross-section of the hall. The air indoors should have as nearly as possible the composition of air outdoors, an increase of the $CO_2$ from 0.3 to 0.6 being the permissible limit. The vitiated air should be continuously removed by mechanical means, taking care, however, not to remove a larger volume of air than is introduced from outdoors.

Regarding the amount of fresh outdoor air to be supplied to keep the inside atmosphere at anything like standard purity, authorities differ somewhat. The theoretical amount, 3,000 cubic feet per person per hour (50 cubic feet per minute), is made a requirement in the Boston theater law. In Austria, the law calls for 1,050 cubic feet. The regulations of the Prussian Minister of Public Works call for 700 cubic feet, Professor von Pettenkofer suggests an air supply per person of from 1,410 to 1,675 cubic feet per hour (23 to 28 cubic feet per minute), General Morin calls for 1,200 to 1,500 cubic feet, and Dr. Billings, an American authority, requires 30 cubic feet per minute, or 1,800 cubic feet per hour. In the Vienna Opera House, which is described as one of the best-ventilated theaters in the world, the air supply is 15 cubic feet per person per minute. The Madison Square Theater, in New York, is stated to have an air supply of 25 cubic feet per person.

In a moderately large theater, seating twelve hundred persons, the total hourly quantity of air to be supplied would, accordingly, amount to from 1,440,000 to 2,160,000 cubic feet. It is not an easy matter to arrange the fresh-air conduits of a size sufficient to furnish this volume of air; it is obviously costly to warm such a large quantity of air, and it is a still more difficult problem to introduce it without creating objectionable currents of air; and, finally, inasmuch as this air can not enter the auditorium unless a like amount of vitiated air is removed, the problem includes providing artificial means for the removal of large air volumes.

Where gas illumination is used, each gas flame requires an additional air supply—from 140 to 280 cubic feet, according to General Morin.

A slight consideration of the volumes of air which must be moved and removed in a theater to secure a complete change of air three or four times an hour, demonstrates the impossibility of securing satisfactory results by the so-called natural method of ventilation—i. e., the removal of air by means of flues with currents due either to the aspirating force of the wind or due to [Pg 89] artificially increased temperature in the flues. It becomes necessary to adopt mechanical means of ventilation by using either exhaust fans or pressure blowers or both, these being driven either by steam engines or by electric motors. In the older theaters, which were lighted by gas, the heat of the flames could be utilized to a certain extent in creating ascending currents in outlet shafts, and this accomplished some air renewal. But nowadays the central chandelier is almost entirely dispensed with; glowing carbon lamps, fed by electric currents, replace the gas flames; hence mechanical ventilation seems all the more indicated.

Two principal methods of theater ventilation may be arranged: in one the fresh air enters at or near the floor and rises upward to the ceiling, to be removed by suitable outlet flues; in this method the incoming air follows the naturally existing air currents; in the other method pure air enters at the top through perforated cornices or holes in the ceiling, and gradually descends, to be removed by outlets located at or near the floor line. The two systems are known as the "upward" and the "downward" systems; each of them has been successfully tried, each offers some advantages, and each has its advocates. In both systems separate means for supplying fresh air to the boxes, balconies, and galleries are required. Owing to the different opinions held by architects and engineers, the two systems have often been made the subject of inquiry by scientific and government commissions in France, England, Germany, and the United States.

A French scientist, Darcet, was the first to suggest a scientific system of theater ventilation. He made use of the heat from the central chandelier for removing the foul air, and admitted the air through numerous openings in the floor and through inlets in the front of the boxes.

Dr. Reid, an English specialist in ventilation, is generally regarded as the originator of the upward method in ventilation. He applied the same with some success to the ventilation of the Houses of Parliament in London. Here fresh air is drawn in from high towers, and is conducted to the basement, where it is sprayed and moistened. A part of the air is warmed by hot-water coils in a sub-basement, while part remains cold. The warm and the cold air are mixed in special mixing chambers. From here the tempered air goes to a chamber located directly under the floor of the auditorium, and passes into the hall at the floor level through numerous small holes in the floor. The air enters with low velocity, and to prevent unpleasant draughts the floor is covered in one hall with hair carpet and in the other with coarse hemp matting, both of which are cleaned [Pg 90] every day. The removal of the foul air takes place at the ceiling, and is assisted by the heat from the gas flames.

The French engineer Péclet, an authority on heating and ventilation, suggested a similar system of upward ventilation, but instead of allowing the foul air to pass out through the roof, he conducted it downward into an underground channel which had exhaust draught. Trélat, another French engineer, followed practically the same method.

A large number of theaters are ventilated on the upward system. I will mention first the large Vienna Opera House, the ventilation of which was planned by Dr. Boehm. The auditorium holds about three thousand persons, and a fresh-air supply of about fifteen cubic feet per minute, or from nine hundred to one thousand cubic feet per hour, per person is provided. The fresh air is taken in from the gardens surrounding the theater and is conducted into the cellar, where it passes through a water spray, which removes the dust and cools the air in summer. A suction fan ten feet in diameter is provided, which blows the air through a conduit forty-five square feet in area into a series of three chambers located vertically over each other under the auditorium. The lowest of these chambers is the cold-air chamber; the middle one is the heating chamber and contains steam-heating stacks; the highest chamber is the mixing chamber. The air goes partly to the heating and partly to the mixing chamber; from this it enters the auditorium at the rate of one foot per second velocity through openings in the risers of the seats in the parquet, and also through vertical wall channels to the boxes and upper galleries. The total area of the fresh-air openings is 750 square feet. The foul air ascends, assisted by the heat of the central chandelier, and is collected into a large exhaust tube. The foul air from the gallery passes out through separate channels. In the roof over the auditorium there is a fan which expels the entire foul air. Telegraphic thermometers are placed in all parts of the house and communicate with the inspection room, where the engineer in charge of the ventilation controls and regulates the temperature.

The Vienna Hofburg Theater was ventilated on the same system.

The new Frankfort Opera House has a ventilation system modeled upon that of the Vienna Opera House, but with improvements in some details. The house has a capacity of two thousand people, and for each person fourteen hundred cubic feet of fresh air per hour are supplied. A fan about ten feet in diameter and making ninety to one hundred revolutions per minute brings in the fresh [Pg 91] air from outdoors and drives it into chambers under the auditorium arranged very much like those at Vienna. The total quantity of fresh air supplied per hour is 2,800,000 cubic feet. The air enters the auditorium through gratings fixed above the floor level in the risers. The foul air is removed by outlets in the ceilings, which unite into a large vertical shaft below the cupola. An exhaust fan of ten feet diameter is placed in the cupola shaft, and is used for summer ventilation only. Every single box and stall is ventilated separately. The cost of the entire system was about one hundred and twenty-five thousand dollars; it requires a staff of two engineers, six assistant engineers, and a number of stokers.

Among well-ventilated American theaters is the Madison Square Theater (now Hoyt's), in New York. Here the fresh air is taken down through a large vertical shaft on the side of the stage. There is a seven-foot suction fan in the basement which drives the air into a number of boxes with steam-heating stacks, from which smaller pipes lead to openings under each row of seats. The foul air escapes through openings in the ceiling and under the galleries. A fresh-air supply of 1,500 cubic feet per hour, or 25 cubic feet per minute, per person is provided.

The Metropolitan Opera House is ventilated on the plenum system, and has an upward movement of air, the total air supply being 70,000 cubic feet per hour.

In the Academy of Music, Baltimore, the fresh air is admitted mainly from the stage and the exits of foul air are in the ceiling at the auditorium.

Other theaters ventilated by the upward method are the Dresden Royal Theater, the Lessing Theater in Berlin, the Opera House in Buda-Pesth, the new theater in Prague, the new Municipal Theater at Halle, and the Criterion Theatre in London.

The French engineer General Arthur Morin is known as the principal advocate of the downward method of ventilation. This was at that time a radical departure from existing methods because it apparently conflicted with the well-known fact that heated air naturally rises. Much the same system was advocated by Dr. Tripier in a pamphlet published in 1864.[7] The earlier practical applications of this system to several French theaters did not prove as much of a success as anticipated, the failure being due probably to the gas illumination, the central chandelier, and the absence of mechanical means for inducing a downward movement of the air.

In 1861 a French commission, of which General Morin was a member, proposed the reversing of the currents of air by admitting fresh air at both sides of the stage opening high up in the

auditorium, and also through hollow floor channels for the balconies and boxes; in the gallery the openings for fresh air were located in the risers of the steppings. The air was exhausted by numerous openings under the seats in the parquet. This ventilating system was carried out at the Théâtre Lyrique, the Théâtre du Cirque, and the Théâtre de la Gaieté.

Dr. Tripier ventilated a theater in 1858 with good success on a similar plan, but he introduced the air partly at the rear of the stage and partly in the tympanum in the auditorium. He removed the foul air at the floor level and separately in the rear of the boxes. He also exhausted the foul air from the upper galleries by special flues heated by the gas chandelier.

The Grand Amphitheater of the Conservatory of Arts and Industries, in Paris, was ventilated by General Morin on the downward system. The openings in the ceiling for the admission of fresh air aggregated 120 square feet, and the air entered with a velocity of only eighteen inches per second; the total air supply per hour was 630,000 cubic feet. The foul air was exhausted by openings in steps around the vertical walls, and the velocity of the outgoing air was about two and a half feet per second.

The introduction of the electric light in place of gas gave a fresh impetus to the downward method of ventilation, and mechanical means also helped to dispel the former difficulties in securing a positive downward movement.

The Chicago Auditorium is ventilated on this system, a part of the air entering from the rear of the stage, the other from the ceiling of the auditorium downward. This plan coincides with the proposition made in 1846 by Morrill Wyman, though he admits that it can not be considered the most desirable method.

A good example of the downward method is given by the New York Music Hall, which has a seating capacity of three thousand persons and standing room for one thousand more. Fresh air at any temperature desired is made to enter through perforations in or near the ceilings, the outlets being concealed by the decorations, and passes out through exhaust registers near the floor line, under the seats, through perforated risers in the terraced steps. About 10,000,000 cubic feet of air are supplied per hour, and the velocity of influx and efflux is one foot per second. The air supplied per person per hour is figured at 2,700 cubic feet, and the entire volume is changed from four and a half to five times per hour. The fresh air is taken in at roof level through a shaft of seventy square feet area. The air is heated by steam coils, and cooled in summer by ice. The mechanical plant comprises four blowers and three exhaust fans of six and seven feet in diameter.


The downward method of ventilation was suggested in 1884 for the improvement of the ventilation of the Senate chamber and the chamber of the House of Representatives in the Capitol at Washington, but the system was not adopted by the Board of Engineers appointed to inquire into the methods.

The downward method is also used in the Hall of the Trocadéro, Paris; in the old and also the new buildings for the German Parliament, Berlin; in the Chamber of Deputies, Paris; and others.

Professor Fischer, a modern German authority on heating and ventilation, in a discussion of the relative advantages of the two methods, reaches the conclusion that both are practical and can be made to work successfully. For audience halls lighted by gaslights he considers the upward method as preferable.

In arranging for the removal of foul air it is necessary, particularly in the downward system, to provide separate exhaust flues for the galleries and balconies. Unless this is provided for, the exhaled air of the occupants of the higher tiers would mingle with the descending current of pure air supplied to the occupants of the main auditorium floor.

Mention should also be made of a proposition originating in Berlin to construct the roof of auditoriums domelike, by dividing it in the middle so that it can be partly opened by means of electric or hydraulic machinery; such a system would permit of keeping the ceiling open in summer time, thereby rendering the theater not only airy, but also free from the danger of smoke. A system based on similar principles is in actual use at the Madison Square Garden, in New York, where part of the roof consists of sliding skylights which in summer time can be made to open or close during the performance.

From the point of view of safety in case of fire, which usually in a theater breaks out on the stage, it is without doubt best to have the air currents travel in a direction from the auditorium toward the stage roof. This has been successfully arranged in some of the later Vienna theaters, but from the point of view of good acoustics, it is better to have the air currents travel from the stage toward the auditorium. Obviously, it is a somewhat difficult matter to reconcile the conflicting requirements of safety from smoke and fire gases, good acoustics and perfect ventilation.

The stage of a theater requires to be well ventilated, for often it becomes filled with smoke or gases due to firing of guns, colored lights, torches, representations of battles, etc. There should be in the roof over the stage large outlet flues, or sliding skylights, controlled from the stage for the removal of the smoke. These, in case of an outbreak of fire on the stage, become of vital  importance in preventing the smoke and fire gases from being drawn into the auditorium and suffocating the persons in the gallery seats.

Where the stage is lit with gaslights it is important to provide a separate downward ventilation for the footlights. This, I believe, was first successfully tried at the large Scala Theater, of Milan, Italy.

The actors' and supers' dressing rooms, which are often overcrowded, require efficient ventilation, and other parts of the building, like the foyers and the toilet, retiring and smoking rooms, must not be overlooked.

The entrance halls, vestibules, lobbies, staircases, and corridors do not need so much ventilation, but should be kept warm to prevent annoying draughts. They are usually heated by abundantly large direct steam or hot-water radiators, whereas the auditorium and foyers, and often the stage, are heated by indirect radiation. Owing to the fact that during a performance the temperature in the auditorium is quickly raised by contact of the warm fresh air with the bodies of persons (and by the numerous lights, when gas is used), the temperature of the incoming air should be only moderate. In the best modern theater-heating plants it is usual to gradually reduce the temperature of the air as it issues from the mixing chambers toward the end of the performance. Both the temperature and the hygrometric conditions of the air should be controlled by an efficient staff of intelligent heating engineers.

But little need be said regarding theater lighting. Twice during the present century have the system and methods been changed. In the early part of the present century theaters were still lighted with tallow candles or with oil lamps. Next came what was at the time considered a wonderful improvement, namely, the introduction of gaslighting. The generation who can remember witnessing a theater performance by candle or lamp lights, and who experienced the excitement created when the first theater was lit up by gas, will soon have passed away. Scarcely twenty years ago the electric light was introduced, and there are to-day very few theaters which do not make use of this improved illuminant. It generates much less heat than gaslight, and vastly simplifies the problem of ventilation. The noxious products of combustion, incident to all other methods of illumination, are eliminated: no carbonic-acid gas is generated to render the air of audience halls irrespirable, and no oxygen is drawn to support combustion from the air introduced for breathing.



It being now an established fact that the electric light increases the safety of human life in theaters and other places of amusement, its use is in many city or building ordinances made imperative—at least on the stage and in the main body of the auditorium. Stairs, corridors, entrances, etc., may, as a matter of precaution, be lighted by a different system, by means of either gas or auxiliary vegetable oil or candle lamps, protected by glass inclosures against smoke or draught, and provided with special inlet and outlet flues for air.

Passing to other desirable internal improvements of theaters, I would mention first the floors of the auditorium. The covering of the floor by carpets is objectionable—in theaters more so even than in dwelling houses. Night after night the carpet comes in contact with thousands of feet, which necessarily bring in a good deal of street dirt and dust. The latter falls on the carpets and attaches to them, and as it is not feasible to take the carpets up except during the summer closing, a vast accumulation of dirt and organic matter results, some of the dirt falling through the crevices between the floor boards. Many theater-goers are not tidy in their habits regarding expectoration, and as there must be in every large audience some persons afflicted with tuberculosis, the danger is ever present of the germs of the disease drying on the carpet, and becoming again detached to float in the air which we are obliged to breathe in a theater.

As a remedy I would propose abolishing carpets entirely, and using instead a floor covering of linoleum, or thin polished parquetry oak floors, varnished floors of hard wood, painted and stained floors, interlocked rubber-tile floors, or, at least for the aisles, encaustic or mosaic tiling. Between the rows of seats, as well as in the aisles, long rugs or mattings may be laid down loose, for these can be taken up without much trouble. They should be frequently shaken, beaten, and cleaned.

Regarding the walls, ceilings, and cornices, the surfaces should be of a material which can be readily cleaned and which is non-absorbent. Stucco finish is unobjectionable, but should be kept flat, so as not to offer dust-catching projections. Oil painting of walls is preferable to a covering with rough wall papers, which hold large quantities of dust. The so-called "sanitary" or varnished wall papers have a smooth, non-absorbent, easily cleaned surface, and are therefore unobjectionable. All heavy decorations, draperies, and hangings in the boxes, and plush covers for railings, are to be avoided.

The theater furniture should be of a material which does not catch or hold dust. Upholstered plush-covered chairs and seats retain a large amount of it, and are not readily cleaned. [Pg 96] Leather-covered or other sanitary furniture, or rattan seats, would be a great improvement.

In the stage building we often find four or five actors placed in one small, overheated, unventilated dressing room, located in the basement of the building, without outside windows, and fitted with three or four gas jets, for actors require a good light in "making up." More attention should be paid to the comfort and health of the players, more space and a better location should be given to their rooms. Every dressing room should have a window to the outer air, also a special ventilating flue. Properly trapped wash basins should be fitted up in each room. In the dressing rooms and in the corridors and stairs leading from them to the stage all draughts must be avoided, as the performers often become overheated from the excitement of the acting, and dancers in particular leave the heated stage bathed in perspiration. Sanitation, ventilation, and cleanliness are quite as necessary for this part of the stage building as for the auditorium and foyers.

It will suffice to mention that defects in the drainage and sewerage of a theater building must be avoided. The well-known requirements of house drainage should be observed in theaters as much as in other public buildings.[8]

The removal of ashes, litter, sweepings, oily waste, and other refuse should be attended to with promptness and regularity. It is only by constant attention to properly carried out cleaning methods that such a building for the public can be kept in a proper sanitary condition. Floating air impurities, like dust and dirt, can not be removed or rendered innocuous by the most perfect ventilating scheme. Mingled with the dust floating in the auditorium or lodging in the stage scenery are numbers of bacteria or germs. Among the pathogenic germs will be those of tuberculosis, contained in the sputum discharged in coughing or expectorating. When this dries on the carpeted floor, the germs become readily detached, are inhaled by the playgoers, and thus become a prolific source of danger. It is for this reason principally that the processes of cleaning, sweeping, and dusting should in a theater be under intelligent management.

To guard against the ever-present danger of infection by germs, the sanitary floor coverings recommended should be wiped every day with a moist rag or cloth. Carpeted floors should be covered with moist tea leaves or sawdust before sweeping to prevent the usual dust-raising. The [Pg 97] common use of the feather duster is to be deprecated, for it only raises and scatters the dust, but it does not remove it. Dusting of the furniture should be done with a dampened dust cloth. The cleaning should include the hot-air registers, where a large amount of dust collects, which can only be removed by occasionally opening up the register faces and wiping out the pipe surfaces; also the baseboards and all cornice projections on which dust constantly settles. While dusting and sweeping, the windows should be opened; an occasional admission of sunlight, where practicable, would likewise be of the greatest benefit.

The writer believes that a sanitary inspection of theater buildings should be instituted once a year when they are closed up in summer. He would also suggest that the granting of the annual license should be made dependent not only, as at present, upon the condition of safety of the building against fire and panic, but also upon its sanitary condition. In connection with the sanitary inspection, a thorough disinfection by sulphur, or better with formaldehyde gas, should be carried out by the health authorities. If necessary, the disinfection of the building should be repeated several times a year, particularly during general epidemics of influenza or pneumonia.

Safety measures against outbreaks of fire, dangers from panic, accidents, etc., are in a certain sense also sanitary improvements, but can not be discussed here.[9]

In order to anticipate captious criticisms, the writer would state that in this paper he has not attempted to set forth new theories, nor to advocate any special system of theater ventilation. His aim was to describe existing defects and to point out well-known remedies. The question of efficient theater sanitation belongs quite as much to the province of the sanitary engineer as to that of the architect. It is one of paramount importance—certainly more so than the purely architectural features of exterior and interior decoration.

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In presenting to the British Association the final report on the northwestern tribes of Canada, Professor Tylor observed that, while the work of the committee has materially advanced our knowledge of the tribes of British Columbia, the field of investigation is by no means exhausted. The languages are still known only in outlines. More detailed information on physical types may clear up several points that have remained obscure, and a fuller knowledge of the ethnology of the northern tribes seems desirable. Ethnological evidence has been collected bearing upon the history of the development of the area under consideration, but no archæological investigations, which would help materially in solving these problems, have been carried on.

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[Pg 98]

# THE NEW FIELD BOTANY.

**By BYRON D. HALSTED, Sc. D.,**

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There is something novel every day; were it not so this earth would grow monotonous to all, even as it does now to many, and chiefly because such do not have the opportunity or the desire to learn some new thing. Facts unknown before are constantly coming to the light, and principles are being deduced that serve as a stepping stone to other and broader fields of knowledge. So accustomed are we to this that even a new branch of science may dawn upon the horizon without causing a wonder in our minds. In this day of ologies the birth of a new one comes without the formal two-line notice in the daily press, just as old ones pass from view without tear or epitaph.

*Phytoecology* as a word is not long as scientific terms go, and the Greek that lies back of it barely suggests the meaning of the term, a fact not at all peculiar to the present instance. Of course, it has to do with plants, and is therefore a branch of botany.

In one sense that which it stands for is not new, and, as usual, the word has come in the wake of the facts and principles it represents, and therefore becomes a convenient term for a branch of knowledge—a handle, so to say—by which that group of ideas may be held up for study and further growth. The word *ecology* was first employed by Haeckel, a leading light in zoölogy in our day, to designate the environmental side of animal life.

We will not concern ourselves with definitions, but discuss the field that the term is coined to cover, and leave the reader to formulate a short concise statement of its meaning.

Within the last year a new botanical guide book for teachers has been published, of considerable originality and merit, in which the subject-matter is thrown into four groups, and one of these is Ecology. Another text-book for secondary schools is now before us in which ecology is the heading of one of the three parts into which the treatise is divided. The large output of the educational press at the present time along the line in hand suggests that the magazine press should sound the depths of the new branch of science that is pushing its way to the front, or being so pushed by its adherents, and echo the merits of it along the line.

Botany in its stages of growth is interesting historically. It fascinated for a time one of the greatest minds in the modern school, and as a result we have the rich and fruitful history of the [Pg 99] science as seen through eyes as great as Julius Sachs's, the master of botany during the last half century. From this work it can be gathered that early in the centuries since the Christian era botany was little more than herborizing—the collecting of specimens, and learning their gross parts, as size of stem and leaf and blossom.

This branch of botany has been cultivated to the present day, and the result is the systematist, with all the refinements of species making and readjustment of genera and orders with the nicety of detail in specific descriptions that only a systematist can fully appreciate.

Later on the study of function was begun, and along with it that of structure; for anatomy and physiology, by whatever terms they may be known, advance hand in hand, because inseparable. One worker may look more to the activities than another who toils with the structural relations and finds these problems enough for a lifetime.

This botany of the dissecting table in contrast with that of the collector and his dried specimens grew apace, taking new leases of life at the uprising of new hypotheses, and long advances with the improvement of implements for work. It was natural that the cell and all that is made from it should invite the inspector to a field of intense interest, somewhat at the expense of the functions of the parts. In short, the field was open, the race was on, and it was a matter of self-restraint that a man did not enter and strive long and well for some anatomical prize. This branch of botany is still alive, and never more so than to-day, when cytology offers many attractive problems for the cytologist. What with his microtome that cuts his imbedded tissue into slices so thin that twenty-five hundred or more are needed to measure an inch in thickness, with his fixing solutions that kill instantly and hold each particle as if frozen in a cake of ice, and his stains and double stains that pick out the specks as the magnet draws iron filing from a bin of bran—with all these and a hundred more aids to the refinement of the art there is no wonder that the cell becomes a center of attraction, beyond the periphery of which the student can scarcely live. In our closing days of the century it may be known whether the blephroblasts arise antipodally, and whether they are a variation of the centrosomes or should be classed by themselves!

One of the general views of phytoecology is that the forms of plants are modified to adapt them to the conditions under which they exist. Thus the size of a plant is greatly modified by the environment. Two grains of corn indistinguishable in themselves and borne by the same cob may be so situated that one grows into a stately stalk with the ear higher than a horse's head, while  the other is a dwarf and unproductive. Below ground the conditions are many, and all subject to infinite variation. Thus, the soil may be deep or shallow, the particles small or large, the moisture abundant or scant, and the food elements close at hand or far to seek—all of which will have a marked influence upon the root system, its size, and form.

Coming to the aërial portion, there are all the factors of weather and climate to work singly or in union to affect the above-ground structure of the plant. Temperature varies through wide ranges of heat and cold, scorching and freezing; while humidity or aridity, sunshine or cloudiness, prevailing winds or sudden tornadoes all have an influence in shaping the structure, developing the part, and fashioning the details of form of the aërial portions. Phytoecology deals with all these, and includes the consideration of that struggle for life that plants are constantly waging, for environment determines that the forms best suited to a given set of conditions will survive. This struggle has been going on since the vegetable life of the earth began, and as a result certain prevailing conditions have brought about groups of plants found as a rule only where these conditions prevail. As water is a leading factor in plant growth, a classification is made upon this basis into the plants of the arid regions called xerophytes. The opposite to desert vegetation is that of the fresh ponds and lakes, called hydrophytes. A third group, the halophytes, includes the vegetation of sea or land where there is an excess of various saline substances, the common salt being the leading one. The last group is the mesophytes, which include plants growing in conditions without the extremes accorded to the other three groups.

This somewhat general classification of the conditions of the environment lends much of interest to that form of field botany now under consideration. As the grouping is made chiefly upon the aqueous conditions, it is fair to assume that plants are especially modified to accommodate themselves to this compound. Plants, for example, unless they are aquatics, need to use large quantities of water to carry on the vital functions. Thus the salts from the soil need to rise dissolved in the crude sap to the leaves, and in order that a sufficient current be kept up there is transpiration going on from all thin or soft exposed parts. The leaves are the chief organs where aqueous vapor is being given off, sometimes to the extent of tons of water upon an acre of area in a single day. This evaporation being largely surface action, it is possible for the plant to check this by reducing the surface, and the leaf is coiled or folded. Other plants have through the ages  become adapted to the destructive actions of drought and a dry, hot atmosphere, and have only needle-shaped leaves or even no true ones at all, as many of the cacti in the desert lands of the Western plains.

Again, the surface of the plant may become covered with a felt of fine hairs to prevent rapid evaporation, while other plants with ordinary foliage have the acquired power of moving the leaves so that they will expose their surfaces broadside to the sun, or contrariwise the edges only, as heat and light intensity determine.

Phytoecology deals with all those adaptations of structure, and from which permit the plants to take advantage of the habits and wants of animals. If we are studying the vegetation of a bog, and note the adaptation of the hydrophytic plants, the chances are that attention will soon be called to colorations and structures that indicate a more complete and far-reaching adjustment than simply to the conditions of the wet, spongy bog. A plant may be met with having the leaves in the form of flasks or pitchers, and more or less filled with water. These strange leaves are conspicuously purplish, and this adds to their attractiveness. The upper portion may be variegated, resembling a flower and for the same purpose—namely, to attract insects that find within the pitchers a food which is sought at the risk of life. Many of the entrapped creatures never escape, and yield up their life for the support of that of the captor. Again, the mossy bog may glisten in the sun, and thousands of sundew plants with their pink leaves are growing upon the surface. Each leaf is covered with adhesive stalked glands, and insects lured to and caught by them are devoured by this insectivorous vegetation.

In the pools in the same lowland there may be an abundance of the bladderwort, a floating plant with flowers upon long stalks that raise them into the air and sunshine. With the leaves reduced to a mere framework that bears innumerable bladders, water animals of small size are captured in vast numbers and provide a large part of the nourishment required by the highly specialized hydrophyte.

These are but everyday instances of adaptation between plants and animals for the purpose of nutrition, the adjustment of form being more particularly upon the vegetative side. Zoölogists may be able to show, however, that certain species of animals are adapted to and quite dependent upon the carnivorous plants.

An ecological problem has been worked out along the above line to a larger extent than generally supposed. If we should take the case of ants only in their relation to structural adaptations for them in plants, it would be seen that fully three thousand species of the latter make use of ants for purposes of protection. The large fighting ants of the tropics, when provided with nectar, [Pg 102] food, and shelter, will inhabit plants to the partial exclusion of destructive insects and larger foraging animals. Interesting as all this is, it is not the time and place to go into the details of how the ant-fostering plants have their nectar glands upon stems or leaf, rich soft hairs in tufts for food, and homes provided in hollows and chambers. There is still a more intimate association of termites with some of the toadstool-like plants, where the ants foster the fungi and seem to understand some of the essentials of veritable gardening in miniature form.

The most familiar branch of phytoecology, as it concerns adaptations for insect visitations, is that which relates to the production of seed. Floral structures, so wonderfully varied in form and color and withal attractive to every lover of the beautiful, are familiar to all, and it only needs to be said in passing that these infinite forms are for the same end—namely, the union of the seed germs, if they may be so styled, of different and often widely separated blossoms.

Sweetness and beauty are not the invariable rule with insect-visited blossoms, for in the long ages that have elapsed during which these adaptations have come about some plants have established an unwritten agreement between beetles and bugs with unsavory tastes. Thus there are the "carrion flowers," so called because of their fetid odor, designed for the sense organs of carrion insects. The "stink-horn" fungi have their offensive spores distributed by a similar set of carrion carriers.

Water and wind claim a share of the species, but here adaptation to the method of fertilization is as fully realized as when insects participate, and the uselessness of showy petals and fantastic forms is emphasized by their absence.

Coming now to the fruits of plants, it is again seen that plants have adapted their offspring, the seed, to the surrounding conditions, not forgetting the wind, the waves, and the tastes and the exterior of passing animals. The breezes carry up and hurl along the light wing-possessed seeds, and the river and ocean bear these and many others onward to a distant land, while by grappling hooks many kinds cling to the hair of animals, or, provided with a pleasing pulp, are carried willingly by birds and other creatures. In short, the devices for seed dispersion are multitudinous, and they provide a large chapter in that branch of botany now styled phytoecology.

How different is the old field botany from the new! Then there was the collector of plants and classifier of his finds, and an arranger of all he could get by exchange or otherwise. His success [Pg 103] was measured by the size of his herbarium and his stock in trade as so many duplicates all taken in bloom, but the time of year, locality, and the various conditions of growth were all unknown.

His implements for work were, first, a can or basket, a plant press, and a manual; and, secondly, a lot of paper, a paste pot, and some way of holding the mounts in packets or pigeonholes.

The eyes grew keen as the hunter scoured the forest and field for some kind of plant he had not already possessed. There was a keen relish in discoveries, and it heightened into ecstasy when the specimen needed to be sent away for a name and was returned with his own Latinized and appended to that of the genus.

This was all well and good so far as it went, but looked at from the present vantage ground there was not so much in it. However, his was an essential step to other things, as much so as that of the census taker.

We need to know the species of plants our fair land possesses, and have them described and named. But when the nine hundred and ninety-nine are known, it is a waste of time to be continually hunting for the thousandth. Look for it, but let it be secondary to that of an actual study of the great majority already known. The older botany was a study of the dried plants in all those details that are laid down in the manuals. It lacked something of the true vitality that is inherent in a biological science, for often the life had gone out before the subject came up for study. To the phytoecologist it was somewhat as the shell without the meat, or the bird's nest of a previous year.

Since those days of our forefathers there has come the minute anatomy of plants, followed closely by physiology; and now with the working knowledge of these two modern branches of botany the student has again taken to the field. He is making the wood-lot his laboratory, and the garden, so to say, his lecture room. He has a fair knowledge of systematic botany, but finds himself rearranging the families and genera to fit the facts determined by his ecological study. If two species of the same genus are widely separated in habitat, he is determining the factors that led to the separation. Why did one smart weed become a climber, another an upright herb, and a third a prostrate creeper, are questions that may not have entered the mind of the plant collector; but now the phytoecologist finds much interest in considering questions of this type. What are the differences between a species inhabiting the water and another of the same genus upon dry land, or what has led one group of the morning-glory family to become parasites and exist as the dodders upon other living plants?

[Pg 104] The older botanist held his subject under the best mental illumination of his time, but his physical light, that of a pine knot or a tallow dip, also contrasts strongly with that of the present gas jet and electric arc.

The wonder should be that he saw so well, and all who follow him can not but feel grateful for the path he blazed through the dense forests of ignorance and the bridges he made over the streams of doubt in specific distinctions. It was a noble work, but it is nearly past in the older parts of our country; and while some of that school should linger to readjust their genera, make new combinations of species, and attempt to satisfy the claims of priority, the rank and file will largely leave systematic botany and the herborizing it embraces, and betake themselves to the open fields of phytoecology. It may be along the line of structural adaptations when we will have morphological phytoecology, or the adjustment of function to the environment when there will be physiological phytoecology. These two branches when combined to elucidate problems of relationship between the plant and its surroundings as involved in accommodation in its comprehensive sense there will be phytoecology with climate, geology, geography, or fossils as the leading feature, as the case may be.

In the older botany the plant alone in itself was the subject of study. The newer botany takes the plant in its surroundings and all that its relationships to other plants may suggest as the subject for analysis. In the one case the plant was all and its place of growth accidental, a dried specimen from any unknown habitat was enough; but now the environment and the numerous lines of relationship that reach out from the living plant *in situ* are the major subjects for study. The former was field botany because the field contained the plant, the latter is field botany in that the plant embraces in its study all else in the field in which it lives. The one had as its leading question, What is your name and where do you belong in my herbarium? while the other raises an endless list of queries, of which How came you here and when? Why these curious glands and this strange movement or mimicry? are but average samples. Every spot of color, bend of leaf, and shape of fruit raises a question.

The collector of fifty years ago pulled up or cut off a portion of his plant for a specimen, and rarely measured, weighed, and counted anything about it. The phytoecologist to-day watches his subject as it grows, and if removed it is for the purpose of testing its vital functions under varying circumstances of moisture, heat, or sunlight, and exact recording instruments are a part of the equipment for the investigation.

[Pg 105] The underlying thought in the seashore school and the tropical laboratory in botany is this of getting nearer to the haunts of the living plant. Forestry schools that have for their class room the wooded mountains and the botanical gardens with their living herbaria are welcome steps toward the same end of phytoecology.

In view of the above facts, and many more that might be mentioned did space permit, the writer has felt that the present incomplete and faulty presentation of the subject of the newer botany should be placed before the great reading public through the medium of a journal that has as its watchword Progress in Education.

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# DO ANIMALS REASON?

By the Rev. EGERTON R. YOUNG.

This interesting subject has been ably handled from the negative side by Edward Thorndike, Ph. D., in the August number of the Popular Science Monthly. Dr. Thorndike, with all his skill in treating this very interesting subject, seems to have forgotten one very important point. His expectation has not only been higher than any fair claim of an animal's reasoning power, but he has overlooked the fact that there are different ways of reasoning. Men of different races and those of little intelligence can be placed in new environments and be asked to perform things which, while utterly impossible to them, are simple and crude to those of higher intelligence and who have all their days been accustomed to high mental exercise. If such difference exists between the highest and most intelligent of the human race and the degraded and uncultured, vastly greater is the gulf that separates the lowest stratum of humanity from the most intelligent of the brute creation. The fair way to test the intelligence of the so-called lower orders of men is to go to their native lands and study them in their own environments and in possession of the equipments of life to which they have been accustomed. The same is true of the brute creation. Only the highest results can be expected from congenial environments. To pass final judgment upon the animal kingdom, having for data only the results of the doctor's experiments, seems to us manifestly unfair. He takes a few cats and dogs and submits them to environments which are altogether foreign to them, and then expects feats of mind from them which would be far greater than the mastering of the reason why two and two make four is to the stupidest child of man. As the doctor has been permitted to tell the results of his experiments, may I claim a similar privilege? While I did not use dogs merely to test their intelligence—my business demanding of [Pg 106] myself and them the fullest use of all our energies and all the intelligence, be it more or less, that was possessed by man or beast—I had the privilege of seeing in my dogs actions that were, at least to me, convincing that they possessed the rudiments of reasoning powers, and, in the more intelligent, that which will be utterly inexplicable if it is not the product of reasoning faculties.

For a number of years I was a resident missionary in the Hudson Bay Territories, where, in the prosecution of my work, I kept a large number of dogs of various breeds. With these dogs I traveled several thousands of miles every winter over an area larger than the State of New York. In summer I used them to plow my garden and fields. They dragged home our fish from the distant fisheries, and the wood from the forests for our numerous fires. They cuddled around me on the edges of my heavy fur robes in wintry camps, where we often slept out in a hole dug in the snow, the temperature ranging from 30° to 60° below zero. When blizzard storms raged so terribly that even the most experienced Indian guides were bewildered, and knew not north from south or east from west, our sole reliance was on our dogs, and with an intelligence and an endurance that ever won our admiration they succeeded in bringing us to our desired destination.

It is conceded at the outset that these dogs of whom I write were the result of careful selection. There are dogs and dogs, as there are men and men. They were not picked up in the street at random. I would no more keep in my personal service a mere average mongrel dog than I would the second time hire for one of my long trips a sulky Indian. As there are some people, good in many ways, who can not master a foreign tongue, so there are many dogs that never rise above the one gift of animal instinct. With such I too have struggled, and long and patiently labored, and if of them only I were writing I would unhesitatingly say that of them I never saw any act which ever seemed to show reasoning powers. But there are other dogs than these, and of them I here would write and give my reason why I firmly believe that in a marked degree some of them possessed the powers of reasoning.

Two of my favorite dogs I called Jack and Cuffy. Jack was a great black St. Bernard, weighing nearly two hundred pounds. Cuffy was a pure Newfoundland, with very black curly hair. These two dogs were the gift of the late Senator Sanford. With other fine dogs of the same breeds, they soon supplanted the Eskimo and mongrels that had been previously used for years about the place.

**Jack and his Master.**

I had so much work to do in my very extensive field that I required to have at least four trains [Pg 107] always fit for service. This meant that, counting puppies and all, there would be about the premises from twenty to thirty dogs. However, as the lakes and rivers there swarmed with fish, which was their only food, we kept the pack up to a state of efficiency at but little expense. Jack and Cuffy were the only two dogs that were allowed the full liberty of the house. They were welcome in every room. Our doors were furnished with the ordinary thumb latches. These latches at first bothered both dogs. All that was needed on our part was to show them how they worked, [Pg 108] and from that day on for years they both entered the rooms as they desired without any trouble, if the doors opened from them. There was a decided difference, however, in opening a door if it opened toward them. Cuffy was never able to do it. With Jack it was about as easily done as it was by the Indian servant girl. Quickly and deftly would he shove up the exposed latch and the curved part of the thumb piece and draw it toward him. If the door did not easily open, the claws in the other fore paw speedily and cleverly did the work. The favorite resting place of these two magnificent dogs was on some fur rugs on my study floor. Several times have we witnessed the following action in Cuffy, who was of a much more restless temperament than Jack: When she wanted to leave the study she would invariably first go to the door and try it. If it were in the slightest degree ajar she could easily draw it toward her and thus open it. If, on the contrary, it were latched, she would at once march over to Jack, and, taking him by an ear with her teeth, would lead him over to the door, which he at once opened for her. If reason is that power by which we "are enabled to combine means for the attainment of particular ends," I fail to understand the meaning of words if it were not displayed in these instances.

Both Jack and Cuffy were, as is characteristic of such dogs, very fond of the water, and in our short, brilliant summers would frequently disport themselves in the beautiful little lake, the shores of which were close to our home. Cuffy, as a Newfoundland dog, generally preferred to continue her sports in the waves some time after Jack had finished his bath. As they were inseparable companions, Jack was too loyal to retire to the house until Cuffy was ready to accompany him. As she was sometimes whimsical and dilatory, she seemed frequently to try his patience. It was, however, always interesting to observe his deference to her. To understand thoroughly what we are going to relate in proof of our argument it is necessary to state that the rocky shore in front of our home was at this particular place like a wedge, the thickest part in front, rising up about a dozen feet or so abruptly from the water. Then to the east the shore gradually sloped down into a little sandy cove. When Jack had finished his bath he always swam to this sandy beach, and at once, as he shook his great body, came gamboling along the rocks, joyously barking to his companion still in the waters. When Cuffy had finished her watery sports, if Jack were still on the rocks, instead of swimming to the sandy cove and there landing she would start directly for the place where Jack was awaiting her. If it were at a spot where she could not alone struggle up, Jack, firmly bracing himself, would reach down to her and then, [Pg 109] catching hold of the back of her neck, would help her up the slippery rocks. If it were at a spot where he could not possibly reach her, he would, after several attempts, all the time furiously barking as though expressing his anxiety and solicitude, rush off to a spot where some old oars, paddles, and sticks of various kinds were piled. There he searched until he secured one that suited his purpose. With this in his mouth, he hurried back to the spot where Cuffy was still in the water at the base of the steep rocks. Here he would work the stick around until he was able to let one end down within reach of his exacting companion in the water. Seizing it in her teeth and with the powerful Jack pulling at the other end she was soon able to work her way up the rough but almost perpendicular rocks. This prompt action, often repeated on the part of Jack, looked very much like "the specious appearance of reasoning." It was a remarkable coincidence that if Jack were called away, Cuffy at once swam to the sandy beach and there came ashore.

Jack never had any special love for the Indians, although we were then living among them. He was, however, too well instructed ever to injure or even growl at any of them. The changing of Indian servant girls in the kitchen was always a matter of perplexity to him. He was suspicious of these strange Indians coming in and so familiarly handling the various utensils of their work. Not daring to injure them, it was amusing to watch him in his various schemes to tease them. If one of them seemed especially anxious to keep the doors shut, Jack took the greatest delight in frequently opening them. This he took care only to do when no member of the family was around. These tricks he would continue to do until formal complaints were lodged against him. One good scolding was sufficient to deter him from thus teasing that girl, but he would soon begin to try it with others.

One summer we had a fat, good-natured servant girl whom we called Mary. Soon after she was installed in her place Jack began, as usual, to try to annoy her, but found it to be a more difficult job than it had been with some of her predecessors. She treated him with complete indifference, and was not in the least afraid of him, big as he was. This seemed to very much humiliate him, as most of the other girls had so stood in awe of the gigantic fellow that they had about given way to him in everything. Mary, however, did nothing of the kind. She would shout, "Get out of my way!" as quickly to "his mightiness" as she would to the smallest dog on the place. This very much offended Jack, but he had been so well trained, even regarding the servants, that he dare not retaliate even with a growl. Mary, however, had one weakness, and after a time Jack found it out. [Pg 110] Her mistress observing that this girl, who had been transferred from a floorless wigwam into a civilized kitchen, was at first careless about keeping the floor as clean as it should be, had, by the promise of some desired gift in addition to her wages, so fired her zeal that it seemed as though every hour that could be saved from her other necessary duties was spent in scrubbing that kitchen floor. Mary was never difficult to find, as was often the case with other Indian girls; if missed from other duties, she was always found scrubbing her kitchen.

In some way or other—how we do not profess to know—Jack discovered this, which had become to us a source of amusement, and here he succeeded in annoying her, where in many other ways which he had tried he had only been humiliated and disgraced. He would, when the floor had just been scrubbed, march in and walk over it with his feet made as dirty as tramping in the worst places outside could make them. At other times he would plunge into the lake, and instead of, as usual, thoroughly shaking himself dry on the rocks, would wait until he had marched in upon Mary's spotless floor. At other times, when Jack noticed that Mary was about to begin scrubbing her floor he would deliberately stretch himself out in a prominent place on it, and doggedly resist, yet without any growling or biting, any attempt on her part to get him to move. In vain would she coax or scold or threaten. Once or twice, by some clever stratagem, such as pretending to feed the other dogs outside or getting them excited and furiously barking, as though a bear or some other animal were being attacked, did she succeed in getting him out. But soon he found her out, and then he paid not the slightest attention to any of these things. Once when she had him outside she securely fastened the door to keep him out until her scrubbing would be done. Furiously did Jack rattle at the latch, but the door was otherwise so secured that he could not open it. Getting discouraged in his efforts to open the door in the usual way, he went to the woodpile and seizing a large billet in his mouth he came and so pounded the door with it that Mary, seeing that there was great danger of the panel being broken in, was obliged to open the door and let in the dog. Jack proudly marched in to the kitchen with the stick of wood in his mouth. This he carried to the wood box, and, when he had placed it there, he coolly stretched himself out on the floor where he would be the biggest nuisance.

Seeing Jack under such circumstances on her kitchen floor, poor Mary could stand it no longer, and so she came marching in to my study, and in vigorous picturesque language in her native Cree described Jack's various tricks and schemes to annoy her and thus hinder her in her work. [Pg 111] She ended up by the declaration that she was sure the *meechee munedoo* (the devil) was in that dog. While not fully accepting the last statement, we felt that the time had come to interfere, and that Jack must be reproved and stopped. In doing this we utilized Jack's love for our little ones, especially for Eddie, the little four-year-old boy. His obedience as well as loyalty to that child was marvelous and beautiful. The slightest wish of the lad was law to Jack.

As soon as Mary had finished her emphatic complaints, I turned to Eddie, who with his little sister had been busily playing with some blocks on the floor, and said:

"Eddie, go and tell that naughty Jack that he must stop teasing Mary. Tell him his place is not in the kitchen, and that he must keep out of it."

Eddie had listened to Mary's story, and, although he generally sturdily defended Jack's various actions, yet here he saw that the dog was in the wrong, and so he gallantly came to her rescue. Away with Mary he went, while the rest of us, now much interested, followed in the rear to see how the thing would turn out. As Eddie and Mary passed through the dining room we remained in that room, while they went on into the adjoining kitchen, leaving the door open, so that it was possible for us to distinctly hear every word that was uttered. Eddie at once strode up to the spot where Jack was stretched upon the floor. Seizing him by one of his ears, and addressing him as with the authority of a despot, the little lad said:

"I am ashamed of you, Jack. You naughty dog, teasing Mary like this! So you won't let her wash her kitchen. Get up and come with me, you naughty dog!" saying which the child tugged away at the ear of the dog. Jack promptly obeyed, and as they came marching through the dining room on their way to the study it was indeed wonderful to see that little child, whose beautiful curly head was not much higher than that of the great, powerful dog, yet so completely the master. Jack was led into the study and over to the great wolf-robe mat where he generally slept. As he promptly obeyed the child's command to lie down upon it, he received from him his final orders:

"Now, Jack, you keep out of the kitchen"; and to a remarkable degree from that time on that order was obeyed.

We have referred to the fact that Jack placed the billet of wood in the wood box when it had served his purpose in compelling Mary to open the door. Carrying in wood was one of his accomplishments. Living in that cold land, where we depended entirely on wood for our fuel, we required a large quantity of it. It was cut in the forests, sometimes several miles from the house. [Pg 112] During the winters it was dragged home by the dogs. Here it was cut into the proper lengths for the stoves and piled up in the yard. When required, it was carried into the kitchen and piled up in a large wood box. This work was generally done by Indian men. When none were at hand the Indian girls had to do the work, but it was far from being enjoyed by them, especially in the bitter cold weather. It was suggested one day that Jack could be utilized for this work. With but little instruction and trouble he was induced to accept of the situation, and so after that the cry, "Jack, the wood box is empty!" would set him industriously to work at refilling it.

To us, among many other instances of dog reasoning that came under our notice as the years rolled on, was one on the part of a large, powerful dog we called Cæsar. It occurred in the spring of the year, when the snow had melted on the land, and so, with the first rains, was swelling the rivers and creeks very considerably. On the lake before us the ice was still a great solid mass, several feet in thickness. Near our home was a now rapid stream that, rushing down into the lake, had cut a delta of open water in the ice at its mouth. In this open place Papanekis, one of my Indians, had placed a gill net for the purpose of catching fish. Living, as he did, all winter principally upon the fish caught the previous October or November and kept frozen for several months hung up in the open air, we were naturally pleased to get the fresh ones out of the water in the spring. Papanekis had so arranged his net, by fastening a couple of ropes about sixty feet long, one at each end, that when it was securely fastened at each side of the stream it was carried out into this open deltalike space by the force of the current, and there hung like the capital letter U. Its upper side was kept in position by light-wooded floats, while medium-sized stones, as sinkers, steadied it below.

Every morning Papanekis would take a basket and, being followed by all the dogs of the kennels, would visit his net. Placed as we have described, he required no canoe or boat in order to overhaul it and take from it the fish there caught. All he had to do was to seize hold of the rope at the end fastened on the shore and draw it toward him. As he kept pulling it in, the deep bend in it gradually straightened out until the net was reached. His work was now to secure the fish as he gradually drew in the net and coiled it at his feet. The width of the opening in the water being about sixty feet, the result was that when he had in this way overhauled his net he had about reached the end of the rope attached to the other side. When all the fish in the net were secured, [Pg 113] all Papanekis had to do to reset the net was to throw some of it out in the right position in the stream. Here the force of the running waters acting upon it soon carried the whole net down into the open place as far as the two ropes fastened on the shores would admit. Papanekis, after placing the best fish in his basket for consumption in the mission house and for his own family, divided what was left among the eager dogs that had accompanied him. This work went on for several days, and the supply of fish continued to increase, much to our satisfaction.

One day Papanekis came into my study in a state of great perturbation. He was generally such a quiet, stoical sort of an Indian that I was at once attracted by his mental disquietude. On asking the reason why he was so troubled, he at once blurted out, "Master, there is some strange animal visiting our net!"

In answer to my request for particulars, he replied that for some mornings past when he went to visit it he found, entangled in the meshes, several heads of whitefish. Yet the net was always in its right position in the water. On my suggesting that perhaps otters, fishers, minks, or other fish-eating animals might have done the work, he most emphatically declared that he knew the habits of all these and all other animals living on fish, and it was utterly impossible for any of them to have thus done this work. The mystery continuing for several following mornings, Papanekis became frightened and asked me to get some other fisherman in his place, as he was afraid longer to visit the net. He had talked the matter over with some other Indians, and they had come to the conclusion that either a *windegoo* was at the bottom of it or the *meechee munedoo* (the devil). I laughed at his fears, and told him I would help him to try and find out who or what it was that was giving us this trouble. I went with him to the place, where we carefully examined both sides of the stream for evidences of the clever thief. There was nothing suspicious, and the only tracks visible were those of his own and of the many dogs that followed him to be fed each morning. About two or three hundred yards north of the spot where he overhauled the net there rose a small abrupt hill, densely covered with spruce and balsam trees. On visiting it we found that a person there securely hid from observation could with care easily overlook the whole locality.

At my suggestion, Papanekis with his axe there arranged a sort of a nest or lookout spot. Orders were then given that he and another Indian man should, before daybreak on the next morning, make a long detour and cautiously reach that spot from the rear, and there carefully conceal themselves. This they succeeded in doing, and there, in perfect stillness, they waited for the [Pg 114] morning. As soon as it was possible to see anything they were on the alert. For some time they watched in vain. They eagerly scanned every point of vision, and for a time could observe nothing unusual.

"Hush!" said one; "see that dog!"

It was Cæsar, cautiously skulking along the trail. He would frequently stop and sniff the air. Fortunately for the Indian watchers, the wind was blowing toward them, and so the dog did not catch their scent. On he came, in a quiet yet swift gait, until he reached the spot where Papanekis stood when he pulled in the net. He gave one searching glance in every direction, and then he set to work. Seizing the rope in his teeth, Cæsar strongly pulled upon it, while he rapidly backed up some distance on the trail. Then, walking on the rope to the water's edge as it lay on the ground, to keep the pressure of the current from dragging it in, he again took a fresh grip upon it and repeated the process. This he did until the sixty feet of rope were hauled in, and the end of the net was reached to which it was attached. The net he now hauled in little by little, keeping his feet firmly on it to securely hold it down. As he drew it up, several varieties of inferior fish, such as suckers or mullets, pike or jackfish, were at first observed. To them Cæsar paid no attention. He was after the delicious whitefish, which dogs as well as human beings prefer to those of other kinds. When he had perhaps hauled twenty feet of the net, his cleverness was rewarded by the sight of a fine whitefish. Still holding the net with its struggling captives securely down with his feet, he began to devour this whitefish, which was so much more dainty than the coarser fish generally thrown to him. Papanekis and his comrade had seen enough. The mysterious culprit was detected in the act, and so with a "Whoop!" they rushed down upon him. Caught in the very act, Cæsar had to submit to a thrashing that ever after deterred him from again trying that cunning trick.

Who can read this story, which I give exactly as it occurred, without having to admit that here

Cæsar "combined means for the attainment of particular ends"? On the previous visits which he made to the net the rapid current of the stream, working against the greater part of it in the water, soon carried it back again into its place ere Papanekis arrived later in the morning. The result was that Cæsar's cleverness was undetected for some time, even by these most observant Indians.

Many other equally clever instances convince me, and those who with me witnessed them, of the possession, in of course a limited degree, of reasoning powers. Scores of my dogs never seemed to reveal them, perhaps because no special opportunities were presented for their exhibition. [Pg 115] They were just ordinary dogs, trained to the work of hauling their loads. When night came, if their feet were sore they had dog sense enough to come to their master and, throwing themselves on their backs, would stick up their feet and whine and howl until the warm duffle shoes were put on. Some of the skulking ones had wit enough, when they did not want to be caught, in the gloom of the early morning, while the stars were still shining, if they were white, to cuddle down, still and quiet, in the beautiful snow; while the darker ones would slink away into the gloom of the dense balsams, where they seemed to know that it would be difficult for them to be seen. Some of them had wit enough when traveling up steep places with heavy loads, where their progress was slow, to seize hold of small firm bushes in their teeth to help them up or to keep them from slipping back. Some of them knew how to shirk their work. Cæsar, of whom we have already spoken, at times was one of this class. They could pretend, by their panting and tugging at their collars, that they were dragging more than any other dogs in the train, while at the same time they were not pulling a pound!

Of cats I do not write. I am no lover of them, and therefore am incompetent to write about them. This lack of love for them is, I presume, from the fact that when a boy I was the proud owner of some very beautiful rabbits, upon which the cats of the neighborhood used to make disastrous raids. So great was my boyish indignation then that the dislike to them created has in a measure continued to this day, and I have not as yet begun to cultivate their intimate acquaintance.

But of dogs I have ever been a lover and a friend. I never saw one, not mad, of which I was afraid, and I never saw one with which I could not speedily make friends. Love was the constraining motive principally used in breaking my dogs in to their work in the trains. No whip was ever used upon Jack or Cuffy while they were learning their tasks. Some dogs had to be punished more or less. Some stubborn dogs at once surrendered and gave no more trouble when a favorite female dog was harnessed up in a train and sent on ahead. This affection in the dog for his mate was a powerful lever in the hands of his master, and, using it as an incentive, we have seen things performed as remarkable as any we have here recorded.

From what I have written it will be seen that I have had unusual facilities for studying the habits and possibilities of dogs. I was not under the necessity of gathering up a lot of mongrels at random in the streets, and then, in order to see instances of their sagacity and the exercise of their highest reasoning powers, to keep them until they were "practically utterly hungry," and [Pg 116] then imprison them in a box a good deal less than four feet square, and then say to them, "Now, you poor, frightened, half-starved creatures, show us what reasoning powers you possess." About as well throw some benighted Africans into a slave ship and order them to make a telephone or a phonograph! My comparison is not too strong, considering the immense distance there is between the human race and the brute creation. And so it must be, in the bringing to light of the powers of memory and the clear exhibition of the reasoning powers, few though they be, that the tests are not conclusive unless made under the most favorable environment, upon dogs of the highest intelligence, and in the most congenial and sympathetic manner.

Testing this most interesting question in this manner, my decided convictions are that animals do reason.

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## SKETCH OF GEORGE M. STERNBERG.

No man among Americans has studied the micro-organisms with more profit or has contributed more to our knowledge of the nature of infection, particularly of that of yellow fever, than Dr. George M. Sternberg, of the United States Army. His merits are freely recognized abroad, and he ranks there, as well as at home, among the leading bacteriologists of the age. He was born at Hartwick Seminary, an institution of the Evangelical Lutheran Church in America (General Synod), Otsego, N. Y., June 8, 1838. His father, the Rev. Levi Sternberg, D. D., a graduate of Union College, a Lutheran minister, and for many years principal of the seminary and a director of it, was descended from German ancestors who came to this country in 1703 and settled in Schoharie County, New York. The younger Sternberg received his academical training at the seminary, after which, intending to study medicine, he undertook a school at New Germantown, N. J., as a means of earning a part of the money required to defray the cost of his instruction in that science. The record of his school was one of quiet sessions, thoroughness, and popularity of the teacher, and his departure was an occasion of regret among his patrons.

When nineteen years old, young Sternberg began his medical studies with Dr. Horace Lathrop, in Cooperstown, N. Y. Afterward he attended the courses of the College of Physicians and Surgeons, New York, and was graduated thence in the class of 1860. Before he had fairly settled in practice

[Pg 117] the civil war began, and the attention of all young Americans was directed toward the military service. Among these was young Dr. Sternberg, who, having passed the examination, was appointed assistant surgeon May 28, 1861, and was attached to the command of General Sykes, Army of the Potomac. He was engaged in the battle of Bull Run, where, voluntarily remaining on the field with the wounded, he was taken prisoner, but was paroled to continue his humane work. On the expiration of his parole he made his way through the lines and reported at Washington for duty July 30, 1861—"weary, footsore, and worn." Of his conduct in later campaigns of the Army of the Potomac, General Sykes, in his official reports of the battles of Gaines Mill, Turkey Ridge, and Malvern Hill, said that "Dr. Sternberg added largely to the reputation already acquired on the disastrous field of Bull Run." He remained with General Sykes's command till August, 1862; was then assigned to hospital duty at Portsmouth Grove, R. I., till November, 1862; was afterward attached to General Banks's expedition as assistant to the medical director in the Department of the Gulf till January, 1864; was in the office of the medical director, Columbus, Ohio, and in charge of the United States General Hospital at Cleveland, Ohio, till July, 1865. Since the civil war he has been assigned successively to Jefferson Barracks, Mo.; Fort Harker and Fort Riley, Kansas; in the field in the Indian campaign, 1868 to 1870; Forts Columbus and Hamilton, New York Harbor; Fort Warren, Boston Harbor; Department of the Gulf and New Orleans; Fort Barrancas, Fla.; Department of the Columbia; Department Headquarters; Fort Walla Walla, Washington Territory; California; and Eastern stations. He was promoted to be captain and assistant surgeon in 1866, major and surgeon in 1875, lieutenant colonel and deputy surgeon general in 1891, and brigadier general and surgeon general in 1893. He has also received the brevets of captain and major in the United States Army "for faithful and meritorious services during the war," and of lieutenant colonel "for gallant service in performance of his professional duty under fire in action against Indians at Clearwater, Idaho, July 12, 1877." In the discharge of his duties at his various posts Dr. Sternberg had to deal with a cholera epidemic in Kansas in 1867, with a "yellow-fever epidemic" in New York Harbor in 1871, and with epidemics of yellow fever at Fort Barrancas, Fla., in 1873 and 1875. He served under special detail as member and secretary of the Havana Yellow-Fever Commission of the National Board of Health, 1879 to 1881; as a delegate from the United States under special instructions of the Secretary of State to the
[Pg 118] International Sanitary Conference at Rome in 1885; as a commissioner, under the act of Congress of March 3, 1887, to make investigations in Brazil, Mexico, and Cuba relating to the etiology and prevention of yellow fever; by special request of the health officer of the port of New York and the advisory committee of the New York Chamber of Commerce as consulting bacteriologist to the health officer of the port of New York in 1892; and he was a delegate to the International Medical Congress in Moscow in 1897.

Dr. Sternberg has contributed largely to the literature of scientific medicine from the results of his observations and experiments which he has made in these various spheres of duty.

His most fruitful researches have been made in the field of bacteriology and infectious diseases. He has enjoyed the rare advantage in pursuing these studies of having the material for his experiments close at hand in the course of his regular work, and of watching, we might say habitually, the progress of such diseases as yellow fever as it normally went on in the course of Nature. Of the quality of his bacteriological work, the writer of a biography in Red Cross Notes, reprinted in the North American Medical Review, goes so far as to say that "when the overzeal of enthusiasts shall have passed away, and the story of bacteriology in the nineteenth century is written up, it will probably be found that the chief who brought light out of darkness was George M. Sternberg. He was noted not so much for his brilliant discoveries, but rather for his exact methods of investigation, for his clear statements of the results of experimental data, for his enormous labors toward the perfection and simplification of technique, and finally for his services in the practical application of the truths taught by the science. His early labors in bacteriology were made with apparatus and under conditions that were crude enough." His work in this department is certainly among the most important that has been done. Its value has been freely acknowledged everywhere, it has given him a world-wide fame, and it has added to the credit of American science. The reviewer in Nature (June 22, 1893) of his Manual of Bacteriology, which was published in 1892, while a little disposed to criticise the fullness and large size of the book, describes it as "the latest, the largest, and, let us add, the most complete manual of bacteriology which has yet appeared in the English language. The volume combines in itself not only an account of such facts as are already established in the science from a morphological, chemical, and pathological point of view, discussions on such abstruse subjects as susceptibility and immunity, and also full details of the means by which these results have been obtained, and
[Pg 119] practical directions for the carrying on of laboratory work." This was not the first of Dr. Sternberg's works in bacteriological research. It was preceded by a work on Bacteria, of 498 pages, including 152 pages translated from the work of Dr. Antoine Magnin (1884); Malaria and Malarial Diseases, and Photomicrographs and How to make Them. The manual is at once a book for reference, a text-book for students, and a handbook for the laboratory. Its four parts include brief notices of the history of the subject, classification, morphology, and an account of methods and practical laboratory work—"all clear and concise"; the biology and chemistry of bacteria, disinfection, and antiseptics; a detailed account of pathogenic bacteria, their modes of action, the way they may gain access to the system, susceptibility and immunity, to which Dr. Sternberg's own contributions have been not the least important; and saprophytic bacteria in water, in the soil, in or on the human body, and in food, the whole number of saprophytes described being three hundred and thirty-one. "The merit of a work of this kind," Nature says, "depends not less on the number of species described than on the clearness and accuracy of the descriptions, and Dr. Sternberg has spared no pains to make these as complete as possible." The bibliography in

this work fills more than a hundred pages, and contains 2,582 references. A later book on a kindred subject is Immunity, Protective Inoculations, and Serum Therapy (1895). Dr. Sternberg has also published a Text-Book of Bacteriology.

Bearing upon yellow fever are the Report upon the Prevention of Yellow Fever by Inoculation, submitted in March, 1888; Report upon the Prevention of Yellow Fever, illustrated by photomicrographs and cuts, 1890; and Examination of the Blood in Yellow Fever (experiments upon animals, etc.), in the Preliminary Report of the Havana Yellow-Fever Commission, 1879. Other publications in the list of one hundred and thirty-one titles of Dr. Sternberg's works, and mostly consisting of shorter articles, relate to Disinfectants and their Value, the Etiology of Malarial Fevers, Septicæmia, the Germicide Value of Therapeutic Agents, the Etiology of Croupous Pneumonia, the Bacillus of Typhoid Fever, the Thermal Death Point of Pathogenic Organisms, the Practical Results of Bacteriological Researches, the Cholera Spirillum, Disinfection at Quarantine Stations, the Infectious Agent of Smallpox, official reports as Surgeon General of the United States Army, addresses and reports at the meetings of the American Public Health Association, and an address to the members of the Pan-American Congress. One paper is recorded quite outside of the domain of microbes and fevers, to show what the author might have [Pg 120] done if he had allowed his attention to be diverted from his special absorbing field of work. It is upon the Indian Burial Mounds and Shell Heaps near Pensacola, Fla.

The medical and scientific societies of which Dr. Sternberg is a member include the American Public Health Association, of which he is also an ex-president (1886); the American Association of Physicians; the American Physiological Society; the American Microscopical Society, of which he is a vice-president; the American Association for the Advancement of Science, of which he is a Fellow; the New York Academy of Medicine (a Fellow); and the Association of Military Surgeons of the United States (president in 1896). He is a Fellow of the Royal Microscopical Society of London; an honorary member of the Epidemiological Society of London, of the Royal Academy of Medicine of Rome, of the Academy of Medicine of Rio de Janeiro, of the American Academy of Medicine, of the French Society of Hygiene, etc.; was President of the Section on Military Medicine and Surgery of the Pan-American Congress; was a Fellow by courtesy in Johns Hopkins University, 1885 to 1890; was President of the Biological Society of Washington in 1896, and of the American Medical Association in 1897; and has been designated Honorary President of the Thirteenth International Medical Congress, which is to meet in Paris in 1900. He received the degree of LL. D. from the University of Michigan in 1894, and from Brown University in 1897.

Dr. Sternberg's view of the right professional standard of the physician is well expressed in the sentiment, "To maintain our standing in the estimation of the educated classes we must not rely upon our diplomas or upon our membership in medical societies. Work and worth are what count." He does not appear to be attached to any particular school, but, as his Red Cross Notes biographer says, "has placed himself in the crowd 'who have been moving forward upon the substantial basis of scientific research, and who, if characterized by any distinctive name, should be called *the New School of Scientific Medicine*.' He holds that if our practice was in accordance with our knowledge many diseases would disappear; he sees no room for creeds or patents in medicine. He is willing to acknowledge the right to prescribe either a bread pill or a leaden bullet. But if a patient dies from diphtheria because of a failure to administer a proper remedy, or if infection follows from dirty fingers or instruments, if a practitioner carelessly or ignorantly transfers infection, he believes he is not fit to practice medicine.... He rejects every theory or dictum that has not been clearly demonstrated to him as an absolute truth."

While he is described as without assumption, Dr. Sternberg is represented as being evidently in [Pg 121] his headquarters as surgeon general in every sense the head of the service, the chief whose will governs all. Modest and unassuming, he is described as being most exacting, a man of command, of thorough execution, a general whose eyes comprehend every detail, and who has studied the personality of every member of his corps. He is always busy, but seemingly never in a hurry; systematic, accepting no man's dictum, and taking nothing as an established fact till he has personal experimental evidence of its truth. He looks into every detail, and takes equal care of the health of the general in chief and of the private.

His addresses are carefully prepared, based on facts he has himself determined, made in language so plain that they will not be misunderstood, free from sentiment, and delivered in an easy conversational style, and his writings are "pen pictures of his results in the laboratory and clinic room."

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The thirty-first year of the Peabody Museum of American Archæology and Ethnology was signalized by the transfer of its property to the corporation of Harvard College, whereby simplicity and greater permanence have been given to its management. The four courses of instruction in the museum were attended by sixteen students, and these, with others, make twenty-one persons, besides the curator, who are engaged in study or special research in subjects included under the term anthropology. Special attention is given by explorers in the service of the museum to the investigation of the antiquities of Yucatan and Central America, of which its publications on Copan, the caves of Loltun, and Labná, have been noticed in the Monthly. These explorations have been continued when and where circumstances made it feasible. Among the gifts acknowledged in the report of the museum are two hundred facsimile copies of the Aztec Codex Vaticanus, from the Duke of Loubat, an original Mexican manuscript of 1531, on agave paper, from the Mary Hemenway estate; the extensive private archæological collection of Mr. George W. Hammond; articles from Georgia mounds, from Clarence B. Moore, and other gifts of perhaps less magnitude but equal interest. Mr. Andrew Gibb, of Edinburgh, has given five pieces of rudely made pottery from the Hebrides, which were made several years ago by a woman who is thought to have been the last one to make pottery according to the ancient method of shaping the clay with the hands, and without the use of any form of potter's wheel. Miss Maria Whitney, sister of the late Prof. J. D. Whitney, has presented the "Calaveras skull" and the articles found with it, and all the original documents relating to its discovery and history. Miss Phebe Ferris, of Madisonville, Ohio, has bequeathed to the museum about twenty-five acres of land, on which is situated the ancient mound where Dr. Metz and Curator Putnam have investigated for several years, and whence a considerable collection has been obtained. Miss Ferris expressed the desire that the museum continue the explorations, and after completing convert the tract into a public park. Mr. W. B. Nicker has explored some virgin mounds near Galena, Ill., and a rock shelter and stone grave near Portage, Ill. The library of the museum now contains 1,838 volumes and 2,479 pamphlets on anthropology.

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# Correspondence.

### DO ANIMALS REASON?

*Editor Popular Science Monthly:*

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Dear Sir: In connection with the discussion of the interesting subject Do Animals Reason? permit me to relate the following incident in support of the affirmative side of the question:

Some years ago, before the establishment of the National Zoölogical Park in this city, Dr. Frank Baker, the curator, kept a small nucleus of animals in the rear of the National Museum; among this collection were several monkeys. On a hot summer day, as I was passing the monkey cage I handed to one of the monkeys a large piece of fresh molasses taffy. The animal at once carried it to his mouth and commenced to bite it. The candy was somewhat soft, and stuck to the monkey's paws. He looked at his paws, licked them with his tongue, and then turned his head from side to side looking about the cage. Then, taking the candy in his mouth, he sprang to the farther end of the cage and picked up a wad of brown paper. This ball of paper he carefully unfolded, and, laying it down on the floor of the cage, carefully smoothed out the folds of the paper with both paws. After he had smoothed it out to his satisfaction, he took the piece of taffy from his mouth and laid it in the center of the piece of paper and folded the paper over the candy, leaving a part of it exposed. He then sat back on his haunches and ate the candy, first wiping one paw and then the other on his hip, just as any boy or man might do.

If that monkey did not show reason, what would you call it?

Yours etc.,
H. O. Hall,

*Library Surgeon General's Office, United States Army.*

Washington, D. C., *October 2, 1899*.

# Editor's Table.

### *HOME BURDENS.*

The doctrine has gone abroad, suggested by the most popular poet of the day, that "white men" have the duty laid upon them of scouring the dark places of the earth for burdens to take up. Through a large part of this nation the idea has run like wildfire, infecting not a few who themselves are in no small degree burdens to the community that shelters them. The rowdier element of the population everywhere is strongly in favor of the new doctrine, which to their minds is chiefly illustrated by the shooting of Filipinos. We do not say that thousands of very respectable citizens are not in favor of it also; we only note that they are strongly supported by a class whose adhesion adds no strength to their cause.

It is almost needless to remark that a very few years ago we were not in the way of thinking that the civilized nations of the earth, which had sliced up Asia and Africa in the interest of their trade, had done so in the performance of a solemn duty. The formula "the white man's burden" had not been invented then, and some of us used to think that there was more of the filibustering spirit than of a high humanitarianism in these raids upon barbarous races. Possibly we did less than justice to some of the countries concerned, notably Great Britain, which, having a teeming population in very narrow confines, and being of old accustomed to adventures by sea, had naturally been led to extend her influence and create outlets for her trade in distant parts of the [Pg 123] earth. Be this as it may, we seemed to have our own work cut out for us at home. We had the breadth of a continent under our feet, rich in the products of every latitude; we had unlimited room for expansion and development; we had unlimited confidence in the destinies that awaited us as a nation, if only we applied ourselves earnestly to the improvement of the heritage which, in the order of Providence, had become ours. We thanked Heaven that we were not as other nations, which, insufficiently provided with home blessings, were tempted to put forth their hands and—steal, or something like it, in heathen lands.

Well, we have changed all that: we give our sympathy to the nations of the Old World in their forays on the heathen, and are vigorously tackling "the white man's burden" according to the revised version. It is unfortunate and quite unpleasant that this should involve shooting down people who are only asking what our ancestors asked and obtained—the right of self-government in the land they occupy. Still, we must do it if we want to keep up with the procession we have joined. Smoking tobacco is not pleasant to the youth of fifteen or sixteen who has determined to line up with his elders in that manly accomplishment. He has many a sick stomach, many a flutter of the heart, before he breaks himself into it; but, of course, he perseveres—has he not taken up the white boy's burden? So we. Who, outside of that rowdy element to which we have referred, has not been, whether he has confessed it or not, sick at heart at the thought of the innocent blood we have shed and of the blood of our kindred that we have shed in order to shed that blood? Still, spite of all misgivings and qualms, we hold our course, Kipling leading on, and the colonel of the Rough Riders assuring us that it is all right.

Revised versions are not always the best versions; and for our own part we prefer to think that the true "white man's burden" is that which lies at his own door, and not that which he has to compass land and sea to come in sight of. We have in this land the burden of a not inconsiderable tramp and hoodlum population. This is a burden of which we can never very long lose sight; it is more or less before us every day. It is a burden in a material sense, and it is a burden in what we may call a spiritual sense. It impairs the satisfaction we derive from our own citizenship, and it lies like a weight on the social conscience. It is the opprobrium alike of our educational system and of our administration of the law. How far would the national treasure and individual energy which we have expended in failing to subdue the Filipino "rebels" have gone—if wisely applied—in subduing the rebel elements in our own population, and rescuing from degradation those whom our public schools have failed to civilize? Shall the reply be that we can not interfere with individual liberty? It would be a strange reply to come from people who send soldiers ten thousand miles away for the express purpose of interfering with liberty as the American nation has always hitherto understood that term; but, in point of fact, there is no question of interfering with any liberty that ought to be respected. It is a question of the protection of public morals, of public decency, and of the rights of property. It is a question of the rescue of human beings—our fellow-citizens—from ignorance, vice, and wretchedness. It is a question of making us as a nation right with ourselves, and making citizenship under our flag something to be prized by every one entitled to claim it.

[Pg 124] It is not in the cities only that undesirable elements cluster. The editor of a lively little periodical, in which many true things are said with great force—The Philistine—has lately declared that his own village, despite the refining influences radiated from the "Roycroft Shop," could furnish a band of hoodlum youths that could give points in every form of vile behavior to any equal number gathered from a great city. He hints that New England villages may be a trifle better, but that the farther Western States are decidedly worse. It is precisely in New England, however, that a bitter cry on this very subject of hoodlumism has lately been raised. What are we to do about it?

Manifestly the hoodlum or incipient tramp is one of two things: either he is a person whom a suitable education might have turned into some decent and honest way of earning a living, or he is a person upon whom, owing to congenital defect, all educational effort would have been thrown away. In either case social duty seems plain. If education would have done the work, society—seeing that it has taken the business of public education in hand—should have supplied the education required for the purpose, even though the amount of money available for waging war in the Philippines had been slightly reduced. If the case is one in which no educational effort is of avail, then, as the old Roman formula ran, "Let the magistrates see that the republic takes no harm." Before, therefore, our minds can be easy on this hoodlum question, we must satisfy ourselves thoroughly that our modes of education are not, positively or negatively, adapted to making the hoodlum variety of character. The hoodlum, it is safe to say, is an individual in whom no intellectual interest has ever been awakened, in whom no special capacity has ever been created. His moral nature has never been taught to respond to any high or even respectable principle of conduct. If there is any glory in earth or heaven, any beauty or harmony in the operations of natural law, any poetry or pathos or dignity in human life, anything to stir the soul in the records of human achievement, to all such things he is wholly insensible. Ought this to be so in the case of any human being, not absolutely abnormal, whom the state has undertaken to educate? If, as a community, we put our hands to the educational plow, and so far not only relieve parents of a large portion of their sense of responsibility, but actually suppress the voluntary agencies that would otherwise undertake educational work, surely we should see to it that our education educates. Direct moral instruction in the schools is not likely to be of any great avail unless, by other and indirect means, the mind is prepared to receive it. What is needed is to awaken a sense of capacity and power, to give to each individual some trained faculty and some direct and, as far as it goes, scientific cognizance of things. Does any one suppose that a youth who had gone through a judicious course of manual training, or one who had become interested in any such subject as botany, chemistry, or agriculture, or who even had an intelligent insight into the elementary laws of mechanics, could develop into a hoodlum? On the other hand, there is no difficulty in imagining that such a development might take place in a youth who had simply been plied with spelling-book, grammar, and arithmetic. Even what seem the most interesting reading lessons fall dead upon minds that have no hold upon the reality of things, and no sense of the distinctions which the most elementary study of Nature forces on the attention.

[Pg 125] But, as we have admitted, there may be cases where the nature of the individual is such as to repel all effort for its improvement. Here the law must step in, and secure the community against the dangers to which the existence of such individuals exposes it. There is a certain element in the population which wishes to live, and is determined to live, on a level altogether below anything that can be called civilization. Those who compose it are nomadic and predatory in their habits, and occasionally give way to acts of fearful criminality. It is foolish not to recognize the fact, and take the measures that may be necessary for the isolation of this element. To devise and execute such measures is a burden a thousand times better worth taking up than the burden of imposing our yoke upon the Philippine Islands and crushing out a movement toward liberty quite as respectable, to all outward appearance, as that to which we have reared monuments at Bunker Hill and elsewhere. The fact is, the work before us at home is immense; and it is work which we might attack, not only without qualms of conscience, but with the conviction that every unit of labor devoted to it was being directed toward the highest interests not of the present generation only, but of generations yet unborn. The "white man," we trust, will some day see it; but meanwhile valuable time is being lost, and the national conscience is being lowered by the assumption of burdens that are *not* ours, whatever Mr. Kipling may have said or sung, or whatever Governor Roosevelt may assert on his word as a soldier.

*SPECIALIZATION.*

That division of labor is as necessary in the pursuit of science as in the world of industry no one would think of disputing; but that, like division of labor elsewhere, it has its drawbacks and dangers is equally obvious. When the latter truth is insisted on by those who are not recognized as experts, the experts are apt to be somewhat contemptuous in resenting such interference, as they consider it. An expert himself has, however, taken up the parable, and his words merit attention. We refer to an address delivered by Prof. J. Arthur Thompson, at the University of Aberdeen, upon entering on his duties as Regius Professor of Natural History, a post to which he was lately appointed. "We need to be reminded," he said, "amid the undoubted and surely legitimate fascinations of dissection and osteology, of section cutting and histology, of physiological chemistry and physiological physics, of embryology and fossil hunting, and the like, that the chief end of our study is a better understanding of living creatures in their natural surroundings." He could see no reason, he went on to say, for adding aimlessly to the overwhelming mass of detail already accumulated in these and other fields of research. The aim of our efforts should rather be to grasp the chief laws of growth and structure, and to rise to a true conception of the meaning of organization.

The tendency to over-specialization is manifest everywhere; it may be traced in physics and chemistry, in mathematics, in archæology, and in philology, as well as in biology. We can not help thinking that there is a certain narcotic influence arising from the steady accumulation of minute facts, so that what was in the first place, and in its early stages, an invigorating pursuit becomes not only an absorbing, but more or less a benumbing passion. We are accustomed to profess great admiration for Browning's Grammarian, who—

[Pg 126] "Gave us the doctrine of the enclitic *De*
Dead from the waist down,"

but really we don't feel quite sure that the cause for which the old gentleman struggled was quite worthy of such desperate heroism. The world could have got along fairly well for a while with an imperfect knowledge of the subtle ways of the "enclitic *De*," and indeed a large portion of the world has neither concerned itself with the subject nor felt the worse for not having done so.

What we fear is that some people are "dead from the waist down," or even from higher up, without being aware of it, and all on account of a furious passion for "enclitic de's" or their equivalent in other lines of study. Gentlemen, it is not worth while! You can not all hope to be buried on mountain tops like the grammarian, for there are not peaks enough for all of you, and any way what good would it do you? There is need of specialization, of course; we began by saying that the drift of our remarks is simply this, that he who would go into minute specializing should be careful to lay in at the outset a good stock of common sense, a liberal dose (if he can get it) of humor, and *quantum suff.* of humanity. Thus provided he can go ahead.

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# Scientific Literature.

**SPECIAL BOOKS.**

The comparison between the United States in 1790 and Australia in 1891, with which Mr. *A. F. Weber* opens his essay on *The Growth of Cities in the Nineteenth Century*[10] well illustrates how the tendency of population toward agglomeration in cities is one of the most striking social phenomena of the present age. Both countries were in nearly a corresponding state of development at the time of bringing them into the comparison. The population of the United States in 1790 was 3,929,214; that of Australia in 1891 was 3,809,895; while 3.14 per cent of the people of the United States were then living in cities of ten thousand or more inhabitants, 33.20 per cent of the Australians are now living in such cities. Similar conditions or the tendency toward them are evident in nearly every country of the world. What are the forces that have produced the shifting of population thus indicated; what the economic, moral, political, and social consequences of it; and what is to be the attitude of the publicist, the statesman, and the teacher toward the movement, are questions which Mr. Weber undertakes to discuss. The subject is a very complicated and intricate one, with no end of puzzles in it for the careless student, and requiring to be viewed in innumerable shifting lights, showing the case in changing aspects; for in the discussion lessons are drawn by the author from every country in the family of nations. Natural causes—variations in climate, soil, earth formation, political institutions, etc.—partly explain the distribution of population, but only partly. It sometimes contradicts what would be deduced from them. Increase and improvement in facilities for communication help the expansion [Pg 127] of commercial and industrial centers, but also contribute to the scattering of population over wider areas. The most potent factors in attracting people to the cities were, in former times, the commercial facilities they afforded, with opportunities to obtain employment in trade, and are now the opportunities for employment in trade and in manufacturing industries. The cities, however, do not grow merely by accretions from the outside, but they also enjoy a new element of natural growth within themselves in the greater certainty of living and longer duration of life brought about by improved management and ease of living in them, especially by improved sanitation, and it is only in the nineteenth century that any considerable number of cities have had a regular surplus of births over deaths. Migration cityward is not an economic phenomenon peculiar to the nineteenth century, but is shown by the study of the social statistics and the bills of mortality of the past to have been always a factor important enough to be a subject of special remark. It is, however, a very lively one now, and "in the immediate future we may expect to see a continuation of the centralizing movement; while many manufacturers are locating their factories in the small cities and towns, there are other industries that prosper most in the great cities. Commerce, moreover, emphatically favors the great centers rather than the small or intermediate centers." In examining the structure of city populations, a preponderance of the female sex appears, and is explained by the accentuated liability of men over women in cities to death from dangers of occupation, vice, crime, and excesses of all kinds. There are also present in the urban population a relatively larger number of persons in the active period of life, whence an easier and more animated career, more energy and enterprise, more radicalism and less conservatism, and more vice, crime, and impulsiveness generally may be expected. Of foreign immigrants, the least desirable class are most prone to remain in the great cities; and with the decline of railway building and the complete occupation of the public lands the author expects that immigrants in the future will disperse less readily than in the past, but in the never-tiring energy of American enterprise this may not prove to be the case. As to occupation, the growth of cities is found to favor the development of a body of artisans and factory workmen, as against the undertaker and employer, and "that the class of day laborers is relatively small in the cities is reason for rejoicing." It is found "emphatically true that the growth of cities not only increases a nation's economic power and energy, but quickens the national pulse.... A progressive and dynamic civilization implies the good and bad alike. The cities, as the foci of progress, inevitably contain both." The development of suburban life, stimulated by the railroad and the trolley, and the transference of manufacturing industries to the suburbs, are regarded as factors of great promise for the amelioration of the recognized evils of city life and for the solution of some of the difficulties it offers and the promotion of its best results.

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Dr. *James K. Crook*, author of *The Mineral Waters of the United States and their Therapeutic Uses*,[11] accepts it as proved by centuries of experience that in certain disorders the intelligent [Pg 128] use of mineral waters is a more potent curative agency than drugs. He believes that Americans have within their own borders the close counterparts of the best foreign springs, and that in charms of scenery and surroundings, salubrity of climate and facilities for comfort, many of our spas will compare as resorts with the most highly developed ones of Europe. The purpose of the present volume is to set forth the qualities and attractions of American springs, of which we have a large number and variety, and the author has aimed to present the most complete and advanced work on the subject yet prepared. To make it so, he has carefully examined all the available literature on the subject, has addressed letters of inquiry to proprietors and other persons cognizant of spring resorts and commercial springs, and has made personal visits. While a considerable number of the 2,822 springs enumerated by Dr. A. C. Peale in his report to the United States Geological Survey have dropped out through non-use or non-development, more than two hundred mineral-spring localities are here described for the first time in a book of this kind. Every known variety of mineral water is represented. The subject is introduced by chapters on what might be called the science of mineral waters and their therapeutic uses, including the definition, the origin of mineral waters, and the sources whence they are mineralized; the classification, the discussion of their value, and mode of action; their solid and gaseous components; their therapeutics or applications to different disorders; and baths and douches and their medicinal uses. The springs are then described severally by States. The treatise on potable waters in the appendix is brief, but contains much.

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# GENERAL NOTICES.

In *Every-Day Butterflies*[12] Mr. *Scudder* relates the story of the very commonest butterflies —"those which every rambler at all observant sees about him at one time or another, inciting his curiosity or pleasing his eye." The sequence of the stories is mainly the order of appearance of the different subjects treated—which the author compares to the flowers in that each kind has its own season for appearing in perfect bloom, both together variegating the landscape in the open season of the year. This order of description is modified occasionally by the substitution of a later appearance for the first, when the butterfly is double or triple brooded. As illustrations are furnished of each butterfly discussed, it is not necessary that the descriptions should be long and minute, hence they are given in brief and general terms. But it must be remembered that the describer is a thorough master of his subject, and also a master in writing the English language, so that nothing will be found lacking in his descriptions. They are literature as well as butterfly history. Of the illustrations, all of which are good, a considerable number are in colors.

Dr. *M. E. Gellé's L'Audition et ses Organes*[13] (The Hearing and its Organs) is a full, not over-elaborate treatise on the subject, in which prominence is given to the physiological side. The first part treats of the excitant of the sense of hearing—sonorous vibrations—including the vibrations themselves, the length of the vibratory phenomena, the intensity of sound, range of audition, tone, and timbre of sounds. The second chapter relates to the organs of hearing, both the peripheric organs and the acoustic centers, the anatomy of which is described in detail, with excellent and ample illustrations. The third chapter is devoted to the sensation of hearing under [Pg 129] its various aspects—the time required for perception, "hearing in school," the influence of habit and attention, orientation of the sound, bilateral sensations, effects on the nervous centers, etc., hearing of musical sounds, oscillations and aberrations of hearing, auditive memory, obsessions, hallucinations of the ear, and colored audition.

Prof. *Andrew C. McLaughlin's History of the American Nation*[14] has many features to recommend it. It aims to trace the main outlines of national development, and to show how the American people came to be what they are. These outlines involve the struggle of European powers for supremacy in the New World, the victory of England, the growth of the English colonies and their steady progress in strength and self-reliance till they achieved their independence, the development of the American idea of government, its extension across the continent and its influence abroad—all achieved in the midst of stirring events, social, political, and moral, at the cost sometimes of wars, and accompanied by marvelous growth in material prosperity and political power. All this the author sets forth, trying to preserve the balance of the factors, in a pleasing, easy style. Especial attention is paid to political facts, to the rise of parties, to the development of governmental machinery, and to questions of government and administration. In industrial history those events have been selected for mention which seem to have had the most marked effect on the progress and make-up of the nation. It is to be desired that more attention had been given to social aspects and changes in which the development has not been less marked and stirring than in the other departments of our history. Indeed, the field for research and exposition here is extremely wide and almost infinitely varied, and it has hardly yet begun to be worked, and with any fullness only for special regions. When he comes to recent events, Professor McLaughlin naturally speaks with caution and in rather general terms. It seems to us, however, that in the matter of the war with Spain, without violating any of the proprieties, he might have given more emphasis to the anxious efforts of that country to comply with the demands of the administration for the institution of reforms in Cuba; and, in the interest of historical truth, he ought not to have left unmentioned the very important fact that the Spanish Government offered to refer the questions growing out of the blowing up of the Maine to arbitration and abide by the result, and our Government made no answer to the proposition.

Mr. *W. W. Campbell's Elements of Practical Astronomy*[15] is an evolution. It grew out of the lessons of his experience in teaching rather large classes in astronomy in the University of Michigan, by which he was led to the conclusion that the extensive treatises on the subject could not be used satisfactorily except in special cases. Brief lecture notes were employed in preference. These were written out and printed for use in the author's classes. The first edition of the book made from them was used in several colleges and universities having astronomical departments of high character. The work now appears, slightly enlarged, in a second edition. In the present greatly extended field of practical astronomy numerous special problems arise, which require prolonged efforts on the part of professional astronomers. While for the discussion of the methods employed in solving such problems the reader is referred to special treatises and journals, these methods are all developed from the *elements* of astronomy and the related sciences, of which it is intended that this book shall contain the elements of practical astronomy, with numerous references to the problems first requiring solution. The author believes that the methods of observing employed are illustrations of the best modern practice.

In *The Characters of Crystals*[16] Prof. *Alfred J. Moses* has attempted to describe, simply and [Pg 130] concisely, the methods and apparatus used in studying the physical characters of crystals, and to record and explain the observed phenomena without complex mathematical discussions. The first part of the book relates to the geometrical characteristics of crystals, or the relations and determination of their forms, including the spherical projection, the thirty-two classes of forms, the measurement of crystal angles, and crystal projection or drawing. The optical characters and their determination are the subject of the second part. In the third part the thermal, magnetic, and electrical characters and the characters dependent upon electricity (elastic and permanent deformations) are treated of. A suggested outline of a course in physical crystallography is added, which includes preliminary experiments with the systematic examination of the crystals of any substance, and corresponds with the graduate course in physical crystallography given in Columbia University. The book is intended to be useful to organic chemists, geologists, mineralogists, and others interested in the study of crystals. The treatment is necessarily technical.

A book describing the *Practical Methods of identifying Minerals in Rock Sections with the Microscope*[17] has been prepared by Mr. *L. McI. Luquer* to ease the path of the student inexperienced in optical mineralogy by putting before him only those facts which are absolutely necessary for the proper recognition and identification of the minerals in thin sections. The microscopic and optical characters of the minerals are recorded in the order in which they would be observed with a petrographical microscope; when the sections are opaque, attention is called to the fact, and the characters are recorded as seen with incident light. The order of Rosenbusch, which is based on the symmetry of the crystalline form, is followed, with a few exceptions made for convenience. In an introductory chapter a practical elementary knowledge of optics as applied to optical mineralogy is attempted to be given, without going into an elaborate discussion of the subject. The petrographical microscope is described in detail. The application of it to the investigation of mineral characteristics is set forth in general and as to particular minerals. The preparation of sections and practical operations are described, and an optical scheme is appended, with the minerals grouped according to their common optical characters.

Mr. *Herbert C. Whitaker's Elements of Trigonometry*[18] is concise and of very convenient size for use. The introduction and the first five of the seven chapters have been prepared for the use of beginners. The other two chapters concern the properties of triangles and spherical triangles; an appendix presents the theory of logarithms; and a second appendix, treating of goniometry, complex quantities, and complex functions, has been added for students intending to take up work in higher departments of mathematics. For assisting a clearer understanding of the several processes, the author has sought to associate closely with every equation a definite meaning with reference to a diagram. Other characteristics of the book are the practical applications to mechanics, surveying, and other everyday problems; its many references to astronomical problems, and the constant use of geometry as a starting point and standard.

A model in suggestions for elementary teaching is offered in *California Plants in their Homes*,[19] by *Alice Merritt Davidson*, formerly of the State Normal School, California. The book consists of two parts, a botanical reader for children and a supplement for the use of teachers, both divisions being also published in separate volumes. It is well illustrated, provided with an index and an outline of lessons adapted to different grades. The treatment of each theme is fresh, and the grouping novel, as is indicated by the chapter headings: Some Plants that lead Easy Lives, Plants
 that know how to meet Hard Times, Plants that do not make their own Living, Plants with Mechanical Genius. Although specially designed for the study of the flora of southern California, embodying the results of ten years' observation by the author, it may be recommended to science teachers in any locality as an excellent guide. The pupil in this vicinity will have to forego personal inspection of the shooting-star and mariposa lily, while he finds the century plant, yuccas, and cacti domiciled in the greenhouse. In addition to these, however, attention is directed to a sufficient number of familiar flowers, trees, ferns, and fungi for profitable study, and the young novice in botany can scarcely make a better beginning than in company with this skillful instructor.

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Prof. *John M. Coulter's Plant Relations*[20] is one of two parts of a system of teaching botany proposed by the author. Each of the two books is to represent the work of half a year, but each is to be independent of the other, and they may be used in either order. The two books relate respectively, as a whole, to ecology, or the life relations of surroundings of plants, and to their morphology. The present volume concerns the ecology. While it may be to the disadvantage of presenting ecology first, that it conveys no knowledge of plant structures and plant groups, this disadvantage is compensated for, in the author's view, by the facts that the study of the most evident life relations gives a proper conception of the place of plants in Nature; that it offers a view of the plant kingdom of the most permanent value to those who can give but a half year to botany; and that it demands little or no use of the compound microscope, an instrument ill adapted to first contacts with Nature. The book is intended to present a connected, readable account of some of the fundamental facts of botany, and also to serve as a supplement to the three far more important factors of the teacher, who must amplify and suggest at every point; the laboratory, which must bring the pupil face to face with plants and their structure; and field work, which must relate the facts observed in the laboratory to their actual place in Nature, and must bring new facts to notice which can be observed nowhere else. Taking the results obtained from these three factors, the book seeks to organize them, and to suggest explanations, through a clear, untechnical, compact text and appropriate and excellent illustrations.

The title of *The Wilderness of Worlds*[21] was suggested to the author by the contemplation of a wilderness of trees, in which those near him are very large, while in the distance they seem successively smaller, and gradually fade away till the limit of vision is reached. So of the wilderness of worlds in space, with its innumerable stars of gradually diminishing degrees of visibility—worlds "of all ages like the trees, and the great deep of space is covered with their dust, and pulsating with the potency of new births." The body of the book is a review of the history of the universe and all that is of it, in the light of the theory of evolution, beginning with the entities of space, time, matter, force, and motion, and the processes of development from the nebulæ as they are indicated by the most recent and best verified researches, and terminating with the ultimate extinction of life and the end of the planet. In the chapter entitled A Vision of Peace the author confronts religion and science. He regards the whole subject from the freethinker's point of view, with a denial of all agency of the supernatural.

In a volume entitled *The Living Organism*[22] Mr. *Alfred Earl* has endeavored to make a philosophical introduction to the study of biology. The closing paragraph of his preface is of interest as showing his views regarding vitalism: "The object of the book will be attained if it succeeds, although it may be chiefly by negative criticism, in directing attention to the important [Pg 132] truth that, though chemical and physical changes enter largely into the composition of vital activity, there is much in the living organism that is outside the range of these operations." The first three chapters discuss general conceptions, and are chiefly psychology. A discussion of the structures accessory to alimentation in man and the higher animals occupies Chapters IV and V. The Object of Classification, Certain General Statements concerning Organisms, A Description of the Organism as related to its Surroundings, The Material Basis of Life, The Organism as a Chemical Aggregate and as a Center for the Transformation of Energy, Certain Aspects of Form and Development, The Meaning of Sensation, and, finally, Some of the Problems presented by the Organism, are the remaining chapter headings. The volume contains many interesting suggestions, and might perhaps most appropriately be described as a Theoretical Biology.

"*Stars and Telescopes*,"[23] Professor *Todd* says, "is intended to meet an American demand for a plain, unrhetorical statement of the astronomy of to-day." We might state the purpose to be to bring astronomy and all that pertains to it up to date. It is hard to do this, for the author has been obliged to put what was then the latest discovery, made while the book was going through the press, in a footnote at the end of the preface. The information embodied in the volume is comprehensive, and is conveyed in a very intelligible style. The treatise begins with a running commentary or historical outline of astronomical discovery, with a rigid exclusion of all detail. The account of the earth and moon is followed by chapters on the Calendar and the Astronomical Relations of Light. The other members of the solar system are described and their relations reviewed, and then the comets and the stars. Closely associated with these subjects are the men who have contributed to knowledge respecting them, and consequently the names of the great discoverers and others who have helped in the advancement of astronomy are introduced in immediate connection with their work, in brief sketches and often with their portraits. Much importance is attributed by Professor Todd to the instruments with which astronomical discovery is carried on, and the book may be said to culminate in an account of the famous instruments, their construction, mounting, and use. The devisers of these instruments are entitled to more credit than the unthinking are always inclined to give them, for the value of an observation depends on the accuracy of the instrument as well as on the skill of the observer, and the skill which makes the instrument accurate is not to be underrated. So the makers of the instruments are given their place. Then the recent and improved processes have to be considered, and, altogether, Professor Todd has found material for a full and somewhat novel book, and has used it to good advantage.

*Some Observations on the Fundamental Principles of Nature* is the title of an essay by *Henry Witt*, which, though very brief, takes the world of matter, mind, and society within its scope. One of the features of the treatment is that instead of the present theory of an order of things resulting from the condensation of more rarefied matter, one of the organization of converging waves of infinitesimal atoms filling all space is substituted. With this point prominently in view, the various factors and properties of the material universe—biology, psychology, sociology, ethics, and the future—are treated of.

Among the later monographs published by the Field Columbian Museum, Chicago, is a paper in the Geological Series (No. 3) on *The Ores of Colombia, from Mines in Operation in 1892*, by *H. W. Nichols*. It describes the collection prepared for the Columbian Exposition by F. Pereira Gamba and afterward given to the museum—a collection which merits attention for the light it throws upon the nature and mode of occurrence of the ores of one of the most important gold-producing countries of the world, and also because it approaches more nearly than is usual the ideal of what a collection in economic geology should be. Other publications in the museum's Geological Series are *The Mylagauldæ, an Extinct Family of Sciuromorph Rodents* (No. 4), by *E. S. Riggs*, [Pg 133] describing some squirrel-like animals from the Deep River beds, near White Sulphur Springs, Montana; *A Fossil Egg from South Dakota* (No. 5), by *O. C. Farrington*, relative to the egg of an anatine bird from the early Miocene; and *Contributions to the Paleontology of the Upper Cretaceous Series* (No. 6), by *W. N. Logan*, in which seven species of *Scaphites*, *Ostrea*, *Gasteropoda*, and corals are described. In the Zoölogical Series, *Preliminary Descriptions of New Rodents from the Olympic Mountains* (of Washington) (No. 11), by *D. G. Elliot*, relates to six species; *Notes on a Collection of Cold-blooded Vertebrates from the Olympic Mountains* (No. 12), by *S. E. Meek*, to six trout and three other fish, four amphibia, and three reptiles; and a

*Catalogue of Mammals from the Olympic Mountains, Washington*, with descriptions of new species (No. 13), by *D. G. Elliot*, includes a number of species of rodents, lynx, bear, and deer.

*Some Notes on Chemical Jurisprudence* is the title given by *Harwood Huntington* (260 West Broadway, New York; 25 cents) to a brief digest of patent-law cases involving chemistry. The notes are designed to be of use to chemists intending to take out patents by presenting some of the difficulties attendant upon drawing up a patent strong enough to stand a lawsuit, and by explaining some points of law bearing on the subject. In most, if not all, cases where the chemist has devised a new method or application it is best, the author holds, to take out a patent for self-protection, else the inventor may find his device stolen from him and patented against him.

A cave or fissure in the Cambrian limestone of Port Kennedy, Montgomery County, Pa., exposed by quarrymen the year before, was brought to the knowledge of geologists by Mr. Charles M. Wheatley in 1871, when the fossils obtained from it were determined by Prof. E. D. Cope as of thirty-four species. Attention was again called to the paleontological interest of the locality by President Dixon, of the Academy of Natural Sciences of Philadelphia, in 1894. The fissure was examined again by Dr. Dixon and others, and was more thoroughly explored by Mr. Henry C. Mercer. Mr. Mercer published a preliminary account of the work, which was followed by the successive studies of the material by Professor Cope preliminary to a complete and illustrated report to be made after a full investigation of all accessible material. Professor Cope did not live to publish this full report, which was his last work, prepared during the suffering of his final illness. It is now published, just as the author left it, as *Vertebrate Remains from the Port Kennedy Deposit*, from the Journal of the Academy of Natural Sciences of Philadelphia. Four plates of illustrations, photographed from the remains, accompany the text.

The machinery of Mr. *Fred A. Lucas's* story of *The Hermit Naturalist* reminds us of that of the old classical French romances, like Télémaque, and the somewhat artificial, formal diction is not dissimilar. An accident brings the author into acquaintance and eventual intimacy with an old Sicilian naturalist, who, migrating to this country, has established a home, away from the world's life, on an island in the Delaware River. The two find a congenial subject of conversation in themes of natural history, and the bulk of the book is in effect a running discourse by the old Sicilian on snakes and their habits—a valuable and interesting lesson. The hermit has a romance, involving the loss of his motherless daughter, stolen by brigands and brought to America, his long search for her and resignation of hope, and her ultimate discovery and restoration to him. The book is of easy reading, both as to its natural history and the romance.

We have two papers before us on the question of expansion. One is an address delivered by John Barrett, late United States Minister to Siam, before the Shanghai General Chamber of Commerce, and previous to the beginning of the attempt to subjugate the islands, on *The Philippine Islands and American Interests in the Far East*. This address has, we believe, been since followed by others, and in all Mr. Barrett favors the acquisition of the Philippine Islands on the grounds, among others, of commercial interests and the capacity of the Filipinos for development in further civilization and self-government; but his arguments, in the present aspect of the Philippine question, seem to us to bear quite as decidedly in the opposite direction. He

gives the following picture of Aguinaldo and the Filipino government: "He (Aguinaldo) captured all Spanish garrisons on the island of Luzon outside of Manila, so that when the Americans were ready to proceed against the city they were not delayed and troubled with a country campaign. Moreover, he has organized a government which has practically been administering the affairs of the great island since the American occupation of Manila, and which is certainly better than the former administration; he has a properly formed Cabinet and Congress, the members of which, in appearance and manners, would compare favorably with Japanese statesmen. He has among his advisers men of ability as international lawyers, while his supporters include most of the prominent educated and wealthy natives, all of which prove possibilities of self-government that we must consider." This pamphlet is published at Hong Kong. The other paper is an address delivered before the New York State Bar Association, by *Charles A. Gardiner*, on *Our Right to acquire and hold Foreign Territory*, and is published by G. P. Putnam's Sons in the Questions of the Day Series. Mr. Gardiner holds and expresses the broadest views of the constitutional power of our Government to commit the acts named, and to exercise all the attributes incidental to the possession of acquired territory, but he thinks that we need a great deal of legal advice in the matter.

A pamphlet, *Anti-Imperialism*, by *Morrison L. Swift*, published by the Public Ownership Review, Los Angeles, Cal., covers the subject of English and American aggression in three chapters—Imperialism to bless the Conquered, Imperialism for the Sake of Mankind, and Our Crime in the Philippines. Mr. Swift is very earnest in respect to some of the subjects touched upon in his essays, and some persons may object that he is more forcible—even to excess—than polite in his denunciations. To such he may perhaps reply that there are things which language does not afford words too strong to characterize fitly.

Among the papers read at the Fourth International Catholic Scientific Congress, held at Fribourg, Switzerland, in August, 1897, was one by *William J. D. Croke* on *Architecture, Painting, and Printing at Subiaco* as represented in the Abbey at Subiaco. The author regards the features of the three arts represented in this place as evidence that the record of the activity of the foundation constitutes a real chapter in the history of progress in general and of culture in particular.

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Meyer, A. B. The Distribution of the Negritos in the Philippine Islands and Elsewhere. Dresden (Saxony): Stengel & Co. Pp. 92.

Nicholson, H. H., and Avery, Samuel. Laboratory Exercises with Outlines for the Study of Chemistry, to accompany any Elementary Text. New York: Henry Holt & Co. Pp. 134. 60 cents.

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## Fragments of Science.

**The Dover Meeting of the British Association.**—While the attendance on the meeting of the British Association at Dover was not large—the whole number of members being 1,403, of whom 127 were ladies—the occasion was in other respects eventful and one of marked interest. The papers read were, as a rule, of excellent quality, and the interchange of visits with the French Association was a novel feature that might bear many repetitions. The president, Sir Michael Foster, presented, in his inaugural address, a picture of the state of science one hundred years ago, illustrating it by portraying the conditions to which a body like the association meeting then at Dover would have found itself subject, and suggesting the topics it would have discussed. The period referred to was, however, that of the beginning of the present progress, and, after remarking on what had been accomplished in the interval, the speaker drew a very hopeful foreview for the future. Besides the intellectual triumphs of science, its strengthening discipline, its relation to politics, and the "international brotherhood of science" were brought under notice in the address. In his address as president of the Physical Section, Prof. J. H. Poynting showed how physicists are tending toward a general agreement as to the nature of the laws in which they embody their discoveries, of the explanations they give, and of the hypotheses they make, and, having considered what the form and terms of this agreement should be, passed to a discussion of the limitations of physical science. The subject of Dr. Horace T. Brown's Chemical Section address was The Assimilation of Carbon by the Higher Plants. Sir William H. White, president of the Section of Mechanical Science, spoke on Steam Navigation at High Speeds. President Adam Sedgwick addressed the Zoölogical Section on Variation and some Phenomena connected with Reproduction and Sex; Sir John Murray, the Geographical Section on The Ocean Floor; and Mr. J. N. Langley, the Physiological Section on the general relations of the motor nerves to the several tissues of the body, especially of those which run to tissues over which we have little or no control. The president of the Anthropological Section, Mr. C. H. Read, of the British Museum, spoke of the preservation and proper exploration of the prehistoric antiquities of the country, and  offered a plan for increasing the amount of work done in anthropological investigation by the use of Government aid. A peculiar distinction attaches to this meeting through its reception and entertainment of the French Association, and the subsequent return of the courtesy by the latter body at Boulogne. About three hundred of the French Associationists, among whom were many ladies, came over, on the Saturday of the meeting, under the lead of their president, M. Brouardel, and accompanied by a number of men of science from Belgium. They were met at the pier by the officers of the British Association, and were escorted to the place of meeting and to the sectional meetings toward which their several tastes directed them. The geological address of Sir Archibald Geikie on Geological Time had been appointed for this day out of courtesy to the French geologists, and in order that they might have an opportunity of hearing one of the great lights of British science. Among the listeners who sat upon the platform were M. Gosselet, president of the French Geological Society; M. Kemna, president of the Belgian Geological Society; and M. Rénard, of Ghent. Public evening lectures were delivered on the Centenary of the Electric Current, by Prof. J. A. Fleming, and (in French) on Nervous Vibration, by Prof. Charles Richet. Sir William Turner was appointed president for the Bradford meeting of the association (1900). The visit of the French Association was returned on September 22d, when the president, officers, and about three hundred members went to Boulogne. They were welcomed by the mayor of the city, the prefect of the department, and a representative of the French Government; were feasted by the municipality of Boulogne; were entertained by the members of the French Association; and special commemorative medals were presented by the French Association to the two presidents. The British visitors also witnessed the inauguration of a tablet in memory of Dr. Duchesne, and of a plaque commemorative of Thomas Campbell, the poet, who died in Boulogne.

**Artificial India Rubber.**—A recent issue of the Kew Gardens Bulletin contains an interesting article on Dr. Tilden's artificial production of India rubber. India rubber, or caoutchouc, is chemically a hydrocarbon, but its molecular constitution is unknown. When decomposed by heat it is broken up into simpler hydrocarbons, among which is a substance called isoprene, a volatile liquid boiling at about 36° C. Its molecular formula is $C_5H_8$. Dr. Tilden obtained this same substance (isoprene) from oil of turpentine and other terpenes by the action of moderate heat, and then by treating the isoprene with strong acids succeeded, by means of a very slow reaction, in converting a small portion of it into a tough elastic solid, which seems to be identical in properties with true India rubber. This artificial rubber, like the natural, seems to consist of two substances, one of which is more soluble in benzene and carbon bisulphide than the other. It unites with sulphur in the same way as ordinary rubber, forming a tough, elastic compound. In a recent letter Professor Tilden says: "As you may imagine, I have tried everything I can think of as likely to promote this change, but without success. The polymerization proceeds *very* slowly, occupying, according to my experience, several years, and all attempts to hurry it result in the production not of rubber, but of 'colophene,' a thick, sticky oil quite useless for all purposes to which rubber is applied."

**Dangers of High Altitudes for Elderly People.**—"The public, and sometimes the inexperienced physician—inexperienced not in general therapeutics but in the physiological effects of altitude on a weak heart," says Dr. Findlater Zangger in the Lancet, "make light of a danger they can not understand. But if an altitude of from four thousand to five thousand feet above the sea level puts a certain amount of strain on a normal heart and by a rise of the blood-pressure indirectly also on the small peripheral arteries, must not this action be multiplied in the case of a heart suffering from even an early stage of myocarditis or in the case of arteries with thickened or even calcified walls? It is especially the rapidity of the change from one altitude to
[Pg 137] another, with differences of from three thousand to four thousand feet, which must be considered. There is a call made on the contractibility of the small arteries on the one hand, and on the amount of muscular force of the heart on the other hand, and if the structures in question can not respond to this call, rupture of an artery or dilatation of the heart may ensue. In the case of a normal condition of the circulatory organs little harm is done beyond some transient discomfort, such as dizziness, buzzing in the ears, palpitation, general *malaise*, and this often only in the case of people totally unaccustomed to high altitudes. For such it is desirable to take the high altitude by degrees in two or three stages, say first stage 1,500 feet, second stage from 2,500 to 3,000 feet, and third stage from 4,000 to 6,000 feet, with a stay of one or two days at the intermediate places. The stay at the health resort will be shortened, it is true, but the patient will derive more benefit. On the return journey one short stay at one intermediate place will suffice. Even a fairly strong heart will not stand an overstrain in the first days spent at a high altitude. A Dutch lady, about forty years of age, who had spent a lifetime in the lowlands, came directly up to Adelboden (altitude, 4,600 feet). After two days she went on an excursion with a party up to an Alp 7,000 feet high, making the ascent quite slowly in four hours. Sudden heart syncope ensued, which lasted the best part of an hour, though I chanced to be near and could give assistance, which was urgently needed. The patient recovered, but derived no benefit from a fortnight's stay, and had to return to the low ground the worse for her trip and her inconsiderate enterprise. Rapid ascents to a high altitude are very injurious to patients with arterio-sclerosis, and the mountain railways up to seven thousand and ten thousand feet are positively dangerous to an unsuspecting public, for many persons between the ages of fifty-five and seventy years consider themselves to be hale and healthy, and are quite unconscious of having advanced arterio-sclerosis and perchance contracted kidney. An American gentleman, aged fifty-eight years, was under my care for slight symptoms of angina pectoris, pointing to sclerosis of the coronary arteries. A two-months' course of treatment at Zurich with massage, baths, and proper exercise and diet did away with all the symptoms. I saw him by chance some months later. 'My son is going to St. Moritz (six thousand feet) for the summer,' said he; 'may I go with him?' 'Most certainly not,' was my answer. The patient then consulted a professor, who allowed him to go. Circumstances, however, took him for the summer to Sachseln, which is situated at an altitude of only two thousand feet, and he spent a good summer. But he must needs go up the Pilatus by rail (seven thousand feet), relying on the professor's permission, and the result was disastrous, for he almost died from a violent attack of angina pectoris on the night of his return from the Pilatus, and vowed on his return to Zurich to keep under three thousand feet in future. I may here mention that bad results in the shape of heart collapse, angina pectoris, cardiac asthma, and last, not least, apoplexy, often occur only on the return to the lowlands."

**The Parliamentary Amenities Committee.**—Under the above rather misleading title there was formed last year, in the English Parliament, a committee for the purpose of promoting concerted action in the preservation and protection of landmarks of general public interest, historic buildings, famous battlefields, and portions of landscape of unusual scenic beauty or geological conformation, and also for the protection from entire extinction of the various animals and even plants which the spread of civilization is gradually pushing to the wall. In reality, it is an official society for the preservation of those things among the works of past man and Nature which, owing to their lack of direct money value, are in danger of destruction in this intensely commercial age. Despite the comparative newness of the American civilization, there are already many relics belonging to the history of our republic whose preservation is very desirable, as well as very doubtful, if some such public-spirited committee does not take the matter in hand; and, as regards the remains of the original Americans, in which the country abounds, the necessity is still more immediate. The official care of Nature's own curiosities is equally needed, as witness the
[Pg 138] way in which the Hudson River palisades are being mutilated, and the constant raids upon our city parks for speedways, parade grounds, etc. The great value of a parliamentary or congressional committee of this sort lies in the fact that its opinions are not only based upon expert knowledge, but that they can be to an extent enforced; whereas such a body of men with no official position may go on making suggestions and protesting, as have numerous such bodies for years, without producing any practical results. The matter is, with us perhaps, one of more importance to future generations; but as all Nature seems ordered primarily with reference to

the future welfare of the race, rather than for the comfort of its present members, the necessity for such an official body, whose specific business should be to look after the preservation of objects of historical interest to the succeeding centuries, ought to be inculcated in us as a part of the general evolutionary scheme.

**Physical Measurements of Asylum Children.**—Dr. Ales Hrdlicka has published an account of anthropological investigations and measurements which he has made upon one thousand white and colored children in the New York Juvenile Asylum and one hundred colored children in the Colored Orphan Asylum, for information about the physical state of the children who are admitted and kept in juvenile asylums, and particularly to learn whether there is anything physically abnormal about them. Some abnormality in the social or moral condition of such children being assumed, if they are also physically inferior to other children, they would have to be considered generally handicapped in the struggle for life; but if they do not differ greatly in strength and constitution from the average ordinary children, then their state would be much more hopeful. Among general facts concerning the condition of the children in the Juvenile Asylum, Dr. Hrdlicka learned that when admitted to the institution they are almost always in some way morally and physically inferior to healthy children from good social classes at large—the result, usually, of neglect or improper nutrition or both. Within a month, or even a week, decided changes for the better are observed, and after their admission the individuals of the same sex and age seem gradually, while preserving the fundamental differences of their nature, to show less of their former diversity and grow more alike. In learning, the newcomers are more or less retarded when put into the school, but in a great majority of cases they begin to acquire rapidly, and the child usually reaches the average standing of the class. Inveterate backwardness in learning is rare. Physically, about one seventh of all the inmates of the asylum were without a blemish on their bodies—a proportion which will not seem small to persons well versed in analyses of the kind. The differences in the physical standing of the boys and the girls were not so great or so general as to permit building a hypothesis upon them, though the girls came out a little the better. The colored boys seemed to be physically somewhat inferior to the white ones, but the number of them was not large enough to justify a conclusion. Of the children not found perfect, two hundred presented only a single abnormality, and this usually so small as hardly to justify excluding them from the class of perfect. Regarding as decidedly abnormal only those in whom one half the parts of the body showed defects, the number was eighty-seven. "Should we, for the sake of illustration, express the physical condition of the children by such terms as fine, medium, and bad, the fine and bad would embrace in all 192 individuals, while 808 would remain as medium." All the classes of abnormalities—congenital, pathological, and acquired—seemed more numerous in the boys than in the girls. The colored children showed fewer inborn abnormalities than the white, but more pathological and acquired. No child was found who could be termed a thorough physical degenerate, and the author concludes that the majority of the class of children dealt with are physically fairly average individuals.

**Busy Birds.**—A close observation of a day's work of busy activity, of a day's work of the chipping sparrow hunting and catching insects to feed its young, is recorded by Clarence M. Weed in a  Bulletin of the New Hampshire College Agricultural Experiment Station. Mr. Weed began his watch before full daylight in the morning, ten minutes before the bird got off from its nest, and continued it till after dark. During the busy day Mr. Weed says, in his summary, the parent birds made almost two hundred visits to the nest, bringing food nearly every time, though some of the trips seem to have been made to furnish grit for the grinding of the food. There was no long interval when they were not at work, the longest period between visits being twenty-seven minutes. Soft-bodied caterpillars were the most abundant elements of the food, but crickets and crane flies were also seen, and doubtless a great variety of insects were taken, but precise determination of the quality of most of the food brought was of course impossible. The observations were undertaken especially to learn the regularity of the feeding habits of the adult birds. The chipping sparrow is one of the most abundant and familiar of our birds. It seeks its nesting site in the vicinity of houses, and spends most of its time searching for insects in grass lands or cultivated fields and gardens. In New England two broods are usually reared each season. That the young keep the parents busy catching insects and related creatures for their food is shown by the minute record which the author publishes in his paper. The bird deserves all the protection and encouragement that can be given it.

**Park-making among the Sand Dunes.**—For the creation of Golden Gate Park the park-makers of San Francisco had a series of sand hills, "hills on hills, all of sand-dune formation." The city obtained a strip of land lying between the bay and the ocean, yet close enough to the center of population to be cheaply and easily reached from all parts of the town. Work was begun in 1869, and has been prosecuted steadily since, with increasing appropriations, and the results are a credit to the city, Golden Gate Park, Mr. Frank H. Lamb says in his account of it in The Forester, having a charm that distinguishes it from other city parks. It has a present area of 1,040 acres, of which 300 acres have been sufficiently reclaimed to be planted with coniferous trees." It is this portion of the park which the visitor sees as one of the sights of the Golden Gate." As he rides through the park out toward the Cliff House and Sutro Heights by the Sea," he sees still great stretches of sand, some loose, some still held in place by the long stems and rhizomes of the sand grass (*Arundo arenaria*). This is the preparatory stage in park-making. The method in brief is as follows: The shifting sand is seeded with *Arundo arenaria*, and this is allowed to grow two years, when the ground is sufficiently held in place to begin the second stage of reclamation, which consists in planting arboreal species, generally the Monterey pine (*Pinus insignis*) and the Monterey cypress (*Cupressus macrocarpus*); with these are also planted the smaller

*Leptospermum lævigatum* and *Acacia latifolia*. These species in two or more years complete the reclamation, and then attention is directed to making up all losses of plants and encouraging growth as much as possible." The entire cost of reclamation by these methods is represented not to average more than fifty dollars per acre.

**A Fossiliferous Formation below the Cambrian.**—Mr. George F. Matthew said, in a communication to the New York Academy of Sciences, that he had been aware for several years of the existence of fauna in the rocks below those containing *Paradoxides* and **Protolenus** in New Brunswick, eastern Canada, but that the remains of the higher types of organisms found in those rocks were so poorly preserved and fragmentary that they gave a very imperfect knowledge of their nature. Only the casts of *Hyolithidæ*, the mold of an obolus, a ribbed shell, and parts of what appeared to be the arms and bodies of crinoids were known, to assure us that there had been living forms in the seas of that early time other than Protozoa and burrowing worms. These objects were found in the upper division of a series of rocks immediately subjacent to the Cambrian strata containing *Protolenus*, etc. As a decided physical break was discovered between the strata containing them and those having *Protolenus*, the underlying series was thought worthy of a distinctive name, and was called Etchemenian, after a tribe of aborigines that once inhabited the region. In most countries the basement of the Paleozoic sediments seems [Pg 140] almost devoid of organic remains. Only unsatisfactory results have followed the search for them in Europe, and America did not seem to promise a much better return. Nevertheless, the indications of a fauna obtained in the maritime provinces of Canada seemed to afford a hope that somewhere "these basement beds of the Paleozoic might yield remains in a better state of preservation." The author, therefore, in the summer of 1898, made a visit to a part of Newfoundland where a clear section of sediments had been found below the horizons of *Paradoxides* and *Agraulos strenuus*. These formations were examined at Manuel's Brook and Smith's Sound. In the beds defined as Etchemenian no trilobites were found, though other classes of animals, such as gastropods, brachiopods, and lamellibranchs, occur, with which trilobites elsewhere are usually associated in the Cambrian and later geological systems. The absence, or possibly the rarity of the trilobites appears to have special significance in view of their prominence among Cambrian fossils. The uniformity of conditions attending the depositions of the Etchemenian terrane throughout the Atlantic coast province of the Cambrian is spoken of as surprising and as pointing to a quiescent period of long continuance, during which the *Hyolithidæ* and *Capulidæ* developed so as to become the dominant types of the animal world, while the brachiopods, the lamellibranchs, and the other gastropods still were puny and insignificant. Mr. Matthew last year examined the red shales at Braintree, Mass., and was informed by Prof. W. O. Crosby that they included many of the types specified as characteristic of the Etchemenian fauna, and that no trilobites had with certainty been obtained from them. The conditions of their deposition closely resemble those of the Etchemenian of Newfoundland.

**The Paris Exposition, 1900, and Congresses.**—The grounds of the Paris Exposition of 1900 extend from the southwest angle of the Place de la Concorde along both banks of the Seine, nearly a mile and a half, to the Avenue de Suffren, which forms the western boundary of the Champ de Mars. The principal exhibition spaces are the Park of the Art palaces and the Esplanade des Invalides at the east, and the Champ de Mars and the Trocadéro at the west. Many entrances and exits will be provided, but the principal and most imposing one will be erected at the Place de la Concorde, in the form of a triumphal arch. Railways will be provided to bring visitors from the city to the grounds, and another railway will make their entire circuit. The total surface occupied by the exposition grounds is three hundred and thirty-six acres, while that of the exposition of 1889 was two hundred and forty acres. Another area has been secured in the Park of Vincennes for the exhibition of athletic games, sports, etc. The displays will be installed for the most part by groups instead of nations. The International Congress of Prehistoric Anthropology and Archæology will be held in connection with the exposition, August 20th to August 25th. The arrangements for it are under the charge of a committee that includes the masters and leading representatives of the science in France, of which M. le Dr. Verneau, 148 Rue Broca, Paris, is secretary general. A congress of persons interested in aërial navigation will be held in the Observatory of Meudon, the director of which, M. Janssen, is president of the Organizing Committee. Correspondence respecting this congress should be addressed to the secretary general, M. Triboulet, Director de Journal l'Aeronaute, 10 Rue de la Pepinière, Paris.

**English Plant Names.**—Common English and American names of plants are treated by Britton and Brown, in their Illustrated Flora of the Northern United States, Canada, and the British possessions, as full of interest from their origin, history, and significance. As observed in Britton and Holland's Dictionary, "they are derived from a variety of languages, often carrying us back to the early days of our country's history and to the various peoples who, as conquerors or colonists, have landed on our shores and left an impress on our language. Many of these Old-World words are full of poetical association, speaking to us of the thoughts and feelings of the Old-World people who invented them; others tell of the ancient mythology of our ancestors, of strange old [Pg 141] mediæval usages, and of superstitions now almost forgotten." Most of these names, Britton and Brown continue in the preface to the third volume of their work, suggest their own explanation. "The greater number are either derived from the supposed uses, qualities, or properties of the plants; many refer to their habitat, appearance, or resemblance, real or fancied, to other things; others come from poetical suggestion, affection, or association with saints or persons. Many are very graphic, as the Western name prairie fire (*Castillea coccinea*); many are quaint or humorous, as cling rascal (*Galium sparine*) or wait-a-bit (*Smilax rotundifolia*); and in some the corruptions are amusing, as Aunt Jerichos (New England) for *Angelica*. The words horse, ox, dog, bull, snake, toad, are often used to denote size, coarseness, worthlessness, or aversion. Devil or devil's is used as a prefix for upward of forty of our plants, mostly expressive of dislike or of some traditional resemblance or association. A number of names have been contributed by the Indians, such as chinquapin, wicopy, pipsissewa, wankapin, etc., while the term Indian, evidently a favorite, is applied as a descriptive prefix to upward of eighty different plants." There should be no antagonism in the use of scientific and popular names, since their purposes are quite different. The scientific names are necessary to students for accuracy, "but the vernacular names are a part of the development of the language of each people. Though these names are sometimes indicative of specific characters and hence scientifically valuable, they are for the most part not at all scientific, but utilitarian, emotional, or picturesque. As such they are invaluable not for science, but for the common intelligence and the appreciation and enjoyment of the plant world."

**Educated Colored Labor.**—In a paper published in connection with the Proceedings of the Trustees of the John F. Slater Fund, Mr. Booker T. Washington describes his efforts, made at the suggestion of the trustees, to bring the work done at the Tuskegee school to the knowledge of the white people of the South, and their success. Mr. Carver, instructor in agriculture, went before the Alabama Legislature and gave an exhibition of his methods and results before the Committee on Agriculture. The displays of butter and other farm products proved so interesting that many members of the Legislature and other citizens inspected the exhibit, and all expressed their gratification. A full description of the work in agriculture was published in the Southern papers: "The result is that the white people are constantly applying to us for persons to take charge of farms, dairies, etc., and in many ways showing that their interest in our work is growing in proportion as they see the value of it." A visit made by the President of the United States gave an opportunity of assembling within the institution five members of the Cabinet with their families, the Governor of Alabama, both branches of the Alabama Legislature, and thousands of white and colored people from all parts of the South. "The occasion was most helpful in bringing together the two sections of our country and the two races. No people in any part of the world could have acted more generously and shown a deeper interest in this school than did the white people of Tuskegee and Macon County during the visit of the President."

**Geology of Columbus, Ohio.**—In his paper, read at the meeting of the American Association, on the geology of Ohio, Dr. Orton spoke of the construction of glacial drifts as found in central Ohio and the source of the material of the drift, showing that the bowlder clay is largely derived from the comminution of black slake, the remnants of which appear in North Columbus. He spoke also of the bowlders scattered over the surface of the region about Columbus, the parent rocks of which may be traced to the shores of the northern lakes, and of Jasper's conglomerate, picturesque fragments of which may be found throughout central Ohio. Some of these bowlders are known to have come from Lake Ontario. Bowlders of native copper also occur, one of which was found eight feet below the surface in excavations carried on for the foundations of the asylum west of the Scioto.

**Civilized and Savage.**—Professor Semon, in his book In the Australian Bush, characterizes the

treatment of the natives by the settlers as constituting, on the whole, one of the darkest chapters in the colonization of Australia. "Everywhere and always we find the same process: the whites arrive and settle in the hunting grounds of the blacks, who have frequented them since the remotest time. They raise paddocks, which the blacks are forbidden to enter. They breed cattle, which the blacks are not allowed to approach. Then it happens that these stupid savages do not know how to distinguish between a marsupial and a placental animal, and spear a calf or a cow instead of a kangaroo, and the white man takes revenge for this misdeed by systematically killing all the blacks that come before his gun. This, again, the natives take amiss, and throw a spear into his back when he rides through the bush, or invade his house when he is absent, killing his family and servants. Then arrive the 'native police,' a troop of blacks from another district, headed by a white officer. They know the tricks of their race, and take a special pleasure in hunting down their own countrymen, and they avenge the farmer's dead by killing all the blacks in the neighborhood, sometimes also their women and children. This is the almost typical progress of colonization, and even though such things are abolished in the southeastern colonies and in southeast and central Queensland, they are by no means unheard of in the north and west."

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# MINOR PARAGRAPHS.

In a brood of five nestling sparrow-hawks, which he had the opportunity of studying alive and dead, Dr. R. W. Shufeldt remarked that the largest and therefore oldest bird was nearly double the size of the youngest or smallest one, while the three others were graduated down from the largest to the smallest in almost exact proportions." It was evident, then, that the female had laid the eggs at regular intervals, and very likely three or four days apart, and that incubation commenced immediately after the first egg was deposited. What is more worthy of note, however, is the fact that the sexes of these nestlings alternated, the oldest bird being a male, the next a female, followed by another male, and so on, the last or youngest one of all five being a male. This last had a plumage of pure white down, with the pin feathers of the primaries and secondaries of the wings, as well as the rectrices of the tail, just beginning to open at their extremities. From this stage gradual development of the plumage is exhibited throughout the series, the entire plumage of the males and females being very different and distinctive." If it be true, as is possibly indicated, that the sexes alternate in broods of young sparrow-hawks as a regular thing, the author has no explanation for the fact, and has never heard of any being offered.

Architecture and Building gives the following interesting facts regarding the building trades in Chicago: "Reports from Chicago are that labor in building lines is scarce. The scarcity of men is giving the building trades council trouble to meet the requirements of contractors. It is said that half a dozen jobs that are ready to go ahead are at a standstill because men can not be had, particularly iron workers and laborers—the employees first to be employed in the construction of the modern building. It is also said that wages have never been better in the building line. The following is the schedule of wages, based on an eight-hour day: Carpenters, $3.40; electricians, $3.75; bridge and structural iron workers, $3.60; tin and sheet-iron workers, $3.20; plumbers, $4; steam fitters, $3.75; elevator constructors, $3; hoisting engineers, $4; derrick men, $2; gas-fitters, $3.75; plasterers, $4; marble cutters, $3.50; gravel roofers, $2.80; boiler-makers, $2.40; stone sawyers and rubbers, $3; marble enamel glassworkers' helpers, $2.25; slate and tile roofers, $3.80; marble setters' helpers, $2; steam-fitters' helpers, $2; stone cutters, $4; stone carvers, $5; bricklayers, $4; painters, $3; hod carriers and building laborers, $2; plasterers' hod carriers, $2.40; mosaic and encaustic tile layers, $4; helpers, $2.40."



In presenting the fourth part of his memoir on The Tertiary Fauna of Florida (Transactions of the Wagner Free Institute of Science, Philadelphia), Mr. William Healey Dall observes that the interest aroused in the explorations of Florida by the Wagner Institute and its friends and by the United States Geological Survey has resulted in bringing in a constantly increasing mass of material. The existence of Upper Oligocene beds in western Florida containing hundreds of species, many of which were new, added two populous faunas to the Tertiary series. It having been found that a number of the species belonging to these beds had been described from the Antillean tertiaries, it became necessary, in order to put the work on a sound foundation, besides the review of the species known to occur in the United States, to extend the revision to the tertiaries of the West Indies. It is believed that the results will be beneficial in clearing the way for subsequent students and putting the nomenclature on a more permanent and reliable basis.

The numerical system of the natives of Murray Island, Torres Strait, is described by the Rev. A. E. Hunt, in the Journal of the Anthropological Society, as based on two numbers—*netat*, one, and *neis*, two. The numbers above two are expressed by composition—*neis-netat*, three; *neis i neis*, or two and two, four. Numbers above four are associated with parts of the body, beginning with the little and other fingers of the left hand, and going on to the wrist, elbow, armpit, shoulder, etc., on the left side and going down on the right side, to 21; and the toes give ten numbers more, to 31. Larger numbers are simply "many."

President William Orton, of the American Association, in his address at the welcoming meeting, showed, in the light of the facts recorded in Alfred R. Wallace's book on The Wonderful Century, that the scientific achievements of the present century exceed all those of the past combined. He then turned to the purpose of the American Association to labor for the discovery of new truth, and said: "It is possible that we could make ourselves more interesting to the general public if we occasionally foreswore our loyalty to our name and spent a portion of our time in restating established truths. Our contributions to the advancement of science are often fragmentary and devoid of special interest to the outside world. But every one of them has a place in the great temple of knowledge, and the wise master builders, some of whom appear in every generation, will find them all and use them all at last, and then only will their true value come to light."

## NOTES.

The number of broods of seventeen-year and thirteen-year locusts has become embarrassing to those who seek to distinguish them, and the trouble is complicated by the various designations different authors have given them. The usual method is to give the brood a number in a series, written with a Roman numeral. Mr. C. L. Marlatt proposes a regular and uniform nomenclature, giving the first seventeen numbers to the seventeen-year broods, beginning with that of 1893 as number I, and the next thirteen numbers (XVIII to XXX) to the thirteen-year broods, beginning with the brood of 1842 and 1855 as number XVIII.

Experimenting on the adaptability of carbonic acid to the inflation of pneumatic tires, M. d'Arsonval, of Paris, has found that the gas acts upon India rubber, and, swelling its volume out enormously, reduces it to a condition like that following maceration in petroleum. On exposure to the air the carbonic acid passes away and the India rubber returns to its normal condition. Carbonic acid, therefore, does not seem well adapted to use in inflation. Oxygen is likewise not adapted, because it permeates the India rubber and oxidizes it, but nitrogen is quite inert and answers the purpose admirably.

Mr. Gifford Pinchot, Forester of the Department of Agriculture, has announced that a few well-qualified persons will be received in the Division of Forestry as student-assistants. They will be assigned to practical field work, and will be allowed their expenses and three hundred dollars a year. They are expected to possess, when they come, a certain degree of knowledge, which is defined in Mr. Pinchot's announcement, of botany, geology, and other sciences, with good general attainments.

In a communication made to the general meeting of the French Automobile Club, in May, the Baron de Zeylen enumerates 600 manufacturers in France who have produced 5,250 motor-carriages and about 10,000 motor-cycles; 110 makers in England, 80 in Germany, 60 in the

United States, 55 in Belgium, 25 in Switzerland, and about 30 in the other states of Europe. The manufacture outside of France does not appear to be on a large scale, for only three hundred carriages are credited to other countries, and half of these to Belgium. The United States, however, promises to give a good account of itself next time.

Mine No. 8 of the Sunday Creek Coal Company, to which the American Association made its Saturday excursion from Columbus, Ohio, has recently been equipped with electric power, which is obtained by utilizing the waste gas from the oil wells in the vicinity. This, the Ohio State Journal says, is the first mine in the State to make use of this natural power.

In a bulletin relating to a "dilution cream separator" which is now marketed among farmers, the Purdue University Agricultural Experiment Station refers to the results of experiments made several years ago as showing that an increased loss of fat occurs in skim milk when dilution is practiced, that the loss is greater with cold than with warm water, and that the value of the skim milk for feeding is impaired when it is diluted. Similar results have been obtained at other experiment stations. The results claimed to be realized with the separators can be obtained by diluting the milk in a comparatively inexpensive round can.

To our death list of men known in science we have to add the names of John Cordreaux, an English ornithologist, who was eminent as a student, for thirty-six years, of bird migrations, and was secretary of the British Association's committee on that subject, at Great Cotes House, Lincolnshire, England, August 1st, in his sixty-ninth year; he was author of a book on the Birds of the Humber District, and of numerous contributions to The Zoölogist and The Ibis; Gaston Tissandier, founder, and editor for more than twenty years, of the French scientific journal *La Nature*, at Paris, August 30th, in his fifty-seventh year; besides his devotion to his journal, he was greatly interested in aërial navigation, to which he devoted much time and means in experiments, and was a versatile author of popular books touching various departments of science; Judge Charles P. Daly, of New York, who, as president for thirty-six years of the American Geographical Society, contributed very largely to the encouragement and progress of geographical study in the United States, September 19th, in his eighty-fourth year; he was an honorary member of the Royal Geographical Society of London, of the Berlin Geographical Society, and of the Imperial Geographical Society of Russia; he was a judge of the Court of Common Pleas of New York from 1844 to 1858, and after that chief justice of the same court continuously for twenty-seven years, and was besides, a publicist of high reputation, whose opinion and advice were sought by men charged with responsibility concerning them on many important State and national questions; Henri Lévègne de Vilmorin, first vice-president of the Paris School of Horticulture; O. G. Jones, Physics Master of the City of London School, from an accident on the Dent Blanche, Alps, August 30th; Ambrose A. P. Stewart, formerly instructor in chemistry in the Lawrence Scientific School, and afterward Professor of Chemistry in the Pennsylvania State College and in the University of Illinois, at Lincoln, Neb., September 13th; Dr. Charles Fayette Taylor, founder of the New York Orthopedic Dispensary, and author of articles in the Popular Science Monthly on Bodily Conditions as related to Mental States (vol. xv), Gofio, Food, and Physique (vol. xxxi), and Climate and Health (vol. xlvii), and of books relating to his special vocation, died in Los Angeles, Cal., January 25th, in his seventy-second year.

Efforts are making for the formation of a Soppitt Memorial Library of Mycological Literature, to be presented to the Yorkshire (England) Naturalists' Union as a memorial of the services rendered to mycological science and to Yorkshire natural history generally, by the late Mr. H. T. Soppitt.

The United States Department of Agriculture has published, for general information and in order to develop a wider interest in the subject, the History and Present Status of Instruction in Cooking in the Public Schools of New York City, by Mrs. Louise E. Hogan, to which an introduction is furnished by A. C. True, Ph. D.

The United States Weather Bureau publishes a paper On Lightning and Electricity in the Air, by Alexander G. McAdie, representing the present knowledge on the subject, and, as supplementary to it or forming a second part, Loss of Life and Property by Electricity, by Alfred J. Henry.

A gift of one thousand dollars has been made to the research fund of the American Association for the Advancement of Science by Mr. Emerson McMillin, of New York.

**FOOTNOTES**

[1] Dodd, Mead & Co., New York, 1899.

[2] A paper read before Section F of the American Association for the Advancement of Science at the Columbus meeting in August, 1899.

[3] When the word "bite" is used in connection with these bugs, it must be remembered that it is really a puncture made with the sharp beak or proboscis (see illustration).

[4] Proceedings of the Academy of Natural Sciences of Philadelphia, vol. vii, p. 404, 1854-'55.

[5] Proceedings of the Academy of Natural Sciences of Philadelphia, vol. vii, p. 404 1854-'55.

[6] A report, published in Nature, from Major Ronald Ross to the Secretary to the Director General, Indian Medical Service, Simla. Dated Calcutta, February 16, 1899.

[7] Dr. A. Tripier. Assainissement des Théâtres, Ventilation, Éclairage et Chauffage.

[8] The reader will find the subject discussed and illustrated in the author's work, Sanitary Engineering of Buildings, vol. i, 1899.

[9] See the author's work, Theater Fires and Panics, 1895.

[10] The Growth of Cities in the Nineteenth Century. A Study in Statistics. By Adna Ferrln Weber. (Columbia University Studies In History, Economics, and Public Law.) New York: Published for Columbia University by the Macmillan Company. Pp. 495. Price, $3.50.

[11] Mineral Waters of the United States and their Therapeutic Uses, with an Account of the Various Mineral Spring Localities, their Advantages as Health Resorts, Means of Access, etc.; to which is added an Appendix on Potable Waters. By James K. Crook. New York and Philadelphia: Lea Brothers & Co. Pp. 588. Price, $3.50.

[12] Every-Day Butterflies. A Group of Biographies. By Samuel Hubbard Scudder. Boston and New York: Houghton, Mifflin & Co. Pp. 386. Price. $2.

[13] L'Audition et ses Organes. By Dr. M. E. Gellé. Paris: Félix Alcan (Bibliothèque Scientifique). Pp. 326. Price, six francs.

[14] A History of the American Nation. By Andrew C. McLaughlin. New York: D. Appleton and Company. Pp. 587. Price, $1.40.

[15] The Elements of Practical Astronomy. By W. W. Campbell. Second edition, revised and enlarged. New York: The Macmillan Company. Pp. 264. Price, $2.

[16] The Characters of Crystals. An Introduction to Physical Crystallography. By Alfred J. Moses. New York: D. Van Nostrand Company. Pp. 211. Price, $2.

[17] Minerals in Rock Sections; the Practical Method of identifying Minerals in Rock Sections with the Microscope. Especially arranged for Students in Scientific Schools. By Lea McIlvaine Luquer. New York: D. Van Nostrand Company. Pp. 117.

[18] Elements of Trigonometry, with Tables. By Herbert C. Whitaker. Philadelphia: Eldredge & Brother. Pp. 200.

[19] California Plants in their Homes. By Alice Merritt Davidson. Los Angeles, Cal.: B .R. Baumgardt & Co. Pp. 215-133.

[20] Plant Relations. A First Book of Botany. By John M. Coulter. New York: D. Appleton and Company. (Twentieth Century Text Books.) Pp. 264. Price, $1.10.

[21] The Wilderness of Worlds. A Popular Sketch of the Evolution of Matter from Nebula to Man and Return. The Life-Orbit of a Star. By George W. Morehouse. New York: Peter Eckler. Pp. 246. Price, $1.

[22] The Living Organism. By Alfred Earl, M. A. New York: The Macmillan Company. Pp. 271. Price, $1.75.

[23] Stars and Telescopes A Handbook of Popular Astronomy. Boston: Little, Brown & Co. Pp. 419. Price, $2.

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**Transcriber's note:**

The transcriber added a Table of Contents to help with navigation.

The scale shown below images in the original, is no longer accurate.

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